应对全球化：

全球矿产资源信息系统数据库建设

（之二十）

亚洲卷：泰国

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前　言

20 世纪 90 年代以来，随着我国工业化进程的加快和经济的高速发展，许多矿产资源的消费增速接近或超过国民经济的发展速度，矿产资源的供需矛盾日益尖锐，集中体现为储量增长赶不上产量增长，产量增长赶不上消费需求增长，一些重要矿产品进口量激增，现有矿产资源储量的保证程度急剧下降。未来几十年是我国实施经济发展第三步战略目标的关键时期，在我国加入 WTO 并参与国际经济全球化的大背景下，我国的矿产资源消费需求将以数倍甚至数十倍的倍率增长。因此可以预计，中国不日将成为矿产资源的世界消费大国之一。

随着国务院《关于加强地质工作的决定》的出台和我国“十一五”规划的制订，如何加大国内矿产资源勘查开发工作的力度，探明更多的矿产资源储量，提高资源对经济建设的保证程度，成为摆在全国地质工作者面前的一项重要任务。与此同时，作为资源保障的另一项重要举措，进一步加强对国内矿业企业的指导和引导，推动企业“走出去”勘查、开发和利用境外矿产资源，构成了实现中国全球矿产资源战略的另一个重要方面。

为了切实贯彻矿产资源“走出去”战略，建立基于 GIS 的全球矿产资源信息系统无疑是当务之急。该系统的建立和完善，对全面把握全球矿产资源分布和供需现状，科学预测未来全球资源的供需态势，圈定全球和周边地区可供勘查和开发的战略基地，构建我国矿产资源安全保障体系，保证我国经济高速、稳定和持续发展，具有积极的现实意义和深远的历史意义。

中国地质调查局急国家之所急，于 2003 年设立了“中国及邻区矿产资源潜力定量评价”项目，2008 年设立了“我国短缺资源的全球分布研究”项目，旨在建立包括地理、地质、矿产和矿业开发信息的全球矿产资源信息系统，为矿产资源“走出去”战略的实施奠定坚实的信息基础。2004 年，商务部启动了援外地质矿产调查项目，进一步推动了全球矿产资源信息系统建设的实施。

全球矿产资源信息系统建设的总体目标和任务是，全面收集全球矿产资源相关信息，研究全球矿产资源的供需关系，结合我国矿产资源形势，提出我国矿产资源发展的宏观战略；分析和对比全球各主要成矿带的地质背景、矿产分布和成矿作用特征，提出可供指导境外风险勘查的资源潜力区域，建立包括地质和矿产资源数据在内的全球矿产资源信息系统。

全球矿产资源信息系统建设最终要利用 GIS 技术，实现对信息的全面、系统的汇总、建库和展示。通过这种方式，一方面为国家和政府部门提供及时、快捷的服务，以利我

国全球矿产资源战略规划的制定、实施与调整；另一方面，为国内企业、研究单位及社会公众了解全球矿产资源分布、开发和利用现状提供信息平台。

在中国地质调查局科技外事部和中国地质调查局发展研究中心的大力支持下，经过项目组全体人员的共同努力，全球矿产资源信息系统建设取得了明显的阶段性成果。为了使政府部门、矿业公司或企业、研究单位以及社会公众及时了解和共享全球矿产资源信息，中国地质调查局发展研究中心境外矿产资源研究室根据现有成果编写了“应对全球化：全球矿产资源信息系统数据库建设”系列报告，以期为对全球矿产资源信息感兴趣的部门、组织、实体和个人提供服务。

此为本系列报告的第二十部。本报告的内容主要包括泰国概况、区域地质、区域矿产和成矿带划分、矿产勘查和矿业开发现状，以及认识和建议等章节。由元春华、韩九曦负责编写；刘大文、张新元统编了全报告。

全球矿产资源信息系统包括的内容相当广泛，将这些内容分门别类地入库并进行管理和提供有效服务是我们的最终目标。但是，由于建库工作时间较短，且大量资料尚未入库，因此，目前我们掌握的信息并不能代表全部，还需在今后的工作中不断补充、更新和完善，并在适当时候更新予以发布。

必须指出的是，全球矿产资源信息系统建设是一项十分重要的基础性工作，涉及面广、工作量大，必须持之以恒，方见其效。

本系列报告是“中国及邻区矿产资源潜力定量评价”和“我国短缺资源全球分布研究”项目的部分成果，得到中国地质调查局科技外事部和中国地质调查局发展研究中心的大力支持。国土资源部科技与国际合作司姜建军司长和地质勘查司彭齐鸣司长、地调局科技外事部叶建良主任、连长云副主任、卢民杰副主任、发展中心邓志奇主任和谭永杰总工程师十分关心此项工作，并给予许多具体指导，在此表示衷心感谢。

由于受所收集资料、语言和时间的限制，加之编纂者能力有限，报告中难免存在错漏和偏颇，敬请广大读者批评指正。

中国地质调查局发展研究中心

境外矿产资源研究室

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第一章　概　况

第一节　自然地理

泰王国（The Kingdom of Thailand）位于中南半岛中部（图 1-1），坐标范围是北纬 5°37′到 20°27′，东经 97°22′到 105°37′，南临泰国湾和安达曼海，东部和东北部分别与柬埔寨和老挝接壤，西部及西北部与缅甸交界，南部疆域沿克拉地峡向南延伸至马来半岛，与马来西亚相接，其狭窄部分居于印度洋与太平洋之间。国土面积 513,115 平方公里，首都曼谷。按照地貌特征，泰国可以分为四个区域：北部和西北部的多山高地，中部平原，东北部的呵叻高原，安曼海和泰国湾之间的南部半岛。公元 1238 年形成较为统一的国家。先后经历素可泰王朝、大城王朝、吞武里王朝和曼谷王朝，原名暹罗。16 世纪，葡萄牙、荷兰、英国、法国等殖民主义者先后入侵。1896 年英法签订条约，规定暹罗为英属缅甸和法属印度支那间的缓冲国，暹罗成为东南亚唯一没有沦为殖民地的国家。19 世纪末，拉玛四世王开始实行对外开放。五世王借鉴西方经验进行社会改革。1932 年 6 月，拉玛七世王时期，民党发动政变，改君主专制为君主立宪。1939 年更名泰国，后经几次更改，1949 年正式定名泰国。泰国属热带季风气候，炎热潮湿。全年分为热、雨、凉三季。热季从每年的 3 月至 5 月，雨季从 6 月至 9 月，凉季从 10 月至翌年 2 月。全年平均气温 28℃，气温年差较小，4 月平均气温为 30℃，12 月为 25℃。凉季和热季很少下雨，也称旱季。

第二节　社会经济状况

泰国全国行政区划分为中部、北部、东北部、东部和南部 5 个地区，共有 76 个府，府下设县、区、村。自治地方行政单位主要设立在民众集中居住的城市地区，其中曼谷是唯一的府级直辖市，而帕塔雅则是唯一效仿美国市镇治理设置的旅游特别行政区。人口总数为 6,670 万（2008 年 12 月）。全国共有 30 多个

民族。泰族为主要民族，占人口总数的 40%，其余为老挝族，华族，马来族，高棉族，以及苗、瑶、桂、汶、克伦、掸、塞芒、沙盖等山地民族。泰语为国语。94%的居民信仰佛教，马来族信奉伊斯兰教，还有少数信奉基督教、天主教、印度教和锡克教。

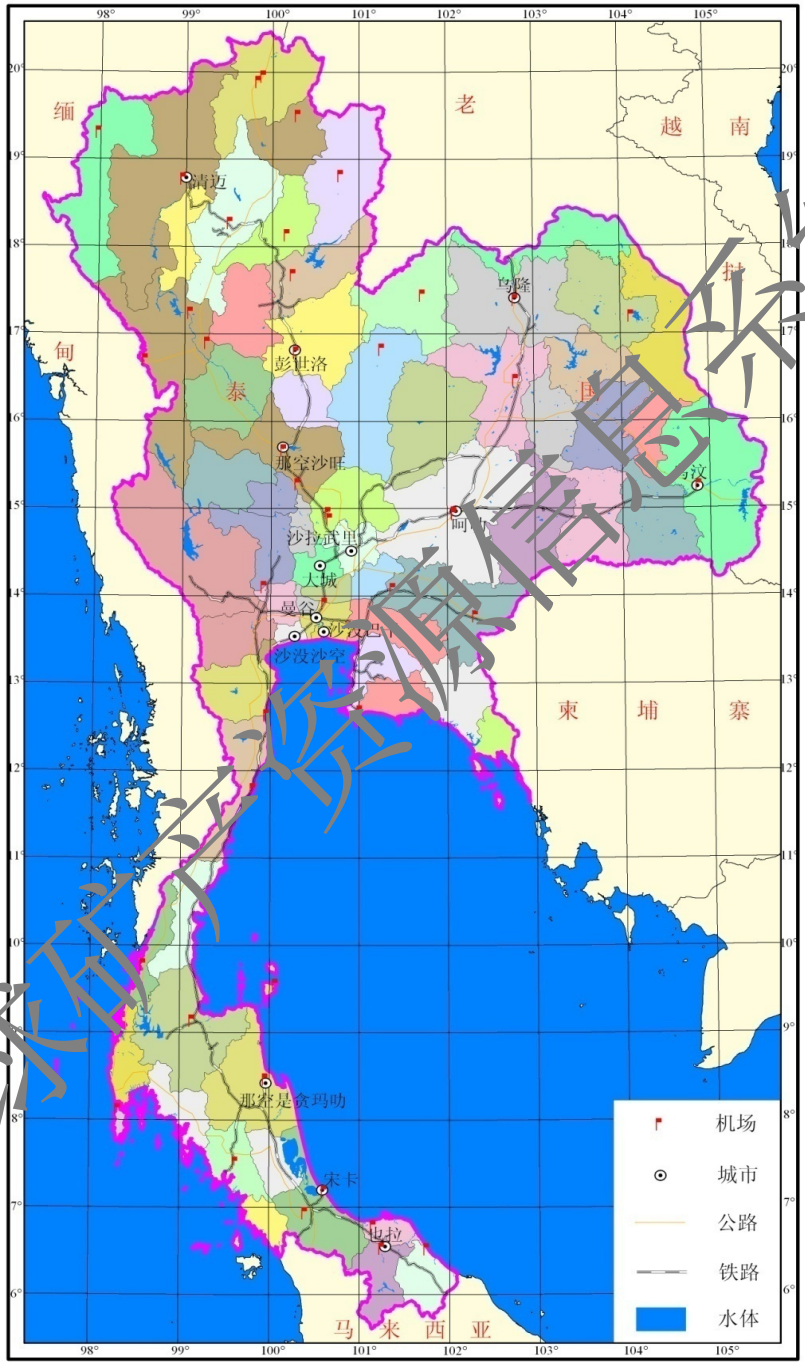

图 1-1　泰王国交通位置与行政区划示意图

泰国实行自由经济政策。属外向型经济，较依赖美、日、欧等外部市场。20 世纪 80 年代，制造业尤其是电子工业发展迅速，经济持续高速增长。1996 年被

列为中等收入国家。1997 年金融危机后陷入衰退。1999 年经济开始复苏。2003 年 7 月提前两年还清金融危机期间向国际货币基金组织借贷的 172 亿美元贷款。1963 年起实施国家经济和社会发展五年计划。2007 年开始第十个五年计划。截至 2008 年 12 月底，泰国外债 648 亿美元，外汇储备 1,110 亿美元。

泰国工业是出口导向型工业。主要门类有：采矿、纺织、电子、塑料、食品加工、玩具、汽车装配、建材、石油化工、软件、轮胎、家具等。工业在国内生产总值中的比重不断上升。2008 年工业生产指数增长 5.3%，商用运输设备生产增长 14.8%，电子设备和食品生产也有不同幅度的增长。

农业是泰国传统经济产业，农业人口约 1,530 万人。全国可耕地面积约 1.4 亿莱（1 莱＝1,600 平方米），占国土面积的 41％。主要作物有稻米、玉米、木薯、橡胶、甘蔗、绿豆、麻、烟草、咖啡豆、棉花、棕油、椰子等。2008 年出口农产品 293.7 亿美元，同比增长 30.1%。

泰国海域辽阔，拥有 2,705 公里海岸线，泰国湾和安达曼湾是得天独厚的天然海洋渔场。此外，还有总面积 1,100 多平方公里的淡水养殖场。曼谷、宋卡、普吉等地是重要的渔业中心和渔产品集散地。泰国是世界市场主要鱼类产品供应国之一，也是位于日本和中国之后的亚洲第三大海洋渔业国。全国从事渔业人口约 50 万人。

旅游业保持稳定发展势头，是外汇收入重要来源之一。主要旅游点有曼谷、普吉、清迈和帕塔亚，清莱、华欣、苏梅岛等地近年来也越来越受到国内外游客的欢迎。近年来由于政局不稳，旅游业受到较大影响。

与东南亚其他各国相比，泰国拥有较为先进的海陆交通设施，近年来，泰国政府不断加大通信、电力基础设施的投入，使整体“硬件”环境有了较大程度的改善。

航空：泰国拥有广泛的空中运输网络，包括 28 个商业机场，从泰国任何一个省份或地区到曼谷的飞行时间仅有 1 小时左右。此外，曼谷的 Don Muang 机场，目前拥有超过 21 万 5 千个航班，82 万 3 千吨货物以及每年超过 0.33 亿的乘客。泰国在普吉、清迈、Hat Yai、Chiang Rai 和 Ko Samui 均设有国际机场。在 2005 年末，曼谷开设了一个全新的国际机场用以取代将被用来运输货物的 Don Muang 机场。当这个新建 Suvarnabhumi 机场投入使用时，将拥有年均 0.45 亿的客流量，一旦机场完全投入运营，客流量将会增加到 1 亿人/年，货物 640 万吨。

铁路：主要为窄轨。总长 4,451 公里，全国共 47 府通火车。拥有近 1 个世

纪历史的泰国的铁路运输覆盖面积非常大。他拥有 3 条线路，占地 4,000 公里，在曼谷交汇。这个系统能从马来西亚边境到达泰国最南面的省，及西面的 Kanchanaburi。他的铁路系统与马来西亚国家铁路系统相连接，可直接输入新加坡，此外，Nong Khai 地区正在建一条铁路，这条铁路将穿越湄公河。

公路：泰国被公认拥有最广泛的公路运输网络，超过 25 万公里的公路，超过 40％的公路为具有国际标准的可通往各个省份的高速公路。城市内部超过 225 公里的摩托车道将曼谷和泰国其他主要地区连接起来，政府正大力改善其市内摩托车道，预计建成后将有 4 车道，且达 4,150 公里长。新的高速公路不断被修建，包括的项目有连接曼谷和新的 Suvarnabhumi 机场，及快速到达泰国南方省份的道路。泰国在 2004 年 4 月 26 日在上海签署了《亚洲公路网政府间协议》，该公路网连接亚洲各国首都、工业中心、重要港口、旅游及商业重镇，覆盖除西亚外的几乎整个亚洲地区，增强了泰国与欧洲和亚洲 32 个国家陆上贸易和运输的联系。

水运：泰国的水路系统长期以来是这个国家历史和工业的重要组成部分。泰国拥有 3,219 公里长的海岸线以及 4,000 公里内陆水路，他的水路运输和海港的基础设施都对全国运输和贸易起着至关重要的作用。目前，泰国拥有 122 个港口、码头，包括 8 个国际深海港口容纳出海进行国际贸易的船只。这些设在曼谷的港口，位于泰国东部海岸的 Laem Chabang Map Ta Phut，南部海岸的 Sonkhla、Satun、Narathiwar、Phuket 以及 Kanong，提供了超过 450 万的标准箱存放空间，一旦扩建项目完工，这个数字还将会翻倍。

通讯：泰国的电信设施品种繁多。目前已有固定电话(以合适的价格提供国际直拨电话)、移动电话、通过 ADSL 与因特网连接、卫星调制解调器以及拨号连接。近年来，因特网的接入速度越来越高，费用却越来越便宜。目前泰国有两大国有电信运营商——CAT 和 TOT，两大运营商在泰国电信运营市场中占据支配地位。CAT 经营国际通信业务、移动通信业务和邮政业务。TOT 经营国内固定电话业务、移动通信业务以及通往邻近国家的国际长途电话业务。除这两个国有运营商外，泰国电信服务市场还有一些民营的电信运营商。这些民营企业主要经营移动通信业务、互联网业务以及其他增值电信业务。为加快电信业和国民经济的发展，泰国政府对电信市场体制进行了一系列改革，其主要内容一是实行政企分开和民营化，二是打破垄断、引入竞争。

电力：泰国电力局主要负责电力供应和输送，与市政电力局和省电力局共同

负责输送电力到曼谷和各省。电力局直接受总理府领导，市政电力局和省电力局受内务部领导。　　泰国淡水面积为 3,750 平方千米，发电总装机容量达 1,058 万千瓦，如全部用于发电，每年可发电 190 亿千瓦时。目前，泰国水力发电的总装机容量约 200 多万千瓦。近几年，泰国的用电量不断上升，为保证充足的电力供应，泰国政府在第六个五年计划期间将原定 8,139MW 的年发电能力调至 9,249MW，投资额则从 44.1 亿美元增加到 51.8 亿美元。根据泰国有关部门的计划，泰国的储备电力水平将从 15%增加到 25%，以提高能源供给的安全。泰国还计划增加 30,929MW 的电力容量，使泰国的总容量到 2011 年达 43,913MW。

第三节　地质工作回顾及现状

泰国矿产资源局成立于 1891 年，尽管在此之前就已经开展过很长时间的矿产资源开发，但直到 1914 年霍格玻姆（Högbom）才对地质调查进行了记录。在过去四十多年中，泰国开展了大量地质调查工作。通过这些工作，在 1981 年完成了覆盖全国的 1:250,000 系统地质填图项目，出版了 1:250,000 地质图 52 幅，1:500,000 地质图 5 幅，并于 1987 年出版了 1:2,500,000 地质图。到目前，1:2,500,000、1:1,000,000、1:500,000 和 1:250,000 地质填图已经覆盖全国，并且在最近三年全部完成数字化工作。除此之外，1982 年开始，对极具成矿潜力的区域进行了 1:50,000 详细地质填图工作和第四纪地质填图计划，到目前 1:50,000 地质填图已经覆盖了全国面积的 60%。

自霍格玻姆（Högbom，1914）、李（Lee，1923）和布朗（Brown，1951）的工作起，在进行矿产调查和填图调查的同时，对泰国的地层分布情况进行了研究。1969 年第二版 1:1,000,000 泰国地质图中，加瓦纳菲特（Javanaphet）首次建立了岩石地层单位。此后，在全国范围内又提出和重新定义了许多新的地层名称。1986 年至 1987 年，一支专门进行地层命名的工作组汇编了所有现有地层的名称，并于 1992 年出版了泰国地层辞典。从 1978 年开始，板块构造的概念已经被许多地质学家广泛应用于泰国地质矿产开发工作中。

1984 年到 1989 年，开展了全国范围的航空地球物理测量。地质填图、测量和矿产勘探的结果显示出 6 个矿种（锡、钨、贱金属、金、宝石、铬、镍和热液矿物），共计 345 处异常区。但最终要实现国内矿产资源的开发还需要实施地表

追踪调查。陆上和近海第三系盆地中的绝大多数化石燃料资源都已经被发现并得到了开发。

对居民生活和农业生产而言，地下水也是极为重要的一种自然资源。作为工业和建筑行业的原料，工业矿物、石材和规格石材的重要性越来越凸显。但由于矿产资源的过度开采，在潜在环境影响区的环境地质学调查也已经受到了重视，这包括海岸地区管理、土地使用、城市规划和地质灾害预防等。已经与许多海外相关机构和国际组织针对一些特定的地质研究项目展开了合作。

第四节　泰国地质调查机构

泰国国土资源分属 3 个部，分别为自然资源与环境部、工业部和能源部，其中能源部分管矿物燃料局，工业部分管第一产业和采矿局，自然资源与环境部分管地下水资源局与矿产资源局。而泰国的矿业管理机构主要是自然资源与环境部下面的矿产资源局，它是全国地矿工作的主管部门，主要分为三个部分：矿产资源局本部、3 个区域矿业资源中心和 24 个省府办事处。局本部设在首都曼谷。在宋卡、普吉、清迈设有区域矿产中心。在 24 个府设有办事处，代表矿产资源局进行矿业法制管理，并为私营矿山企业提供技术服务。泰国矿产资源局除从事区域性和基础性地质工作、承揽矿产勘查、矿业技术咨询服务之外，主要是通过政策和计划导向、矿业执法进行全国地矿工作的监督和管理。同时还负责发放有关许可证，制定发放标准，执行有关法规。其具体职能是：

（1）进行全国区域地质调查、基础地质研究和矿产勘查工作，包括 1:25 万和 1:5 万区域地质调查；古生物研究；综合地质研究和物化分析；能源和非能源矿产勘查；地下水勘查、钻井、干旱区找水、大城市供水和地面沉降研究。

（2）为私人公司提供地质勘查、采选冶技术咨询服务，包括对所有采矿技术问题进行检查、监督和提出建议；承做选冶试验、化验、鉴定、租赁部分仪器设备，编制和提供矿产品进出口资料。

（3）行使国家赋与的矿业法制管理，包括颁发探矿许可证和采矿特许执照；征收矿区使用费；租借地测量划界；控制全国矿山开采量；监督矿产品进出口量以及监督和检查勘探开采、选矿和冶炼等生产工作。

（4）研究制定矿产资源政策和地矿工作计划，确定和实施国内重大的投资

开发项目，包括主持全国矿产统计工作；协调国内外合作项目；以及通过招标方式吸引国内外私人投资者参与政府提供的开发项目。

矿产资源局现有职工 5000 人左右。局本部共有 415 人左右。矿业资源局本部设有 16 个处室，分别是办事处、秘书办公室、财务处、经济信息处、地质调查处、采矿登记处、经济地质处、燃料处、地下水处、测绘处、工程处、采矿技术处、冶炼处、监督惩罚处、总审计办公室、机关审计办公室。除办公室、财务、审计等部门外，大部分处都是业务处。

1．经济信息处

进行矿业经济分析和研究，提供制定政策所需的信息；进行有关国内外矿产品的经济分析，提供编制计划和协调工作所需的信息；收集和宣传矿产资源局的成果，发行出版物，发布地矿新闻；跟踪和评价矿产资源开的社会效益；收集存档资料，编制矿产统计资料；举办对外展览等。

2．地质调查处

从事所有地质调查工作，包括图件编制和出版、航片解译、古生物研究、岩矿物化分析等。

3．采矿登记处

负责采矿登记和颁发许可证，控制锡矿生产和销售；征收矿业生产税，依法检查监督矿业经营活动。

4．经济地质处

进行各类矿产勘查、矿床经济评价和矿床详细研究。

5．燃料处

控制石油勘探，进行燃料矿产矿床的勘查和化学分析等。

6．地下水处

负责地下水的钻探、开发、利用和保护。

7．测绘处

承担全部地形测绘工作；包括矿区地形详测、勘查和采矿租地划界测量及制图等。

8．工程处

承接仪器、设备、汽车维修，提供大型采矿设备，推广采矿设备和机械的应用，并承担局系统的土建工程，以及局系统和私人企业的钻探任务。

9．采矿技术处

负责全部采矿技术，包括采矿工程的检查和技术研究、矿区复田、环境保护、矿产品开发、安全生产、矿工福利、救护和培训以及提供技术咨询服务。

10．冶炼处

管理冶炼方面的技术业务工作，包括拟定金属原料工业的国家发展计划，组织技术性实验和设备修配。

11．监督惩罚处

监督和控制采矿活动，处理非法采矿事件。

矿产资源局的资金来源：政府预算拨款、国际银行货款和外援，以及用户支付的项目承包费，其中以政府财政拨款为主。勘探阶段的费用由开采单位或私人公司承担。

近几年，矿产资源局在地质勘查方面主要致力于下述五个方面的工作：

（1）地热、煤、油页岩、铀和独居石等能源矿产的调查和开发；

（2）锡、钨矿产的勘探；

（3）磷酸盐、石灰石、长石、粘土、铝土矿和石棉等工业矿产的勘查和开发；

（4）在矿产资源潜力区进行区域地质调查；

（5）进行航空物探、化探等技术方法的研究和开发。

第二章　区域地质

泰国位于中南半岛地区。在地质历史上，中南半岛古生代为冈瓦纳古陆和劳亚古陆之间、特提斯洋中的一系列具有前寒武纪结晶基底的海山、洋岛。中生代以来，主体与欧亚板块碰撞缝合相连为一体。新生代以来，位于逐渐隆起的青藏高原东南缘，伴随着欧亚板块和印澳板块的拼合碰撞，成为逃逸构造活动带的一部分。因此，中南半岛是西南部冈瓦纳古陆地块群和东北部劳亚古陆地块群经一系列俯冲蛇绿混杂岩带、断裂带多期改造拼合而成的复合地块群。

泰国位于两个古微大陆的交界部位。这两个微大陆裂解自冈瓦纳大陆，西侧的被称为掸-泰地体，而东侧的则被称为印支地体。从板块构造的角度来看，掸-泰地体和印支地体在中元古代从冈瓦纳大陆裂解，漂移进入古特提斯洋。在三叠纪末两个地体发生碰撞。在三叠纪末期到侏罗纪碰撞结束，进入造山后阶段，特提斯洋仅残留东部的浅海，分布在泰国西部的狭长地带内。但从中侏罗纪开始，泰国已经形成了统一的陆块。由于印度-欧亚板块在新生代开始碰撞，东南亚地壳板块发生转动，沿南北向正断层系统发育了一系列伸展断陷盆地。随着泰国湾的打开，在泰国南部可能开始拉张，同时也进入现在这些山脉的主隆升期，随后地体遭受剥蚀。

第一节　地　层

泰国境内的岩石年代从前寒武纪一直到第四纪，呈南北向分布（图 2-1）。

前寒武纪岩层被推断为一套角闪岩相的高级变质岩石，被早古生代岩层不整合上覆。这套前寒武纪岩层还构成了西部山脉（位于泰国北部和西部）的核心部分，并延伸到泰国湾东部和泰国半岛。

早古生代的整套岩层主要为海相成因。硅质碎屑碳酸盐岩大陆架和火山岛弧分别发育在现在掸-泰地体的西侧和东侧，形成时间为古生代，在掸-泰地体和印支地体发生碰撞之前。

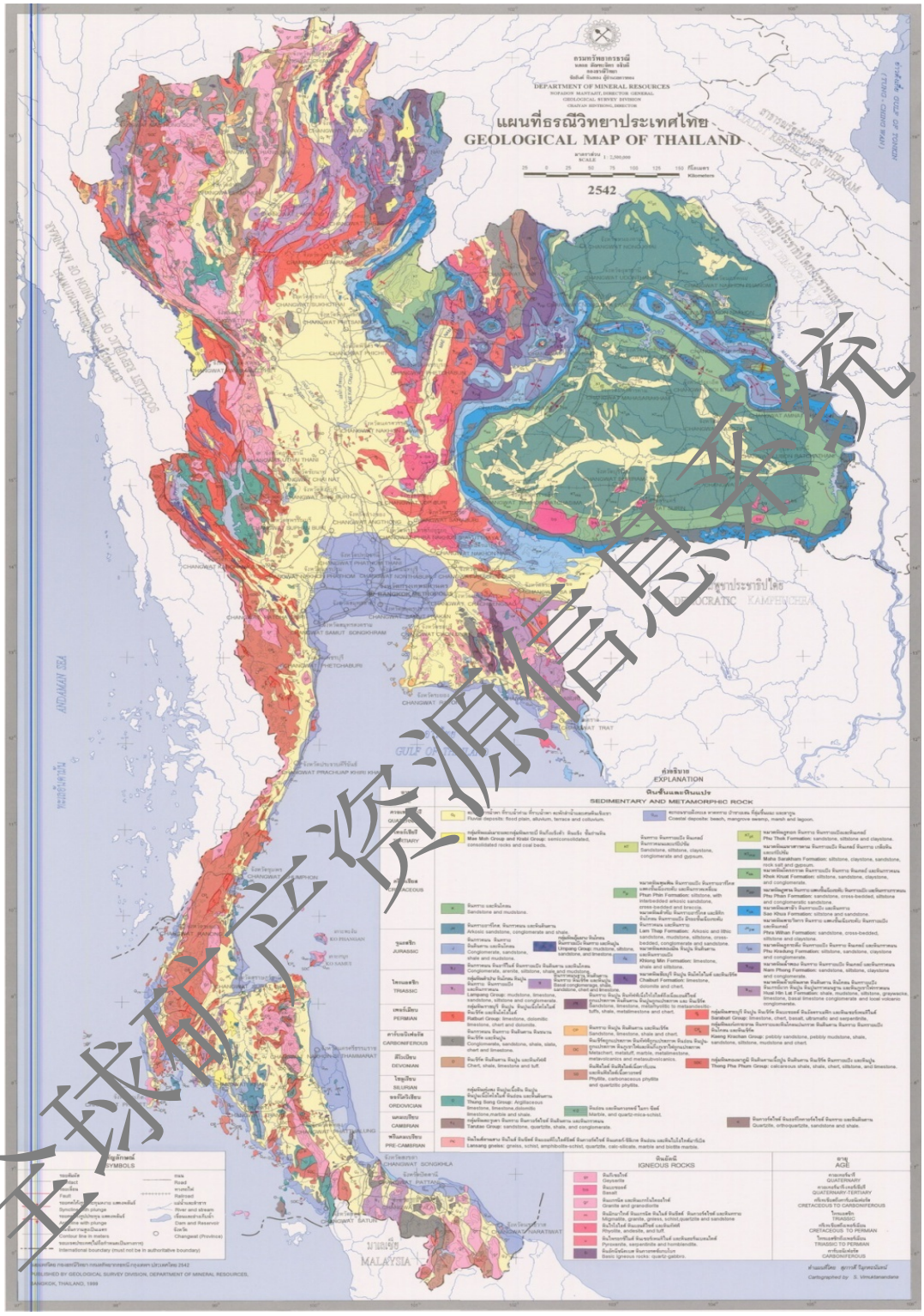

图 2-1　泰国地质图

中生代地层主要可以分为两个岩相，即海相和陆相。三叠纪和侏罗纪海相地层仅分布在狭长的断层限定盆地内。更年轻的陆相中生代岩石主要为侏罗纪和白垩纪红层及蒸发岩，覆盖了呵叻高原的绝大部分地区。

新生代岩层全部为陆相硅质碎屑岩和伴生的烃类，沉积在陆上和近海的在第三纪和第四纪伸展盆地内。

一、前寒武系

在以前的填图工作中，泰国北部的角闪岩相高级变质岩被划定为前寒武纪变质岩。鲍姆等 1970 年首次认定该套岩石形成于前寒武纪。此后，所有西部山脉地区具有矿化特征的高级变质岩石都被认为是前寒武纪或推断前寒武纪岩石。这些岩石被认为构成了掸-泰地体的最核心部分，呈近南北向线状展布，从清迈一直延伸到加察那布里（Kanachanaburi）地区、春武里（Chonburi）的东部海湾地区以及泰国的南部半岛（图 2-2）。这些岩石可能与云南南部下伏于中寒武统地层的溪门群及缅甸掸邦的抹谷片麻岩相对应，代表了掸-泰克拉通的一部分，该克拉通在早侏罗世陆陆碰撞阶段从印支克拉通分离出来。但在泰国的印支地体内尚未有发现前寒武系岩石的报道。

西部山脉地区前寒武系岩石的岩性组合相当一致，主要包括：条带状花岗质副片麻岩、石英-云母片岩、大理岩、钙硅酸盐岩，以及少量角闪岩、变质石英岩和正片麻岩。而泰国东部地区岩石中镁铁质组分更多，除了上述岩石组合外，还出现更富角闪石组分的岩石类型。

一般来说，除了东部海湾地区，角闪岩相前寒武纪岩石、早古生界浅变质砂岩和石灰岩常相伴产出于泰国全境。前寒武纪和早古生代的岩层经常呈断层接触关系或由于花岗岩侵入而模糊不清。在前寒武纪岩石中发现有部分熔融现象，这一般表明在岩石形成时曾经发生过高级变质作用。根据变质程度，这些岩石的变质相被确定为铁铝榴石-角闪石相和堇青石-角闪石相。最近麦克唐纳等提供了相关证据，支持了后一种变质相。

这些前寒武系岩石地层的最低变质相为低级角闪岩相，而下古生界岩石地层的最高变质相为高级绿片岩相。所有的变质作用都属于同一种高温-低压型。这一观察结果和早先的野外工作成果能够表明从前寒武纪到早古生代的地层序列是连续的，并只发生过一次变质作用。上述结论与同位素测年结果是一致的。

对前寒武系岩石的同位素测年结果表明高压-低温角闪岩相和绿片岩相变质作用的变质年代为早白垩世或晚三叠世。据报道，前寒武系副片麻岩的原岩年龄为晚前寒武世-早寒武世或小于 600Ma。

二、下古生界

泰国下古生界地层可划分为下下古生界和上下古生界两部分，前者包括寒武

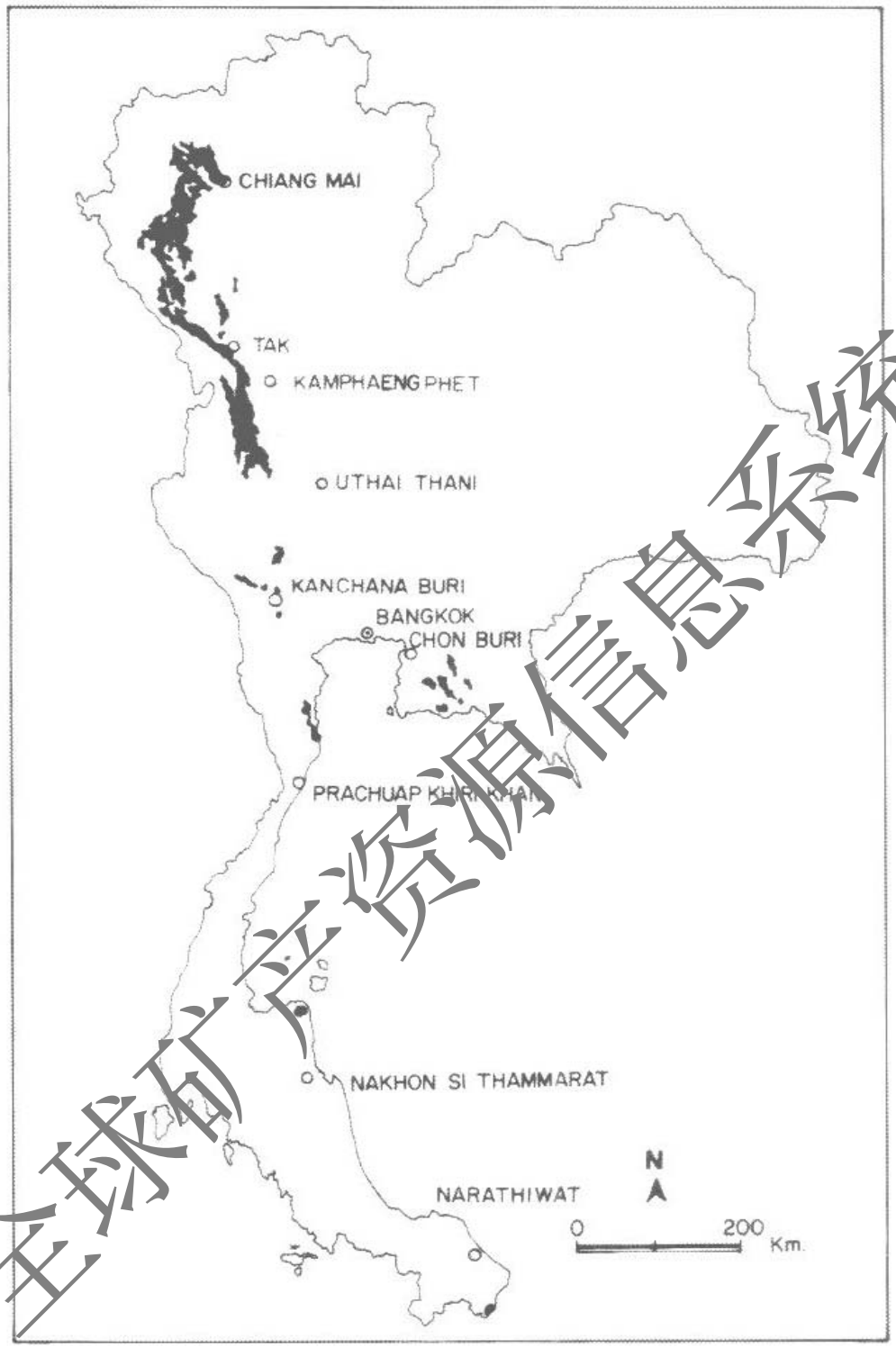

图 2-2　泰国前寒武纪岩石分布图

系和奥陶系，后者包括志留系和泥盆系，部分岩体甚至包括下石炭统（图 2-3）。在掸-泰地体中，该套地层广泛分布于西部山区，西起北碧府往北延伸到清迈府、夜丰颂府、程逸府，往东延伸到春武里府。在泰国半岛，该地层沿汗銮山脉主要

呈南北走向分布，自素叻他尼府，穿过洛坤府和沙敦府到达马来西亚北部。印支地体中，上下古生界地层只出露于黎府的东北部地区，包括横穿泰国-老挝边界、到达老挝西部的北-南向狭带地带。

总体来说，大部分的泰国下下古生界地层都经历了低级区域变质作用（绿片岩相），在邻近的花岗岩地区地层内包含变质岩成分。同时，地层还受到强烈的褶皱和断层的作用。在掸-泰地体中，这部分地层与下伏的前寒武纪高级变质的岩石呈不整合接触，并存在紧密联系。泰国下下古生界地层可划分为两部分整合接触的岩石单元：下部塔如涛岛（Tarutao）群的硅质碎屑岩和上部宋通（Thong Song）群的碳酸盐岩。塔如涛岛群位于沙敦府塔如涛岛上，发育一套红色砂岩、砂泥岩、页岩和砾岩，在层序的上部发现含有晚寒武世的三叶虫化石。但是，在大陆上主要发育石英岩。该组为浅水陆棚沉积层序，受间歇性风暴潮的影响。上覆的宋通群为奥陶纪碳酸盐岩，是一套含三叶虫灰岩、白云岩和灰质页岩。在南部地区至少可识别出七个岩石地层单元：马拉卡（Malaka）组、塔洛党（Talo Dang）组、罗牙河（La Nga）组、南坝（Pa Nan）组、莱城塘（Lae Tong）组、如昂诺克（Rung Nok）组和坝恺（Pa Kae）组。在南部地区，宋通群的顶部坝恺组为一套红色叠层石灰岩，是早奥陶世长期海侵过程中台地缓坡-潮缘环境的沉积，在浅滩、礁沉积之后，为一套中奥陶世的深潮缘沉积及晚奥陶世更深环境的沉积。泰国境内所有的塔洛党组碳酸盐岩在岩性方面都极为相似。然而在东部地区，这套地层的年代仍然具有争议。寒武纪-奥陶纪界线位于塔如涛岛群的顶部，而奥陶纪-志留纪的界线位于上下古生界坝恺组之上 25 米处的王通（Wang Tong）组黑色笔石页岩内。

泰国上下古生界地层整合上覆于下下古生界地层之上，可划分为 2 个主要呈南-北向展布的相带，西部和半岛地区的陆架-盆地相和素可泰（Sukhothai）褶皱带和半岛东部部分区域的火山岛弧相。从北碧府到夜丰颂府的西部地区发育陆架到弧后盆地相的黑色笔石和竹叶石页岩、角石、砂岩、砂泥岩和杂色叠层结核状灰岩沉积。这套地层过去认为是塔纳奥斯（Tana osi）群和北碧（Kanchanaburi）群，但是现在被重新定义为通帕蓬（Thong Pha Phum）群。从素叻他尼府、瑟拉特他尼府到沙敦府的半岛地区，这一地区的地层代表了深水硅质碎屑岩和碳酸盐岩的连续沉积序列。在沙敦府至少可识别出三个岩石地层单元。它们是王通（Wang Tong）组、关东（Kuan Tung）组和坝沙美岛（Pa Samed）组。诸多古生物学家开展了对笔石、三叶虫、腕足类、菊石和牙形石的研究，表明半岛地区陆

棚-盆地相的上下古生界地层的年龄介于晚奥陶世和早石炭世之间。它们看似与上覆的上下古生界地层整合接触。然而，据布科教授及其团队对坝沙美岛（Pa Samed）组内更深层位水中所含化石的最新研究，表明在埃姆斯期（Emsian）富珠胚节石化石层和上覆产石炭纪生物群化石的硅质碎屑岩层之间存在大型不整合。

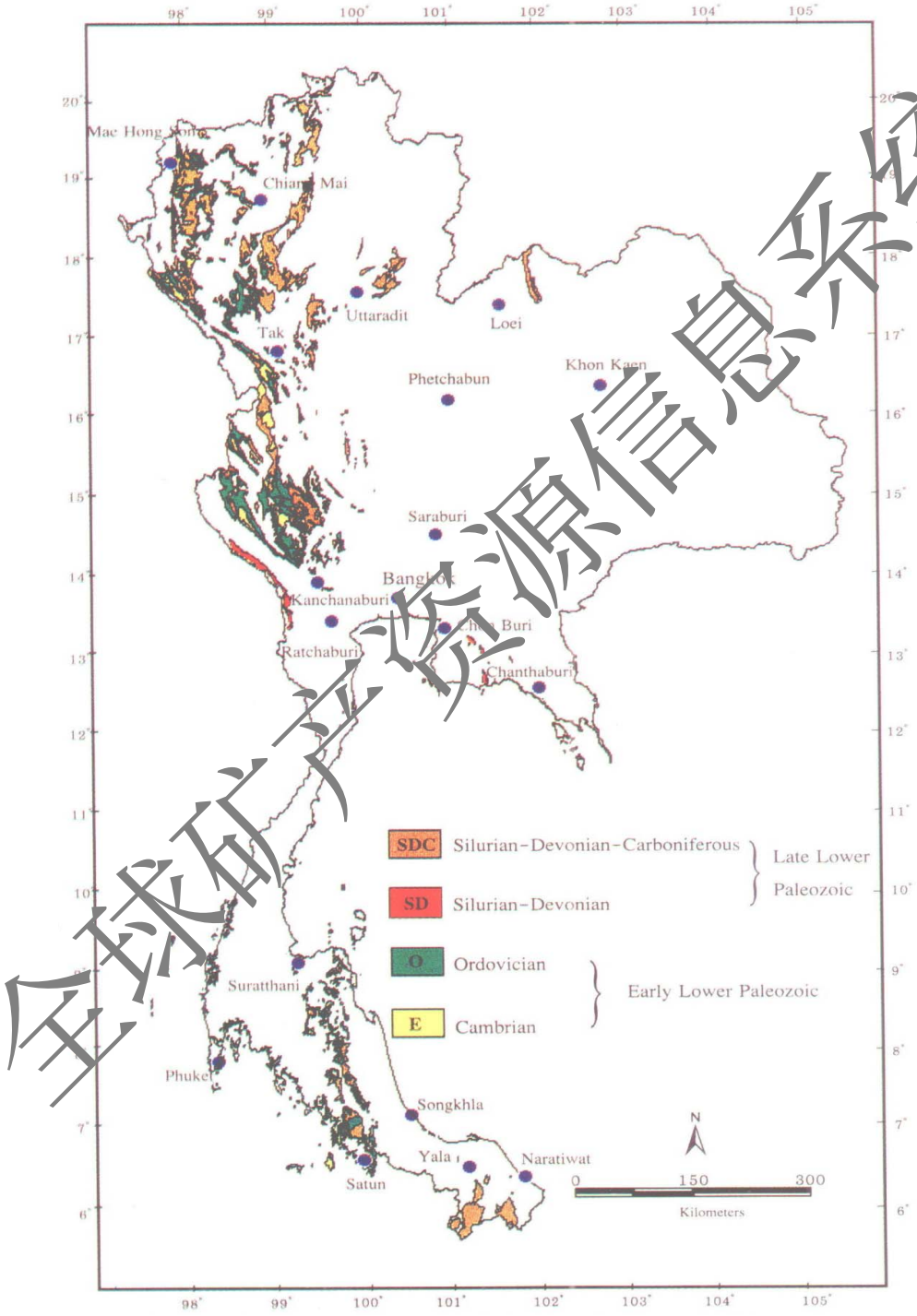

图 2-3　泰国早古生界岩石分布图

分布于掸-泰地体素可泰褶皱带内、北方高地的东部地区、东方海湾和南方东部地区的上下古生界地层可划分为三个相带，包括：1）西部的弧后盆地相；2）中部的火山岛弧相；3）东部的弧后盆地海沟-内陆坡相。

从方（Fang）到清迈府、南邦府，沿西部山脉的东翼到达克府、北碧府，再到东部海湾和南半岛东部、也拉府的弧后盆地相地层发育黑色笔石和竹叶石页岩和角石，偶见灰岩。此带更往东的地区发育火山岛弧相沉积，以有限出露的角闪岩、云母片岩、集块细粒凝灰岩为代表。此相带西起清莱府到南邦府、甘烹碧府、那空沙旺府和素攀武里府，东南到达那拉提瓦府。低级变质的沉积岩、大理岩、层状燧石代表了弧后内陆坡，分布自素可泰府往北延伸至那空沙旺府，往东延伸至罗勇府和庄他武里府。然而，薄层砂岩夹页岩的海沟相沉积也同时在南府出露。

印支地体的上下古生界地层呈现另一个南-北向展布的格架，分布于黎府和乌隆他尼府之间。该地层发育一套薄层燧石夹深灰色硅质页岩、石英岩、凝灰砾岩、含志留纪-泥盆纪-晚石炭世化石的灰岩，即是先前认为的董陡布阿（Dong Dok Bua）组，现在被重新命名为北春（Pak Chom）组。它们不整合上覆于志留系纳莫（Namo）组的石英岩、千枚岩和片岩之上。纳莫组被认为是泰国印支地体西缘最古老的地层。

澳大利亚、英格兰、日本和美国的诸多古生物学家开展了对腕足类、三叶虫、牙形石、微脊椎动物、腹足类的古生物学与地层学研究，表明泰国的生物群可与缅甸、中国、澳大利亚和南美对比。这不仅表明晚古生代泰国曾是冈瓦纳古陆的一部分，并且在晚晚古生代这些地体还紧邻澳大利亚。

三、上古生界

1．石灰系

（1）北部和上西部地区

在该地区的东部和中部，石炭纪地层不整合的上覆于志留纪-泥盆纪地层之上，然而在西部地区的一些区域该地层与下古生代地层整合接触。

石炭纪岩石的许多群和组已经命名或者记录在了泰国地层学命名的词典上。在该地区的西部，梅丰松（Mae Hong Son）群已经确定是志留纪-泥盆纪岩石，主要包含砂岩、页岩，间或有石灰岩条带的角岩，延伸到浅海大陆架的沉积物。该群的下部与志留纪-泥盆纪时期的杜伊马斯（Doi Musur）群能进行很好的地层对比。

杜伊孔姆（Doi Kong Mu）组和方（Fang）红层主要由成层性很好的砾岩、

红色和紫红色的砂岩、以及沉积在近海环境下的页岩组成。该地区中部区域的这套地层被认为是上古生代地层。梅斯（Mae Tha）群和丹蓝海（Dan Lan Hoi）群已经被认为是石炭纪地层。梅斯群由石英质砂岩、高岭土页岩、火山凝灰岩和角砾岩、角岩、板岩以及沉积在浅海大陆架的再结晶石灰岩组成。丹蓝海群从下到上分别命名为可：考亥玛（Khao Khi Ma）火山碎屑岩、兰海（Lan Hoi）组和考鲁昂（Khao Luang）火山碎屑岩。考亥玛火山碎屑岩不整合上覆在下古生代地层之下，包含有凝灰质的粗砂岩、页岩、以及由火山物质沉积而成的海底安山岩结块。

兰海组由红棕色砂岩、粉砂岩、页岩、灰绿色的凝灰质砂岩，反映浅海沉积物的层组间砾岩组成。考鲁昂火山碎屑岩主要包含红紫色的流纹岩结块、砾岩、凝灰质砂岩、以及在火山弧附近的中等深度海域形成的海底沉积物页岩。

在该地区的东部区域，帕府群被认为是石炭纪-二叠纪的地层。该群沉积在弧-沟间隔的盆地上，并且被细分成马克赛（Mae Sai）组和容克旺（Rong Kwang）组。前一个组不整合且棱角分明地上覆于下古生代地层的发萨姆（Pha Som）群之上。该地层的下部由结块、角岩、上部组成成分是凝灰质砂岩、页岩以及砾岩组成。后一组包含从绿色到灰色的凝灰质砂岩、粉砂岩、页岩、还有大量的厚层结晶石灰岩。

从古地理的角度来说，该区域涉及到西部地区的浅海，在石炭纪时期加深了其向东延展的程度。在该地区的东部和中部，火山碎屑岩起着重要作用。

（2）劳伊-帕特查本（Loei-Petchabun）地区

1984 年，查若普瑞外特（Charocnprawat）等人在劳伊府的邻近地区将石炭纪的地层划分为两个组，也即在下部的农杜克布阿（Nong Dok Bua）组和上部的旺撒丰（Wang Saphung）组。前一个组包含细层状角岩、硅质页岩、凝灰质砂岩以及石灰岩。根据层状角岩中的放射虫类动物化石和石灰岩中甲壳类动物化石年代，该组被标定为早泥盆纪-石炭纪年代的地层。后一组包含有属于上古生代时期的页岩、凝灰质砂岩、砾岩、石灰岩、角岩。1984 年，充拉克玛尼（Chonglakmani）和色塔亚瑞克（Sattayarak）将石炭纪地层标注在二叠纪时代的两个组中，即位于下部的杜克杜（Dok Du）组和上部的怀赛姆（Huai Som）组。前一组从岩石地层学角度可以与农杜克布阿（Nong Dok Bua）组对比。然而后一组与旺赛丰组是等同的。卡戎斯（Chairangsee）等人 1990 年提出劳伊府邻近地区的石炭纪时期的地质历史是由早石炭纪严重侵蚀的开始的，粗粒碎片组成硬砂岩和海盆中的

砾岩。随后，海洋的深度足够浅以生成珊瑚礁，当地壳板块运动，珊瑚礁开始下降，从而影响到早石炭纪的晚期沉积盆地。在晚石炭纪的早期，由有机体构建的礁体再次搬运并形成局部斑片礁。在晚石炭纪晚期，盆地中的海底沉积物逐渐转变为海岸沼泽环境，尽管大量的植物产生足够的有机物质来形成煤层，然而海洋有机物包括筐类和鳃脚籍一直在附近生存着。

（3）东部地区

东部地区石炭纪地层的露头研究已经开展了十多年，但是有关岩石层位学的命名系统的层序并没有正式地提出。只有一些非正式岩石单位被指定，例如 C1 和 C2。C1 地层单元是由砂岩、云母质粉砂岩、页岩、板状页岩、角岩、石英岩、石灰岩以及砾岩组成。反映早石炭纪年代的苔藓动物类、有孔虫类、珊瑚的化石在碎屑岩和石灰岩中均能找到。珊瑚的发现反映当时气候比较温暖，也与劳伊-帕查布恩区域内发现的珊瑚具有相似性。C2 地层单元主要包含低级变质岩，例如：黑板岩、千枚岩、石墨质片岩、角闪岩、石英岩以及无火山碎屑岩。

（4）下西部和南部地区

在整个地区的上面部分，介于奥陶纪的松桑（Thung Song）石灰岩和二叠纪的瑞特布瑞（Ratburi）群石灰岩的层序被认为是洪发福姆（Thong Pha Phum）群。该群的沉积作用了从最初的奥陶纪-志留纪-泥盆纪到石炭纪，没有中断。这些连续地层的上部，包括多砾石岩石、混积岩，已经被岩石层序学正式规定为卡恩克瑞辰（Kacng Krachan）群。卡恩克瑞辰群广泛分布在泰国半岛，1975 年第一次被皮亚森（Piyasin）提出。随后在 1993 年由瑞克撒斯库旺（Raksaskulwong）以及旺洼内斥（Wongwanich）对其进行了改进。1995 年，特苏旺（Tansuwan）等人对 900 米厚的连续层不整合地上覆于下石炭纪页岩、砂岩以及宽克郎（Kuan Klang）组的角岩和整合的下伏在二叠纪的瑞特布瑞（Ratburi）石灰岩。该群被细分四组，从下到上依次为考旺克瑞特（Khao wang Kradat）组、斯皮为（spillway）组、古合（Ko He）组、考夫瑞（Khao Phra）组。其中，考旺克瑞特组主要由硬砂岩、长石砂岩、粉砂岩和页岩夹层组成。它们的内部结构明显为鲍玛层序，同时反映浊流沉积。斯皮为组包含有叠层泥岩，其互层有页岩、粉砂岩、硬砂岩和长石砂岩。蠕虫洞穴、生物扰动作用、软沉积物变形、崩移和脱水裂缝这些为特征的内部结构。孤石、外来石英岩碎屑、花岗岩、粉砂岩、脉纹石英、砂岩和片岩的粒径范围从卵石到巨石，很容易用肉眼观察。一些孤石反映了落石的结构和旋塞特征。人们偶然也会发现沟渠填充沉积引起的砾状砂岩透镜体。石英质砂岩

床有着尖锐的基部和丘状起伏表面，该表面穿插连续层的零星扰动。该组被解释为在冰雪漂流和风暴汹涌的影响下的大陆架的沉积物。古合组典型的特征是含有成层或非成层状的多砾岩石和混积岩，这些岩石多是由泥石流堆积和再沉积作用。考夫瑞组组成成分为：长石砂岩、石英质砂岩、泥岩、粉砂岩、页岩和偶尔出现的角岩床。大量苔藓动物类、腕足类动物、海百合等的化石集合被系统识别为早二叠纪时代。此地层单元已经被解释为次潮间带和潮间带沉积。

2. 二叠系

泰国的二叠纪岩石主要是石灰岩，且广泛发育喀斯特地貌。前文提到的瑞特布瑞（Ratburi）群并没有细分到组，认为是遍布泰国的二叠纪地层。从岩性和古生物学的角度，每个地区的层序当前已经被研究证实，随后也认识到其差异性。因此，在岩石层位学方面每个地区的二叠纪地层的认识已经很正式化。

（1）北部和上西部地区

该区的二叠纪地层已经被确认为是恩高（Ngao）群，并且被分为三个组，从下到上一次为：克尤伦姆（Kiu Lom）组，发浩特（Pha Huat）组以及怀它克（Huai Tak）组。克尤伦姆组不整合上覆于丹蓝海（Dan Lan Hoi）群。这些下二叠纪地层主要由一些碎屑岩和中间含有石灰岩薄夹层的火山碎屑沉积物组成。它们会包含筵类石、石炭纪的麦蛞类、类假希瓦格属、腕足类动物、纹线长身蜿、纹线长身蜿、腹足类、海百合类等化石。发浩特组主要包含大面积的重结晶石灰岩，间或有角岩结核和穿插凝灰质石灰岩。筵类、新希瓦格属、腕足类动物、马丁贝属、迪拉斯属、苔藓动物门、网格苔藓虫属、多孔苔藓虫属、有孔虫目、海百合这些化石集合体现了中二叠纪的特征。怀它克组的组成成分有暗灰色页岩，叠层的薄的的层状石灰岩。包含的化石有：腕足类动物、蕉叶贝属、新斯皮瑞发属、菊石以及有孔虫类，反映该地层晚二叠纪时期沉积。

（2）劳伊-帕特查本（Loei –Petchabun）地区

出现在劳伊-帕特查本地区的二叠纪岩石的组成成分主要是碳酸盐岩和碎屑岩，这些碳酸盐岩和碎屑岩组成沙拉武里（Saraburi）群，该群是 1981 年被布奴帕斯（Bunopas）第一次划定，1985 年海松（Hinthong）等人进行了进一步的修正。将其细分为六个组，从下到上分别为发尤夫（Phu Phe）组、考克旺（Khao Khwang）组、农彷（Nong Pong）组、畔艾色克（Pang Asok）组、考克海德（Khao Khad）组以及塞布本（Sab Bon）组。其中，考克海德组的主要组成成分是暗灰色厚薄不一的层状石灰岩，以及间或有凝灰质砂岩和页岩穿插的白云石。在整个

序列上还穿插有角岩结核和散开的透镜体。由从石灰岩中发现的化石可以知道：该组被认定为下二叠纪（萨克马林阶）时期的地层。农彷组组成成分有页岩、石灰岩和角岩，属于下二叠纪（亚丁斯克（Artinskian）空谷尔阶（Kungurian））时期的地层。畔艾色克组主要组成成分为：页岩、板状页岩以及砂岩。该组的年代从菊石和阿加斯菊石属（Agathiceras）可定为下二叠纪（亚丁斯克-空谷尔阶）时期沉积。考克海德组主要组成成分为深灰色石灰岩和白云岩，结核状和层状的角岩很普遍。在页岩和砂岩中，频繁穿插着石灰岩。该组的年代也是下二叠纪（亚丁斯克-空谷尔阶-）时期。塞布本组的组成成分主要有从灰色到棕色的凝灰质砂岩、页岩、角岩和薄层的石灰岩。该组被认为属于中二叠纪[空谷尔阶-若丁（Roadian）]时期。

威尔州思克(Wielchowsky)和杨（Young）1984 年提出沙拉武里（Saraburi）群的碳酸盐相代表着六种沉积环境，分别为：盆地平原、盆地边缘、台地边缘、台地内部、局限台地、滨海，而硅质碎屑岩则代表着浅海、浅海和滨海的沉积环境。另外，它们证实了三个古地理府的存在，西部的碳酸盐台地、中部硅质碎屑-碳酸盐的混合盆地和东部的碳酸盐、硅质碎屑混合台地。

（3）东部地区

东部地区的二叠纪石灰岩，以前被认为是瑞特布瑞（Ratburi）群，后来被认为是辰它布瑞（Chantaburi）群。该群划分为下部的色瑞克（Srakaeo）组和上部的考查克恩（Khao Chakarn）组。前一组由角岩、石灰岩超基性岩和蛇绿岩组成。从角岩层中放射性元素得到其所处的年代为中二叠纪时期到晚二叠纪时期。后一组中主要由中晚二叠纪时期的含有大量化石的石灰岩组成。二叠纪石灰岩被清楚的划分为两个区域，这两个区域分别代表着两段不同的时期，西部以格子蜓属，单纯的新米瓦格蜓属为代表的若丁（Roadian）时期，东部以亚贝纳（Yabena），鳞蜓属（Lepidolina）为主。

（4）下西部和南部地区

泰国半岛的二叠纪岩石主要是由普遍发育喀斯特地貌的石灰岩组成，在岩石层位学角度，已经被确定命名为瑞特布瑞（Ratburi）群或者瑞特布瑞（Ratburi）石灰岩。

瑞特布瑞群整合地上覆于卡恩克瑞辰（Kaeng Krachan）群。它的主要组成成分为厚度大约有 800 米的大量层状石灰岩和穿插其中的碎屑岩。该序列的中部和下部结核状角岩很常见。苔藓动物（Bryozoan）、纺锤蜓目（Fusulinids）、腕足

类动物、藻类以及有孔虫的化石集合反映了其所处时期为中到晚二叠纪。

哈瑞森（Harrison）等人 1997 年将出现在苏拉塔尼府邻近地区的瑞特布瑞群划分为四个组，从下到上分别为为松南令（Thung Nang Ling）组、帕布帕（Phab Pha）组、普瑞努曼旺（Pra Nom Wang）组和阿鲁克（Um Luk）组。松南令组大约有 80 米厚，整合上覆于卡恩克瑞辰群的碎屑岩上，组成成分为含有深色到浅灰色化石的石灰岩。帕布帕组大约 200 米厚，组成成分为深灰色中薄层层状石灰岩夹层、泥岩和页岩。普瑞努曼旺组的主要组成成分为粗粒中厚夹层石灰岩、白云质石灰岩和白云岩。阿鲁克组厚度超过 200 米，主要组成成分为浅灰色厚层且非晶质的层状石灰岩。

方泰恩（Fontaine）和苏瑟赛恩（Sutheethorn）1988 年提出该区域的瑞特布瑞石灰岩有六种特征：1）很多人证实的少量物种，该石灰岩包含很少此种动物群，且密度很小，藻类植物群也一般少见；2）珊瑚仅在几个地区可以找到；3）石灰岩的年代范围从中二叠纪到晚二叠纪；4）下二叠纪主要由碎屑沉积物组成；5）含砾泥岩的硼含量分析接近于石炭纪到二叠纪，不能有力地支持冰成事件理论；6）瑞特布瑞石灰岩沉积于相对远离海岸的大陆架，含有很少，小的主要浮游生物化石。

四、中生代海相岩石

1．三叠系

三叠纪时期，南邦（Lampang）群过去曾被划分为五个单元，现在划分为七个单元，自下向上分别命名为帕那（Phra That）组，帕坎（Pha Kan）组，香海（Hong Hoi）组，大井龙（Doi Long）组，帕铃（Pha Daeng）组，康帕（Kang Pla）组以及宏展（Wang Chin）组。这些岩性地层单元主要由泥岩、灰岩、灰色到绿灰色砂岩和次生砾岩组成，总厚度为 5,000 米。这些岩石不整合上覆于二叠-三叠纪的火山岩之上，并与呈不整合和整合与二叠纪岩石接触。不整合接触主要分布在沉积盆地的边缘。南邦群也同样与下伏的侏罗纪红层呈整合和不整合接触。整合接触主要在沉积盆地的中部。这些盆地可以被划分为南邦次盆和帕府次盆，前者位于泰国北方西部的南邦和帕姚（Pha Yao）地区。南邦群在这些地区包括的岩石地层单元从帕那（Phra That）组到帕铃组，通过鱼鳞蛤属、海浪蛤属、脊褶蛤属和克氏蛤属化石确定为 240～220 百万年。帕铃组地层沉积时期，沉积盆地迁移到现今盆地的东部沉积了帕府次盆的地层，该次盆覆盖了帕府地区、南邦地区的东部、帕姚省以及清莱省。这里的南邦群包括帕铃组，康帕组以及宏展组，

通过双壳类海燕蛤属、海浪蛤属以及古心蛤属表明地层属于中卡尼阶到诺利阶（227～208 百万年）。然而，南邦群的灰岩局限分布在帕坎组、香海组、土井龙组以及康帕组地层内。

三叠纪岩石在纳内（Na Noi），塔旺帕（Tha Wang Pha），宋奎（Song Khwae）区以及楠省和程逸省南帕（Nam Pat）区出露，根据他们横向相变可以划分为 3 套地层。布罗帕斯（Bunopas）1981 年建立了一个南帕群的非正式划分方法，由欣叻（下）和怀博孔岛（上）组组成，在比例尺为 1:250,000 的填图中不包括灰岩单元（trl）。南帕群厚约 1,400 米，由绿灰色到红色含有次生砂岩、花岗岩、灰岩、燧石和白色石英火山岩碎屑的砾岩、砂岩以及互层的显示鲍马序列的暗灰色至灰绿色泥岩组成，根据牙形动物厚耙牙形石属，南帕群属于斯西西阶时期。trl 单元（不包括在南帕群内）的岩性由深灰色薄层到厚层灰岩互层组成，偶见泥岩和砂岩。这个地层单元解释为怀宝坤（Huai Bo Khoa）组地层的横向相变，在楠省的纳内区北部和博格洛（Bo Klua）区西部的孤山有很好的露头。依据菊石类蚌形蛤属和双壳类脊褶蛤属，该地层单元属于中三叠世。

湄丰颂省湄萨良（Mae Sariang）区附近地区的三叠纪海相岩石与下伏的古生界地层呈不整合接触，同样与上覆的侏罗纪地层呈不整合接触。该套地层可划分为两套非正式地层单元：下部地层和上部地层。这两套地层厚约 220 米，主要由（从底到顶）薄层粘土岩夹绿红色薄层（<10 厘米）燧石，偶见灰岩。此外，红棕色到灰色砾岩、砂岩和泥岩层序也主要呈现鲍马序列，粒序递变层序以及向上变细层序。根据放射虫类、双壳类海燕蛤属、海浪蛤属、鱼鳞蛤属和苏门答腊蜓属，该套地层属于中三叠世。

布莱昂（Braun）和乔丹（Jordan）1976 研究德省湄苏（Mae Sot）区附近的卡玛卡拉（Karnawkala）地区的剖面。剖面中的岩石由 90 米厚的页岩和绿灰色砂岩，并且向上页岩变多的层序组成。这些岩石中的化石包括双壳类海燕蛤属、海浪蛤属以及菊石类，该岩石形成于晚三叠纪时期。对于卡玛卡拉（Kamawkala）灰岩，米索克（Meesook）等人 1994 年认为形成于侏罗纪时期，这些灰岩通过断层接触与三叠纪岩石有关。三叠纪岩石在德省附近出露，沿湄平（Mae Ping）断裂带分布于一条北西-南东向的狭长条带，宽 3 米，长 20 米。那里的岩石厚度为 350-500 米。罗帕斯（Bunopas）1981 年给出这些岩石的地层数据，并指出下部岩石厚度为 235 米，由分选较差红色砾岩与砂岩互层、砂岩夹层以及灰岩、碎屑由火山岩、燧石、灰岩、砂岩和石英组成。中部岩石厚约 140 米，由灰色泥岩

与砂岩互层，包含双壳类鱼鳞蛤属苏门答腊蜓，为中卡尼阶时期沉积。

北碧府省西沙瓦（Si Sawat）区和通帕蓬（Thong Pha Phum）区附近的三叠纪海相岩石露头为 200 米厚地层，由灰岩、粉砂岩、泥岩以及砂岩层序组成。泥岩中有独特的铅笔状构造，灰岩被白云岩交代。在沙瓦区发现双壳类鱼鳞蛤属和海浪蛤属，在灰岩中发现早安尼阶的蒙伯尔格新舟牙形石、新片牙形石属、舟牙形石属（Mosher&Clark）和诺利阶的高舟牙形石属。因为灰岩碎屑中发现侏罗纪化石，过去在耿拉波特（Kaeng Raboet）的三叠纪砾岩和砂岩认为是侏罗纪沉积。

泰国东部的三叠纪海相岩石可以划分成 4 套地层单元，从下往上依次命名为：苏克瑞武（Sookpriwun）组，嫩埔（Noen Po）组，邦南隆（Pong Nam Ron）组以及嫩富亚伊青进（Noen Phu Yai Yua）组。苏克瑞武组总厚度为 100 米，由弱变形的灰色、深灰色以及紫罗兰褐色灰岩组成。该套地层不整合上覆于晚二叠纪岩石之上，含有有孔虫目回旋虫属、球旋虫属以及藻类，表明地层属于斯西西阶-拉丁阶。嫩埔组由灰色到深灰色泥岩和页岩与 3-5 厘米厚的灰色石英燧石互层。邦南隆组地层 2,000 米厚，由深灰色分选较差厚层长石质砂岩组成，为浅灰色和绿灰色。砂岩组分主要由火山岩、长石以及次生石英组成。一些地区的砂岩和泥岩互层，砾岩的碎屑磨圆较好，分选差到一般的火山岩和纺锤蜓灰岩。砾石呈粒度向上变小粒序渐变为嫩富亚伊青进组。该组地层厚 300 米，与下伏邦南隆组地层整合接触，由深灰色中粒层理发育的（10-20 厘米）砂岩与发育平行层理的泥岩互层，该互层呈现鲍马序列与递变层理，尤其是砂岩粒度递变为泥岩时通常为突变和面状接触，页岩比率为 2:1 到 1:1 组成。现在认为这套地层是在海底扇环境沉积形成。

泰国西部，三叠纪海相岩石主要由与石炭-二叠纪德坦武里（Ratburi）群岩性相似的灰岩组成。这些灰岩、砂岩、页岩以及泥灰岩互层，总厚度为 300 米。肯伯等 1976 年和考期 1973 年在奎艾（Khwae Yai）附近地区发现海燕蛤属和鱼鳞蛤属。根据提到的双壳类和微体化石，岩石的年代为安尼阶到诺利阶（中-晚三叠世）。

泰国南部半岛，三叠纪海相岩石在宋卡省和博他仑省附近出露。格雷德-马克依克等 1980 年将宋卡省的萨巴尧（Saba Yoi）区的地层划分为四套地层单元，自下往上分别命名为：苏安湛（Suan Cham）组、柴迪（Chedi）砾岩、卡隆空（Khlong Kon）灰岩以及沙尼（Sani）组。苏安湛组地层由 1,700 米厚的粉砂岩和层理发育的砂岩组成，柴迪砾岩由厚层砾岩和含油中粒状砂岩透镜体的砂岩组成。卡隆

空灰岩厚约 600 米，由灰色，厚层灰岩组成。格雷德-马克依克等 1980 年认为卡隆空灰岩可以和南邦群的安尼阶帕坎（Pha Kan）组或诺利阶多伊昌（Doi Chang）组对比。将来可能需要关于地层对比的深入研究。近年来，撒斯德等 1999 年提及到卡隆空灰岩可能是在低能、礁后区或泻湖环境沉积，根据有孔虫研究，这套地层发育年代可能从中三叠纪到上三叠纪。沙尼组厚约 4,300 米，由粉砂岩、细粒砂岩、深灰色燧石以及细到中粒砾岩组成。

在宋卡省纳塔威（Na Thawi）区三叠纪岩石在空麦（Khlong Mak）42 号公路附近发现双壳类鱼鳞蛤属，为卡尼阶。格雷德-马克依克等 1980 年划分了新的地层单元，自下往上分别命名为永吉米（Mi Kiat）砾岩、纳塔威（Na Thawi）组、王艾（Wang Yai）粉砂岩以及林龙（Lam Long）砂岩。永吉米砾岩大约有 500 米厚，由砾岩和砂岩组成。纳塔威组为厚约 3,000 米的粉砂岩和硅质砂岩地层。格雷德-马克依克等 1980 年认为这套地层可以和马来西亚西北的三叠纪双门歌（Semanggol）组对比。粉砂岩中发现的双壳类鱼鳞蛤属证实地层属于中卡尼阶时期（晚三叠纪下部）。近年来，撒斯德等 1998 年在沿 42 号公路的韩王艾（Han Wang Yai）地区的燧石透镜体中发现石炭纪放射虫。王艾（Wang Yai）粉砂岩、薄层状钙质粉砂岩和林龙（Lam Long）砂岩的细粒薄层砂岩厚度分别为 225 米和 3,700 米。

在博他仑（Phatthalung）地区，三叠纪海相岩石被安普马哈（Ampornmaha）1995 年将蔡武里（Chaibun）组划分为三套地层单元，从下到上分别为：富考通（Phukhaothong）白云岩段、柴科（Chiak）灰岩段以及帕侬王（Phanomwang）灰岩段。该地层的总厚度为 500 米的浅灰色灰岩、白云质灰岩以及白云岩组成。地层沿南北走向，向东倾 40°。下部地层由白云岩组成，马子因（Mazin）等 1991 年发现一个新型蜻（爬行纲），认为该地层为早三叠纪。中部由灰岩和含有团块的薄层燧石互层组成，上部地层通过微体化石研究，由厚层到巨厚层灰岩组成。该地层年代主要通过牙形石确定为下三叠纪到上三叠纪。

2．侏罗系

（1）北部和西北部地区的侏罗纪海相岩石

泰国北部和西北部地区的侏罗纪海相岩石在泰国和缅甸的边界夜丰颂省坤荣（Khun Yuam）区和孟（Muang）区以及德省湄苏（Mae Sot）区和翁庞（Umphang）附近都有很好的露头。

米索克（Meesook）和格莱德-马克依（Grant-Mackie）1996 年将这些地区的

侏罗纪海相地层划分成十二套新的地层单元。在湄丰颂（Mae Hong Son）地区，怀凤（Huai Pong）群可以划分成三套地层，从下往上依次为：霸蓝（Pa Lan）组、麦黄（Mai Hung）组以及孔目（Kong Mu）组，地层厚度为 200 米，下伏三叠纪海相岩石，上覆第四纪沉积物。霸蓝组厚约 90 米，由深灰色泥岩与薄层状砂岩组成，麦黄组厚约 50 米，为砂质灰岩与薄层状粉砂岩互层，孔目组主要由厚层砂岩组成。根据发现的菊石类光腔贝属和双壳类小盾海扇属满苏氏虫属，怀凤群沉积时期为图阿尔阶到阿连阶早期。

在湄苏地区侏罗纪海相岩石同样有很好的露头，但是因为湄苏盆地内的断层作用，岩石与上覆地层和下伏地层的接触关系目前尚未查清。该地层被划分为四套新的岩性地层单元，又下到上依次为：华晖（Hua Fai）群的昆淮（Khun Huai）组、土井尧（Doi Yot）组以及辉德（Pha De）组。昆淮组厚 140 米，由灰色灰岩与深灰色泥岩互层组成。土井尧组厚 370 米，由深灰色泥岩与灰色灰岩会场组成。上覆的辉德组厚 390 米，由灰岩、泥灰岩与深灰色，薄层泥岩互层组成。根据发现的菊石类光腔贝属以及双壳类海浪蛤属，华晖群沉积时期为图阿尔阶到早巴柔阶。

侏罗纪海相岩石在翁庞（Umphang）地区也广泛发育，命名为翁庞群。翁庞群厚约 430 米，从下到上依次由科乐寿（Klo Tho）组、钽苏哥（Ta Sue Kho）组、浦咯川崎（Pu Khloc Khi）组以及陆咯图（Lu Kloe Tu）组组成。科乐寿组厚约 60 米，由深灰色泥岩与薄层状砂岩互层组成。钽苏哥组地层厚约 60 米，由薄层到厚层灰岩组成，上覆的陆咯图组主要由最少 200 米厚的砂岩组成。根据发现的菊石类光腔贝属、双壳类小盾海扇属满苏氏虫、有孔虫以及藻类，翁庞群地层沉积时期为图阿尔阶到阿伦阶。根据前文提及的岩性和古生物数据，认为泰国北部和西北部的侏罗纪海相岩石沉积于浅海相环境（浅海带）。

（2）西部和南部地区的侏罗纪海相地层

泰国西部和南部地区的侏罗纪海相地层主要分布在四个地区，北碧府省通帕蓬（Thong Pha Phum）区、春蓬省考勒（Khao Lak）区和普拉胡（Pralhiu）区、那空是贪玛叻省的童颂（Thung Song）区、通艾（Thung Yai）区以及华赛（Hua Sai）区、甲米省的克隆托姆（Klong Thom）区和蓝塔（Lam Thap）区。

米索克（Meesook）和格莱德-马克依（Grant-Mackie）1996 年将这些地区的侏罗纪海相地层划分了一套新的地层单元（考勒（Khao Lak）组）。这套地层厚 190 米，由泥岩、粉砂岩、砂岩、灰岩以及泥灰岩组成。根据发现的菊石，考勒

组地层在巴柔阶时期沉积。

在通帕蓬地区，米索克（Meesook）和格莱德-马克依（Grant-Mackie）1996年提及到一些辅助数据，但是并没有划分地层单元。通过对于这些数据的一些研究将该地区的灰色灰岩和深灰色泥岩的侏罗纪海相地层与翁庞地区的翁庞群中的钽苏哥（Ta Sue Kho）组和浦咯川崎（Pu Khloc Khi）组对应。该地区的灰岩中发现一些侏罗纪有孔虫目化石。

格莱德-马克依（Grant-Mackie）1980 年将厚 100 米的细粒厚层装砂岩、泥岩和粉砂岩互层的地层命名为帕蝙（Phra Bat）组。根据岩石中发现的植物遗体，双壳类偏顶蛤属和足迹化石似海藻迹，认为该岩石为图阿尔阶。

提拉兰斯格（Teerarungsigul）1999 年对于那空是贪玛叻省的马青（Map Ching）区和童颂（Thung Song）区附近的空米（Khlong Mia）组进行了深入研究。空米组厚 116 米，根据介形纲达尔文介属、双壳纲偏顶蛤属、棱蛎属、始心蛤属和脊椎动物以及孢粉研究，确定为侏罗纪时期半咸水泻湖环境沉积的地层。

根据米索克（Meesook）和格莱德-马克依（Grant-Mackie）1994 年的研究，根据菊石类、双壳类、有孔虫目和藻类资料，对泰国侏罗纪海相岩石进行生物地层对比。这个对比在图阿尔阶到早巴柔阶时期地层主要是根据菊石类光腔贝属、双壳类小盾海扇属。不用珊瑚和腕足动物进行对比是因为这些化石的分布年代跨度太大，整个下侏罗纪或图阿尔阶都有分布。

根据米索克（Meesook）和格莱德-马克依（Grant-Mackie）1997 年对这些地区下侏罗纪海相（图阿尔阶到早巴柔阶）岩石的古生态和古环境研究主要是根据双壳类群丛、菊石类、腕足类动物和微体化石的辅助资料。一般来说，在一些露头，底栖双壳类群丛比较富集，主要是内栖动物、半-内栖动物和表栖动物食悬浮物的生物。在这些生物中主要为内栖动物。这些底栖双壳类群丛的差异主要是由泥量大小、基底、沉积速率和盐度造成的。底到中等能量水平，较软的细粒硅质碎屑基底是控制动物化石分布的因素，也能解释内栖动物为什么比表栖动物食悬浮物的生物更富集，和他们的差异。

古环境在空间和时间上均有变化，也就是说，从北往南（湄丰颂（Mae Hong Son）到春蓬（Chumphon）），从图阿尔阶到早巴柔阶。图阿尔阶时期，翁庞（Umphang）和湄丰颂（Mae Hong Son）的许多露头化石主要是底栖的双壳类包括内栖动物，半内栖动物，表栖动物群丛。除了湄苏（Mae Sot）地区是处于水深较大（陆架外侧可能一直到大陆坡下部，50-200 米）且缺氧的封闭盆地的条件

外，认为其余地区温暖的浅水（陆架地区内部，50-100 米）富氧条件适合双壳类海浪蛤属的生存。图阿尔阶到阿连阶，从高能条件转变成为低能条件，沉积物供给变少，但是湄苏地区仍然属于封闭盆地。这个地区岩石中出现的菊石类认为海平面升高的同时盆地中的氧含量也增高了。阿连阶末期到早巴柔阶，除了湄苏和春蓬的封闭盆地之外许多地区向近岸方向能量增加，主要存在有菊石类-双壳类群丛以及珊瑚和微体化石。巴柔阶中期，通过红层能反映沉积条件从海相到非海相转变。

3．中生代非海相岩石

（1）呵叻台地附近地区

一般来说，呵叻台地的中生代非海相呵叻群由九个地层单元组成，从下往上依次命名为：怀欣叻（Huai Hin Lat）组、南蓬（Nam Phong）组、富卡东（Phu Kradung）组、帕哈努斯维汉（Phra Wihan）组、绍化（Sao Khua）组、普潘（Phu Phan）组、空阔（Khok Kruat）组、马哈堪（Maha Sarakham）组以及富托格（Phu Thok）组。这些地层组分别与下伏二叠纪和三叠纪以及上覆的第三纪和第四纪沉积不整合接触。在彭世洛省北部以及黎省西部，考雅库尔德（Khao Ya Puk）组和富哈特（Phu Khat）组的红层上覆的玛哈堪组之上分布广泛。考雅库尔德组可以与呵叻台地的富托格组进行地层对比。

根据脊椎动物、双壳类和孢粉，呵叻群地层发育年代从上三叠纪到白垩-第三纪。

1）三叠纪

呵叻高原的半海相三叠纪岩石包括怀欣叻组和南蓬组。最下面的单元为怀欣叻组，平均厚度为 250 米（100 米-400 米之间），并且以不整合与下伏的南鸭（Nam Duk）组和上二叠统灰岩接触，以整合与上覆的怀欣叻组接触。怀欣叻组由底砾岩和互层的灰岩组成。最上部的 50 米由砂岩和互层的深灰色泥岩组成，当风化时，为湿灰绿色泥岩。通过化石组合研究，该组的年龄在卡尼阶（Carnian）到诺利阶（Norian）或者可能到雷蒂亚阶（Rhaetian）（晚三叠世）之间。该地层被解释为半地堑盆地沉积，盆地古地形高低不平，在半湿润-半干旱气候条件下，局部小水域的碳酸钙含量很高。

南蓬组地层厚 1,465 米（在 100 米与 1,500 米之间变化），以整合与下伏的怀欣叻组接触，由红褐色粉砂岩、砂岩和粘土岩组成。根据与下伏地层-怀欣叻组的地层关系以及动物区系组合，南蓬组的年龄被定为雷蒂亚阶。该地层开始沉积

于半干旱古气候条件下的冲积扇环境，随后过渡为曲流河沉积体系，包括河道和洪泛平原沉积物。

2）侏罗纪-白垩纪

在标准剖面，富卡东组厚 1,001 米，但在其他区域，厚度在 800 到 1,200 米之间。该组地层由栗色粉砂岩、粘土岩、砂岩和砾岩组成，在粘土岩的上部，发现了钙结岩结核、钙质壳和硅质壳层结核，在某些地区，发育 5-10 米厚的灰白色砂岩夹层。根据对发现化石的研究，地层形成的时代在早侏罗世与晚侏罗世之间，根据地层对比的结果，地层形成的时代为中侏罗世到晚侏罗世。该组地层开始沉积于半干旱古气候条件下的流河沉积体系，发育高能古水道，随后过渡为洪泛平原，局限水域和湖泊沉积。

帕哈努斯维汉组的厚度通常在 100 米到 250 米之间，平均厚 30 米，分别与下伏的富卡东组和上覆的绍化组呈整合接触。该组地层由黄白色，细到中等粒度，分选好，磨圆好的石英砂岩、粉砂岩、薄层粘土岩和砾岩组成。根据化石组合及地层对比研究，帕哈努斯维汉组地层的形成年代在晚侏罗世与早白垩世之间，主要沉积于半潮湿气候条件下的辫状河及间歇性曲流河环境。

3）白垩纪

绍化组地层的厚度通常在 200 米到 760 米之间，在普潘地区的平均厚度为 120 米（在 50 米到 200 米之间）。该组地层分别与下伏的普潘组和上覆的绍化组呈整合接触，由不同旋回的红棕色粉砂粘土岩和粉砂岩互层，细粒到中粒的砂岩和砾岩组成，通常含有钙质壳、钙质岩结核和薄层的结核状硅质壳。与富卡东组和空阔组相比，该组含有更多明显发育的红褐色钙结岩水平层。根据化石组合及地层对比研究，帕哈努斯维汉组地层的形成年代在晚侏罗世与早白垩世之间，主要沉积于半潮湿气候条件下的曲流河环境。

普潘组地层厚 80 米到 140 米，下伏和上覆的地层分别为空阔组和绍化组。该组地层由浅灰色，厚层，发育板状和槽状交错层理，磨圆好，分选差，中粗粒含砾砂岩组成。矿物成分为白色的石英、火山岩、暗灰色、红棕色和绿色的燧石。在一些地区，砂岩中发育深灰色页岩夹层以及页岩透镜体。根据化石组合研究，普潘组的形成年代为早白垩世，沉积环境为半潮湿半干旱古气候条件下的辫状河及间歇性流河环境，但河流的能量比帕哈努斯维汉组要高。

空阔（组地层厚 430 米到 700 米，与下伏的普潘组呈整合接触，与上覆的玛哈堪组呈不整合接触。主要由红棕色至紫红色砂岩、粉砂岩、粘土岩和砾岩组成，

在粘土岩的顶部发育钙结岩结核和钙质壳。根据脊椎动物化石，空阔组的形成年代在阿伯梯安（Abtian）阶到阿尔布阶之间，或者早白垩世，沉积于半干旱-干旱古气候条件下的流河环境。

玛哈堪组地层厚 610 米到 1,000 米，与下伏的空阔组呈不整合接触，与上覆的富托格和考雅库尔德组呈整合接触。根据孢粉研究，该组的形成年代被定为森诺曼阶（晚白垩世早期）。玛哈堪组沉积于干旱古气候条件下的咸水湖泊和局限水域环境。

4）白垩纪-第三纪

在富托格和富哇（Phu Wua）地区，富托格组地层厚 205 米，与下伏的玛哈堪组呈整合接触。该组地层由两种砂岩组成，分别为红褐色，中细粒，槽状交错层理砂岩和棕红色，波状纹层钙质砂岩。富托格组可以被分为 4 个段，根据地层发育背景，形成的年代在晚白垩世到早第三纪之间，沉积于半干旱-干旱古气候条件下的间歇性流河以及风成环境。

考雅普克组地层厚 200 米到 350 米，在查特达拉干（Chat Trakan）国家公园出露良好。通过对地层发育背景和彭世洛省那空区班南拉特（Ban Nam Lat）的 150 米测井曲线研究，确定了该组地层与下伏的玛哈堪组呈整合接触，与上覆的富哈特组呈不整合接触。考雅普克组上部为砖红色，厚层状，粗粒，磨圆好，分选中等的砂岩，红棕色至栗色的粉砂岩、粘土岩以及砾岩；中部为槽状交错层理，波状纹层，细粒，含云母和钙质的砂岩与棕色至红棕色粉砂岩互层，发育波痕和龟裂痕；下部为红棕色的粉砂岩与石膏浸染粘土岩互层。根据地层发育背景研究，该组的形成年代被确定为白垩纪到第三纪。考雅普克组沉积于半干旱-干旱古气候条件下的间歇性流河及风成环境。

富哈特组地层厚 150 米到 500 米左右，与下伏的考雅普克组呈不整合接触。该组地层由棕色至栗色，中细粒，分选好的钙质砂岩与粉砂岩互层。该组的下部为栗色的，分选差，磨圆好砾岩。碎屑由石英、碎石、砂岩、粉砂岩、火山岩和石灰岩组成。富哈特组与考雅普克组的时代大致相近，均为白垩纪到第三纪，沉积于半干旱古气候条件下的曲流河和冲积扇环境。

（2）南部和上西部地区

1）三叠纪

非海相三叠纪岩石主要出露在泰国北部的上，中以及东北部分，包括帕那（Phra That）组和普拉当（Pba Daeng）组。在帕尧南（Nan Phra Yao）盆地出露

Ms1 单元（边缘相），由发育的底砾岩可知，该组与下伏的三叠纪海相地层呈渐变和不整合接触。碎屑由深灰色到绿色砂岩、红色燧石、灰色至暗灰色石灰岩、来自于三叠纪海相地层的红色至绿色泥岩和砾岩和二叠系和石炭-二叠系的礁灰岩组成。Ms1 单元沉积于晚三叠世（诺利克阶）的冲积扇环境，最大厚度为 300 米。

Ms1 单元（Ms1 相）由红色、紫色和浅灰色的中酸性喷出流纹岩、流纹英安岩、安山岩和红棕色至黄色的细粒凝灰岩组成。该地层呈南北走向，在清莱和帕尧省东部以及南省西部出露。Ms2 单元与下伏的 Ms1 单元呈整合接触，与下伏的三叠纪和二叠系海相地层呈不整合接触。Ms2 单元厚 300 米到 550 米，形成于晚三叠世（瑞提阶）。

2）侏罗纪

Ms3 单元（Ms3 相）在泰国北部（楠省和帕尧省）的东部广泛分布，由下部单元（Ms3.5）和上部单元（Ms3.6）组成。根据可以与 Ms3.4 单元（Hahn，1982）以及呵叻高原的富卡东（Phu Kradung）组和帕哈努斯维汉（Phra Wihan）组发现孢粉对比的孢粉型 Corollina sp.，该单元的年龄被定为侏罗纪。此外，在楠省发现了双壳类的 Modiolus，海因同（Hinthong）1999 年同样提到过该发现。Ms3 单元厚 300 米到 400 米，沉积于冲积扇和流河沉积环境，该单元的下部为向上变细的序列，由 Ms2 单元剥蚀形成的细粒-中粒砾岩组成；上部同样为向上变细的序列（从底到顶），由火山岩（Ms2）剥蚀形成的砾岩组成，并且由细粒-粗粒砾岩和细粒-粗粒砂岩，逐渐向上过渡为粉砂岩和泥岩。该单元的上部（红色纹层状粉砂岩和粘土岩）与下部（含钙粘土岩）以渐变界面接触。除此之外，在流河向上变细的沉积序列中，还发现了钙结岩结核，钙结岩水平层，泥裂，波状纹层，生物扰动作用以及云母。

Ms4 单元（Ms4 相）沉积于流河环境，与下伏的 Ms3 单元呈整合接触。Ms4 单元厚 400 米到 500 米。在侏罗纪的泥岩夹层中发现的生物群包括卵圆形的圆形锥瘤孢属，似南美杉属、科莫棒瘤孢、凹边瘤面孢属、小桫椤孢属和光面单缝孢属。该单元由沉积于河口坝区域的向上变细的灰色至灰绿色，分选好的石英砂岩组成、粗粒的砂岩、砾岩和含白色石英砾石，粒度达到 1 厘米，通常发育各种交错层理，如槽状，下切型板状，有交角的和纵向型式的。

在那空泰盆地的西部和南部广泛发育富卡东组和帕哈努斯维汉组地层，根据对呵叻群下部进行的地层对比研究，可以确定这两个组的地层年代。在彭世洛-

罗姆沙克公路附近的废弃采石场，富卡东组出露较好，该组地层厚 22.5 米，沉积于流河环境，由（顶部到底部）灰色，厚层状（20 米）中粒砂岩和页岩夹层（0.7 米）组成。在上部，钙质含砾砂岩（0.6 米-1.0 米）中含磨圆很好的绿色至灰色燧石、安山岩、流纹岩以及泥岩砾石。厚 50 米到 100 米的砂岩向上逐渐过渡为绿色至栗色，厚 0.5 米的页岩，以及厚 1 米，红灰色含侏罗纪化石的细粒砂岩。该地区的帕哈努斯维汉组地层与下伏的富卡东组呈整合接触，由灰白色，细粒-粗粒，分选好，发育交错层理的石英砂岩与浅灰色至褐色页岩互层组成。砂岩的矿物成分为 90%的石英，少量的长石，以及硅质胶结物。

3）白垩纪

白垩纪的非海相岩石都沿着位于楠省班博格洛（Ban Bo Klua）和淮干班（Ban Huai Kon）东部的泰国和老挝的边界线（南北走向）分布。接下来，将以单元的形式对岩石论述：

Ms5 单元（Ms5 相）

根据泰国的 1:1,000,000 地质图（1999/B.E. 2542），在楠省博格洛（Bo Klua）附近，在该单元的下部发现了盐层。Ms5 单元由一个向上变粗的过度序列组成，包括红色，细粒砂岩、粉砂岩、粘土岩、发育钙结岩水平层和爬升波纹。

覆盖彭世洛省东部的绍化（Sao Khua）组地层分布于那空泰（Nakhon Thai）盆地的东部。该组地层与下伏的帕哈努斯维汉组呈整合接触，由红棕色泥岩与浅灰色，细粒-中粒砂岩互层组成。

普潘组在彭世洛省查特达拉干（Chat Trakan）附近的那空泰盆地边缘出露，与下伏的绍化组呈整合接触，主要由灰白色含砾砂岩组成。

玛哈堪（Maha Sarakham）组在那空泰盆地中部呈狭长的带状出露，由砖红色粉砂岩和粘土岩组成，并且在上部发育盐层和浸染石膏。该组地层分别在彭世洛省和黎省的查特达拉干区博班帕帕（Ban Bo Phak）、娜哈区（Na Haew）和班孟帕府（Ban Muang Phrae）出露良好。根据 1999 年在彭世洛省那空泰区班南拉特（Ban Nam Lat）钻的地下水井（深 150 米），在深约 108 米处发现了厚约 6 米的硬石膏层。这意味着在该区域发育玛哈堪组。

（3）东部区域

1）侏罗纪

该区域的非海相中生代岩石主要局限于庄他武里省的南部，泰国和柬埔寨边境的达勒省东部，泰国湾的高吉祥（Ko Kut），以及尖竹汶省的南部。下面将对

侏罗纪的岩石分别叙述：

兰辛（Laem Sing）组

兰辛组的标准剖面位于考兰辛（Khao Laem Sing）附近，其下为三叠纪的邦南隆（Pong Nam Ron）组海相地层，两者呈不整合接触。该组地层主要出露于兰辛，考泰来（Khao Thalai）、考达库伯（Khao Ta Krub）和空罗布姆（Khlong Rabom）大坝附近，由红棕色、槽状层理和递变层理的石英砂岩和粉砂岩、褐红色泥岩以及次生的砾岩组成，显示向上变细的序列。该组地层陡倾，并且发生了翻转，沉积于曲流河和冲积扇环境。根据与呵叻群的地层对比，推测该组的年代为侏罗纪。

富卡东（Phu Kradung）组

该地区的富卡东组地层主要沿泰国和柬埔寨的边境出露，由栗色至灰色，胶结不好的页岩与栗色至灰色，细粒-中粒，分选胶结好的长石砂岩和粉砂岩组成，地层倾角较小。在灰色页岩中发现有火山岩碎屑和植物碎片。该组地层沉积于流河环境，根据与呵叻群的地层对比推测该组的年代为侏罗纪。

高吉祥地区的富卡东组地层由红棕色砂岩和粉砂岩组成。在灰色含砾砂岩中有植物碎片和小型的脊椎动物化石。该组地层沉积于流河环境，并受间歇性海岸环境的影响。根据脊椎动物骨骼、淡水鲨鱼、鳞齿鱼属鱼类、龟甲片和淡水球状蛇颈龙化石研究，该组地层的年代被定为侏罗纪。这些化石可以与老挝提克丰（Tchepone）的化石进行对比。

2）侏罗纪-白垩纪

在董雷克（Dong Rek）山脉地区，帕哈努斯维汉组与下伏的富卡东组呈整合接触，由浅灰色，厚层状，交错层理石英砂岩组成。该组地层沉积于辫状河环境，根据与呵叻群的地层对比推测该组的年代为侏罗纪。

（4）下西部和南部地区

1）侏罗纪-白垩纪

加娃那佛特（Javanaphet）1969 年在 1:1,000,000 的泰国地质图上对泰国南部的非海相中生代岩石进行了报告，并将其归为呵叻群。加尔松（Garson）等 1975 年对攀牙湾（Phang Nga Bay）的阁尧（Ko Yao）组地层进行了研究，该地区的中生代岩石与下伏的二叠系地层呈不整合接触，由砂岩、粉砂岩和砾岩组成，厚度小于 400 米。

小林（Kobayashi）和德山（Tokuyama）1959 年对泰国南部海相三叠纪地层

中的化石进行过研究，随后哈雅米（Hayami）1960 年也进行了同样的研究，并认为从春蓬省春蓬河口海德塞瑞（Had Sai Ri）的泥质砂岩中采集的双壳类化石为始中齿蛤属，进而指示该地层形成的时代为侏罗纪。

在 1975 年到 1980 年期间，矿产资源部的地质学家们在泰国南部进行了系统的 1:250,000 地质填图。在这次填图中，散昂斯坎格（Sananscang）等 1977 年将那空是贪玛叻（Nakhon Si Thammarat）岩席的中生代红层划分为侏罗纪，白垩纪的地层由棕色至红棕色，交错层理砂岩、粉砂岩和砾岩组成。

乌都姆拉切（Udomratr）等 1981 年将泰国南部的中生代岩石分为 4 个单元，下面将按降序依次论述：

①最下面的单元（M1）：该单元由互层的油页岩、砂岩、泥质灰岩以及含双壳类和植物化石的炭质灰岩。

②下部单元（M2）：该单元由砂岩、粉砂岩和含双壳化石的石灰岩透镜体组成。

③中部单元（M3）：该单元由粉砂岩、砂岩、含砾砂岩和砾岩组成，并含有石灰岩、灰质白云岩和白云岩夹层，同时可以发现植物化石。

④上部单元（M4）：该单元主要由砂岩和页岩组成，形成于晚三叠世与早白垩世之间。

阿莎马（Asama）等 1981 年通过对从首页省（Trang Province）周边的粉砂岩、细砂岩或灰绿色至红褐色和细粒中生代砂岩中采集的植物化石的研究，识别出以下 6 类植物化石：

蕨类植物，包括拟里白属 gagauensis Kon'no 和拟里白属 pantiensis Kon'no；本内苏铁目，包括耳羽叶属 gagauensis Kon'no 和耳羽叶属；松柏纲，包括苏铁杉属 gagauensis Asama；以及拟节柏属。

从庄省采集植物化石不能与怀欣叻组的化石对比，但是与马来西亚的早白垩世植物化石十分相似。

在泰国的南部，南北走向的中生代非海相岩石主要分布在帕卡健汗（Prachaup Kin Khan）、春蓬（Chumphon）、素叻他尼（Surat Thani）、甲米（Krabi）和首页省，部分分布在攀牙湾的小岛屿以及那空是贪玛叻省和宋卡省的孤立小山丘。

在春蓬和那空是贪玛叻地区，南北走向的非海相红层分别在那空是贪玛叻省，甲米和首页省的通艾（Thung Yai）、空托伦（Khlong Thorn）和王韦斯特（Wang

Viset）附近出露良好。三叠纪的海相岩石同样在宋卡省的纳塔威（Na Thawi）和宋卡（Sabayoi）附近出露良好，并与下伏的二叠系石灰岩呈不整合接触。

那卡撒斯库洪（Raksaskuhwong）等 1989 年对以下地区进行了详细的区域地质填图（比例尺 1:50,000）：那空是贪玛叻省的通艾（Thung Yai）和童颂（Thung Song）地区；素叻他尼省的渊减缩剂（Wiang Sra）；甲米省的空托伦（Khlong Thorn）和诺空（Nua Khlong）地区。从岩性上说，该组地层下部为砂岩、粉砂岩、砾岩和石灰岩透镜体；中部为厚层的砂岩，以及上覆的含化石钙质页岩和砾岩；上部为红色的交错层理砂岩。这些岩石主要沉积于河流和冲积扇环境，在大多数层位有油气显示，但没有对成因进行过详细的研究。

那卡撒斯库洪（Raksaskuhwong）1994 年的研究，建立了首页群，并根据他们的岩性、沉积构造、化石和沉积环境将其划分为 4 个组，按从下到上的顺序依次为：春蓬（Chumphon）红层、科隆民（Klong Min）、三春景（Sam Chom）和喷平（Phun Phin）组。通常，该群与下伏的上三叠统海相岩石呈不整合接触，并从侏罗纪到白垩纪逐渐过渡为非海相。

特克拉郎斯格（Tccrarungsigul）1999 年在通艾（Thung Yai）和空托姆（Khlong Thom）地区的标准剖面对首页群进行了更为详细的研究。根据岩性、沉积构造、化石以及沉积环境，将该群划分为 4 个组，从下到上依次为空民（Khlong Min）、拉姆撒泼（Lam Thap）、三春景（Sam Chom）和喷平（Phun Phin）组。其中空民组由含化石的石灰岩与泥岩互层，以及含生物微晶灰岩夹层的粉砂岩；拉姆撒泼组由厚层的砂岩和粉砂岩组成；但是，三春景）组为砾岩和砂岩；喷平组由棕红色，交错层理，细粒砂岩组成。首页群沉积于非海相环境，形成时代从早中侏罗世到晚白垩世。其下伏的地层为卡曼-诺利阶的朋世（Sai Bon）组海相地层，包含双壳类标准化石 Palaencardita。在标准剖面，该组地层的厚度在 65 米到 1,145 米之间，根据空民组出现的侏罗纪介形类达尔文介属化石，推定该群地层沉积于半咸-淡水环境。

五、第三系

除了呵叻台地，泰国的第三纪沉积盆地在全国基本为山间盆地和裂谷盆地，盆地的长轴一般为南-北向，与印度板块和亚洲板块的碰撞有关。大部分在几何形态上呈现地堑和半地堑。现今，至少有 70 个第三纪盆地已经定名（图 2-4），大部分的大型盆地也包含许多次盆。这些第三纪岩石被第四纪沉积覆盖在自然露头很少出露，除了盆地边缘的第三纪地层被断层活动带到地表出露。因为同沉积

断层以及沉积后断层活动，现今第三纪盆地构型是大型盆地抬升剥蚀后的残余盆地。因为缺乏出版论文和大部分的地下数据保密，过去对这些岩石的研究非常困难。现在意识到这些岩石的重要性，它们对于石油和天然气来说不仅是烃源岩，也是储层，而且还富含煤，油页岩，硅藻土以及球粘土。一些盆地已经开始采矿作业，例如煤，其中主要是褐煤和亚烟煤分布范围就包括麦克米（Mac Moh）盆地、麦克比（Mac Than）盆地、蒋武安（Chiang Muan）盆地、博銮（Bo Luang）盆地、里（Li）盆地、农亚布隆（Nong Ya Plong）盆地以及甲米（Krabi）盆地，一些盆地的储量也有很好的远景，如渊幸（Wiang Haeng）盆地、南高（Ngao）盆地、汪努阿（Wang Nua）盆地、蔡坤（Chae Khon）盆地、梅拉马特（Mea Ramat）盆地、麦克拉毛（Mac Lamao）盆地、坚在（Khian Sa）盆地和萨巴亥（Saba Yoi）盆地；石油富集在彭世洛（Phitsanulok）盆地、祖潘武里（Suphan Buri）盆地、方（Fang）盆地以及泰国湾的盆地；球粘土主要富集在麦克比（Mac Than）盆地与煤有关的区域；硅藻土富集于南邦（Lampang）盆地的湄他（Mae Tha）次盆。湄索（Mae Sot）盆地发现大量的油页岩沉积。

1．北部和上西部地区

（1）方（Fang）盆地

方盆地位于清迈省的方区，大约有 18 公里宽，60 公里长，覆盖面积约 575 平方公里。几何形态上为半地堑，西部为南-北走向的断层，东部为倾向断层边界，北部为走向东北东-西南西的湄辰（Mea Chan）断层，地层向西增厚，最大厚度约 2800-3000 米。基于布格重力等值线图，方盆地有三个伸展型次盆，淮河巴桑（Huai Pa Sang）次盆、怀恩古（Huai Ngu）次盆和坝南爵（Pa Ngew）次盆。盆地发现六个构造油藏，分别是湾柴帕卡恩（Chai Phra Karn）、湄苏（Mae Soon）、庞诺克（Pong Nok）、淮安邦（Huay Born）、帕党（Pha Dang）以及坝南爵（Pa Ngew），前三个油田已经由国防能源部投入生产。方盆地的第三纪地层由两个地层单元组成。下部地层单元为渐新世-中中新世湄索（Mae Sod）组。这套地层内部可以划分三个部分：下部主要由曲流河环境下沉积的红棕色砂岩和粉砂岩，中部地层最少 700 米厚，主要为粘土岩、泥岩、油页岩和湖泊环境沉积的煤层，偶见河流相砂岩地层。石油主要由这部分地层生成。上部地层包括灰色粘土岩、泥岩以及常见田螺属 sp.叶片和鱼类碎片化石的砂岩。湄方（Mae Fang）地层不整合上覆在湄索（Mae Sod）组之上，主要由红色泥岩和长石砂岩组成，布拉瓦斯（Buravas）1985 年认为不整合形成于下全新世，普拉弟坦（Pradidtan）1989 年认为此不整

合形成晚于晚上新世-更新世。

从几个不同地方的地层层序取样进行孢粉分析，样品包括湄苏油田的渐新世页岩、中新世-上新世的褐煤以及早中新世晚期 IF-16 钻孔生油层段。

（2）渊幸盆地

渊幸盆地位于缅甸边界附近，清迈省的渊幸地区，约 10 公里宽，高达 19 公里长，西部为断层边界。第三纪地层包括超过 200 米厚的河流相粘土岩以及下部含少量砾石的砂岩。上覆单元为超过 100 米的湖泊相和河流-湖泊相沉积的粘土岩、泥岩、砂岩、褐煤以及油页岩。褐煤的实测储量为 93.02 百万吨。最顶部地层单元超过 300 米覆盖在第四纪砂岩和砾岩不整合之上。这套地层由河流相和冲积平原沉积的灰色到褐色粘土岩、砂岩和少量砾石组成。

（3）蔡坎盆地

蔡坎盆地位于南邦省蔡坎地区，大约 5 公里宽，20 公里长。盆地东部边缘有第三纪岩石出露，地层倾角 10-15°，层面西向。第三纪层序的下部为超过 150 米厚的湖泊相沉积，为棕色、栗色和绿灰色砂岩、粉砂岩、泥岩和河流沉积的砾石。与上覆的约 200 米厚的湖泊相沉积的灰色泥岩整合接触，下部有砂岩夹层，上部见煤层和油页岩。煤层最后高达 6-7 米，实测储量 15.8 百万吨。煤层顶部油页岩常见田螺属 sp.叶片和鱼类化石。

（4）蔡坤盆地

蔡坤盆地是蔡坎盆地的北向延伸，位于南邦市北部 86 公里。盆地宽约 1.5 公里，长约 5 公里。1982 年，能源开发及推广部和国家能源局部署了一些钻井，发现盆地含有约 15 百万吨褐煤和亚烟煤。第三纪地层超过 100 米厚与三叠纪红霍依（Hong Hoi）组不整合接触。地层被一系列南北向断层切割，三叠纪岩石在东翼被抬升到地表，层面倾角为 10-15°，倾向为西。地层上来说，下部为红棕色泥岩和粒度渐变为灰色泥岩的砂岩、煤层（高达 5-16 米厚）以及湖泊环境的淡水灰岩。煤层厚度向盆地方向减薄。煤层中见田螺属 sp.鱼类碎片化石。

（5）蒋武安盆地

南北走向的蒋武安盆地位于帕耀省的蒋武安地区，宽 8 公里，长 25 公里，几何形态呈现地堑。现在蒋武安矿业公司（Chiang Muan Mine Co.）在盆地有一处开采的煤矿。根据斯恰井（Strogen）1994 年的研究，466 米厚的第三纪地层分成三个单元：下部单元为砂岩向上渐变为产煤的泥岩层序。煤层约 14-20 米厚，实测储量为 62 百万吨。顶部单元为砂岩和粗粒沉积物。

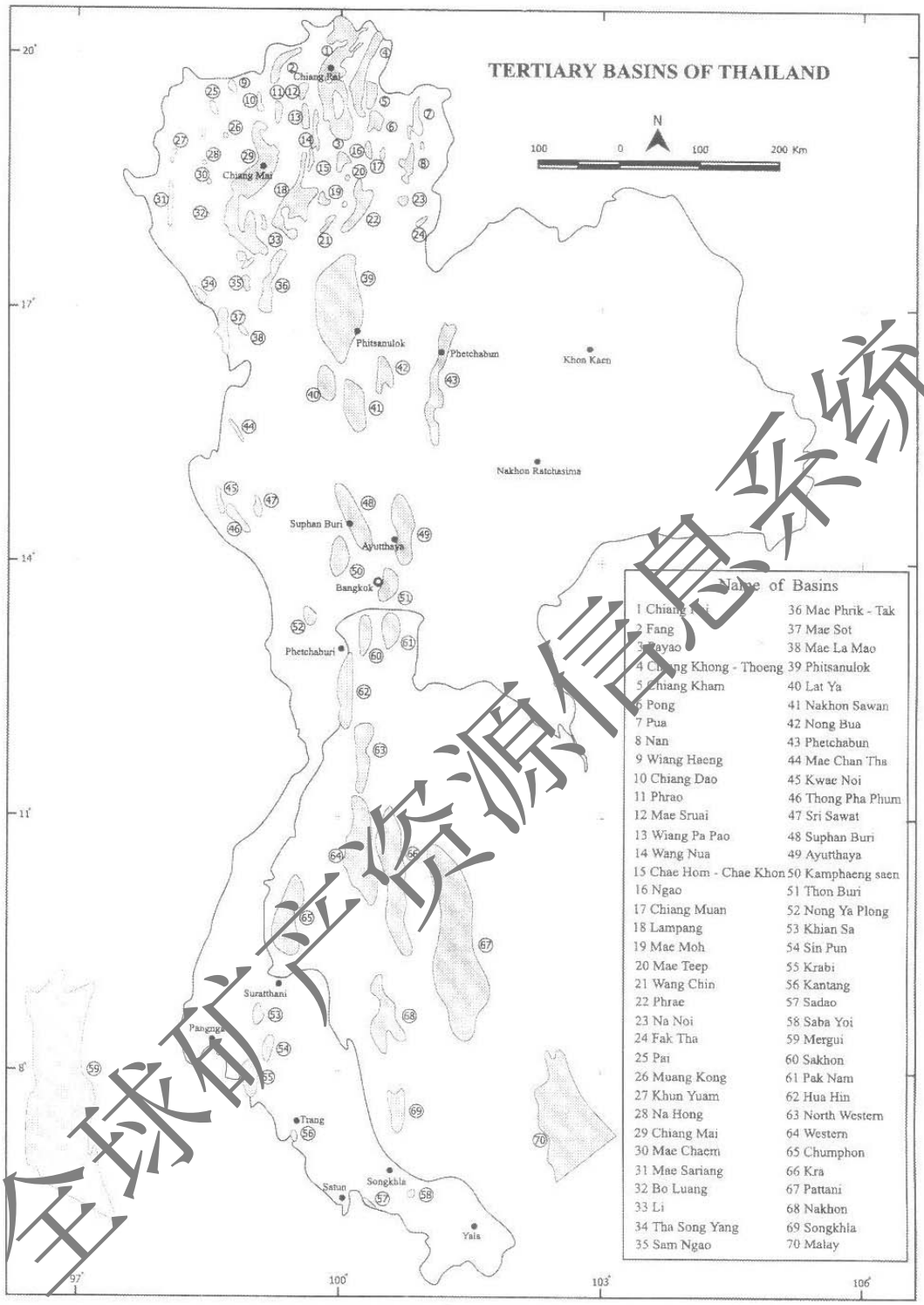

图 2-4　泰国第三纪盆地分布图

（6）南高盆地

南高盆地位于南邦省南高地区，几何形态呈三角形，地堑，西北边界为东北-西南走向断层，西南边界为西北-东南走向断层。盆地宽 13 公里，长 22 公里，在盆地西部不整合覆盖在二叠纪地层之上，东部不整合覆盖在中生代地层之上。

已有一些机构在这个区域开展研究工作，如矿产资源部、泰国电力管理局以及能源开发及推广部。第三纪地层厚约 650 米，其下部为约 200 米厚的河流相环境沉积的砂岩、砾岩以及泥岩。中部为约 150 米厚湖泊相环境沉积泥岩和页岩。发现两套褐煤夹层，下部约 17 米厚，上部约 14 米厚，实测储量为 124 百万吨。煤层厚度像盆地方向减薄。薄层淡水灰岩局部钻遇厚度高达 20 米。第三纪地层上部为厚约 300 米地层，包括泥岩、砂岩以及砾岩，与下部地层相似。南北向断层不仅仅使得第三纪地层在盆地外侧出露，还使得盆地中部的地层相对埋藏得更深。

（7）南邦盆地

南邦盆地是泰国北部大型盆地之一。基于重力地球物理测量，盆地至少由六个次盆组成，分别是：孟恒（Muang Hang）、查特（Chat）、湄他（Mae Tha）、森农（Serm）、奈干（Ngam）、 索帕伯（Sop Parb）以及湄瑞（Mae Than）次盆。有三口较深的国防能源部的钻井在此盆地进行石油勘探，还有许多略浅的钻井在此盆地进行煤和硅藻土勘探。

1）湄他次盆地

湄他次盆位于南邦盆地的东部边缘。次盆第三纪地层都超过 460 米，属于湄莫（Mae Moh）群，划分为两套地层：湄苏组，下部含有超过 430 米厚的地层，由湖泊相灰色和绿灰色泥岩、粘土岩、层内油页岩和煤组成。上覆的高黎（Ko Kha）组由高达 35 米厚的白色和浅棕色硅藻土和硅藻粘土组成，实测储量为 243 百万吨。硅藻土中含直链藻属羽瘖碎粒（EHR）、硅藻属（sp.）、舟形藻属（sp.）和脆杆藻属（sp.），可能为中新世地层。化学组分为二氧化硅 72%～73%，三氧化二铝 7.5%～13.5%，三氧化二铁 2.7%～5%，总体密度为 0.25gm/cm^3。

2）湄瑞次盆地

次盆为一个小型裂谷盆地位于南邦盆地的南部，4～5 米宽，10～12 米长。第三纪岩石与湄莫盆地相似，划分为三个地层单元；下部单元不整合上伏在三叠纪南邦群和二叠-三叠纪火山岩之上，可能与湄莫盆地的淮王（Huai King）组地层相对应，为一套厚约 25～70 米的红棕色砂岩、粉砂岩和砾岩地层；中部单元厚约 70～200 米为河流-湖泊相沉积的泥岩、砂岩、球粘土和煤（黑色褐煤到亚烟煤）。中部地层单元从发现一些脊椎动物化石推测地层属于中中新世。一般来说，盆地的北部有一套平均厚度为 10 米的煤夹层，但是盆地南部有两套平均厚度约为 10～15 米的煤夹层。木恩勒科（Muenlek）1992 年报告中提及煤的实测储量约 6 百万吨。球粘土主要在盆地西南部有所发现，在地表下平均厚度 5～20

米，最厚高达 100 米。球粘土的重要化学组分为二氧化硅 74%，三氧化二铝 20.3%，三氧化二铁 1.29%；上部地层单元约 30～80 米厚，由河流相沉积的浅灰色到红棕色砂岩、粉砂岩、泥岩和少量砾岩组成。

3）湄莫次盆地

湄莫次盆位于南邦省的东部，宽约 7 公里，长约 16 公里，盆地几何形态为地堑，东部和西部均为断层边界。因为同沉积断层和沉积后断层的作用，盆地现今形态为被基底隆起分开的两个近平行的盆地。超过 800 米厚的第三纪盆地不整合上伏于三叠纪南邦群之上，由三套地层组成。下部地层为淮王组，厚约 140 米，下部先为辫状河沉积然后向上转变为曲流河的泛滥平原沉积地层，岩性由红棕色和灰色砂岩、粉砂岩和少量砾岩组成。上覆的娜康巴（Na Kham）组厚约 400 米，主要为湖泊相和沼泽相得钙质泥岩和富钙煤组成。有人把盆地发育的五套褐煤级煤夹层从底到顶命名为 S，R，Q，K 以及 J 带。Q 和 K 带平均厚度分别为 10-30 米和 15-30 米，是主要的产煤层。在煤夹层内常见中新世的腹足类化石、滴螺属 sp.、拟黑螺属 sp.、扁卷螺属 sp.、田螺属 sp.、鱼类碎片以及介形纲化石。过去认为乳齿象属是下-中古新世的早李氏叶肢介属脊棱齿象，重新确定为中中新世的脊棱齿象属 sp.。瓦塔那斯卡（Watinasak）1989 年通过孢粉研究也认为这些主要煤夹层为中中新世。怀銮（Huai Luang)组上覆娜康巴（Na Kham）组之上，既有整合接触（盆地边缘），也有不整合接触（盆地中心）。该组地层超过 400 米厚，主要由泛滥平原、沼泽以及河流相环境沉积的红色的泥岩和粉砂岩组成。富含原生和次生的石膏晶体。

（8）湄提普盆地

湄提普小型盆地位于南邦省南高（Ngao）区，宽 3 公里，长 10 公里。过去曾在由于沉积后断层作用使得第三纪地层出露地表的盆地东部边缘开采煤矿。浅层的钻井资料表明这个第三纪盆地的地层厚度超过 200 米，不整合上覆与二叠-三叠纪南邦群的火山岩和碎屑岩之上。下部地层由河流沉积的砂岩、粉砂岩和砾岩组成，被湖泊相和沼泽相沉积所覆盖。在这套地层里面有约 10 米厚的亚烟煤、油页岩以及球粘土。在主要煤夹层之下收集到的乳齿象属化石定为早-中中新世的脊棱齿象属 sp.。然而，那塔那斯梯恩（Ratanasthien）1984 年的孢粉研究报告表明产煤层的地质年代属于塞农阶或古近纪。

（9）里盆地

里盆地位于南奔省里地区，宽约 10 公里，长 55 公里。盆地有被基底隆起分

开的两个走向近南北向次盆组成。所有的煤矿都集中在东部次盆，那里的煤层均被抬升到浅层。地层向东倾斜，也逐渐加厚。西部的次盆钻遇 400 米新生代地层仍未到达基底。里盆地的第三纪地层由两个地层组成；下部单元为里组，厚约 250 米，由砂岩、砾岩、厚度超过 50 米粉砂岩、向上粒度变小为泥岩和含有亚烟煤级煤夹层的油页岩组成。沉积环境由下部的冲积扇向上渐变为曲流河以及顶部的湖泊沉积。随后顶部的沉积环境又转变回网状河河流相沉积。气候在沉积作用类型中的影响非常重要，上渐新世的粗粒沉积物多于细粒沉积物，中新世却是细粒沉积作为主体。帕卡（Pha Kka）矿有两套煤夹层，下部和上部的煤夹层厚度分别为 15-20 米和 10-15 米。向北部的班普（Ban Pu）矿只有一套煤夹层，厚度可高达 50 米，恩度（Endo）1964 年最先发现古近纪的植物化石。随后瓦塔那斯卡（Watanasak）1989 年基于孢粉研究花粉带，指出里盆地的主要煤夹层为渐新世-早中新世。上覆的娜赛（Na Sai）组厚约 80-500 米，主要由湖泊相沉积的粘土岩和泥岩组成。在里盆地南部的班娜赛（Ban Na Sai）次盆，塔斯因（Tassy）等 1992 年曾报告从钙质泥岩的褐煤夹层中发现早中新世哺乳动物化石，属于脊棱齿象属。西部湄龙（Mae Long）灌溉水库，发现许多中中新世的哺乳动物化石，包括乳齿象属、鹿和啮齿动物。

（10）湄索盆地

湄索盆地宽约 30 公里，长约 50 公里，位于德省湄索地区，三分之二位于泰国境内，三分之一位于缅甸。基于布格异常图可以去顶盆地包括两个次盆，北部和南部次盆。盆地第三纪地层划分为三个单元，自上而下分别为湄拉马（Mae Ramat）组厚度为 240-600 米，由河流相砂岩、砾岩以及红色和绿灰色泥岩组成。在北部次盆发现古近纪化石，琵琶螺属 sp.、八角枫属 sp.、木兰属 sp.、桃螺属 sp.和豆科 sp.等。上覆的湄帕（Mae Pa）组解释为湖泊相和河流-湖泊相沉积，厚约 1,222 米，由页岩、泥岩、油页岩和砂岩组成，可见中新世-古新世的腹足类和鱼类碎片化石。

2．中部地区

（1）彭世洛盆地

彭世洛盆地是一个南北走向的克拉通内裂谷盆地，覆盖面积约 6,000 平方公里。盆地西部为断层边界，东部边界为碧差汶（Phetchabun）断层，北部边界为程逸（Uttaradit）断层，南部边界为湄廷（Mae Ptng）断层。盆地被冲积扇、扇三角洲、冲积平原、湖泊三角洲和出口湖相沉积充填。沉积物在盆地西部高达 8

公里厚。泰国壳牌在盆地的斯提克特（Sitikit）油田已经布井钻探并开始生产。石油储量约为 100 百万桶。

泰国壳牌将彭世洛盆地地层被划分为八套岩性地层单元，由渐新统到现今的彭世洛群组成。最底部的单元为萨拉博（Sarabop）组，由渐新世的冲积扇、扇三角洲沉积的砾石、粘土岩和棕红色砂岩组成，厚约 1,200 米。农磨（Nong Bua）组则由泛滥平原沉积的粘土岩、深灰色粘土岩和红色砂岩组成。孔目（Khom）组只在盆地的东部边缘发育。沉积物由扇三角洲沉积的砾石、粘土岩和红色砂岩组成。兰格拉布（Lan Krabu）组是盆地主要的油气储层。沉积厚度约 2,100 米，由粘土岩、粉砂岩和夹煤层的灰色到棕红色砂岩组成。春盛（Chum Saeng）组是高品质的湖泊相藻类烃源岩，厚约 1,000 米。沉积物由夹煤层的富含有机质的粘土岩组成。普拉图陶（Pratu Tao）组厚约 1,400 米，由粘土岩夹河流相沉积的砂岩组成。柚姆（Yom）组为厚约 1,000 米的冲积平原沉积，主要有粗砂岩、棕色粘土岩和少量煤层组成。平（Ping）组为厚约 1,2000 米的冲积扇沉积，主要由夹杂砾石的黄色粘土岩和少量煤夹层组成。

勒根德乐（Legendre）等 1988 年也曾报告在泰国壳牌的探井深度为 887-894 米的破碎的二叠纪灰岩岩心中发现早中新世晚期到中中新世的哺乳动物化石（啮齿动物，蝙蝠类）。

南部的农磨地堑盆地，彭世洛群只有五套地层单元，从下往上依次为农磨组、兰格拉布组、普拉图陶组、柚姆组和平组。

（2）祖潘武里盆地

祖潘武里盆地在下中部平原。盆地位于祖潘武里省，覆盖面积为 800 平方公里。盆地呈半地堑，南北向延伸，西部为断层遍及。在此盆地发现油-洞（U-Thong）和卡狠帕盛撒恩（Khampaeng Saen）油田，在 1991-1998 年间产油 2,702,960 桶。盆地沉积厚度约 3,000 米。地层被划分为两个单元。下部单元为厚约 600 米的河流-湖泊相沉积的夹砂岩和砾石的深棕色钙质泥岩。上部单元为厚 1,000 米的河流相沉积，由砂岩和夹灰岩的泥岩组成。

（3）吞武里盆地

吞武里盆地为三帕高达（Three Pagoda）断裂带运动造成的半地堑盆地。盆地向西加深。根据泰国湾石油公司的钻井资料，第三纪地层可以划分为五个地层单元。盆地的第三系沉积的基底为石英砂岩，经历了两次变形，一次在早二叠纪（273±14 百万年），一次在上白垩纪（75±6 百万年）。最下部的地层单元 A 厚度

约 169.5 米，为渐新世的泛滥平原和湖泊相沉积。沉积物主要为绿色到灰红色页岩夹杂薄层的砂岩和棕红色灰岩。地层单元 B 不整合上伏于单元 A 之上，为厚约 515 米的中新世河流相沉积，由白色砂岩、页岩、泥岩、棕色灰岩和少量煤层组成。地层单元 C 与地层单元 B 的沉积物相似，为厚约 745 米的河流相沉积。地层单元 D 整合上伏于单元 C 之上，为厚约 345 米的河流相沉积。沉积物由砂岩、页岩和砾石组成。地层单元 E 为第四纪沉积物覆盖在地层单元 D 之上。

（4）碧差汶盆地

碧差汶盆地位于呵叻台地西部边缘。盆地很窄，南北向延伸，宽约 30 公里，长约 120 公里。盆地形成于晚渐新世，是与北西-南东向湄平断裂和三帕高达断裂的右侧向运动以及沿北北东-南南西向共轭走向滑动断层的左侧向运动有关的简单剪切运动的结果。盆地为地堑和半地堑，被晚渐新世到全新世沉积充填的冲积相和河流相沉积。盆地由五个次盆组成，分别是：武里（Buri）次盆、农征（Nong Chaeng）次盆、坤匡（Khon Khwang）次盆、柴蒙坤（Chai Mongkhon）次盆和北碧差汶（North Phetchabun）次盆。盆地的基底为二叠-三叠纪的变质沉积和火山岩。三叠纪沉积被划分为四套地层单元。最底部的地层单元命名为“底部第三纪”，由河流沉积物和晚渐新世的细粒火山岩组成。岩性主要为红色泥岩夹能与彭世洛盆地农磨组对应的 400 米厚砂岩。上覆地层为厚约 1,800 米的威迁武里（Wichian Buri）群地层。沉积物由可作为烃源岩的黑色，富含有机质的湖相页岩组成。页岩中含有煤夹层和砂岩的薄层三角洲砂体为威迁武里油气藏的储层。在中中新世 11.6 百万年的上部地层发育一个不整合。上伏的乍良赖波（Chaliang Lab）组厚约 350 米的晚中新世-上新世地层，主要由河流相和湖泊相沉积的泥岩、砂岩和煤层组成。最顶部的地层单元为上新世-更新世的厚约 157 米的河流相沉积，与下部地层不整合接触，现今火山岩单元在地层层序中普遍发育，也威迁武里次盆中广泛分布。这套地层包括根据 K/Ar 就位年龄在 15 百万年的风化细粒火山岩、闪长岩和辉绿岩。

许多中新世的淡水鱼类在距碧差汶省北西方向 7 公里的龙马萨克（Lomsak）区班农帕莱（Ban Nong Pla）的薄层页岩中发现。

3．下西部和泰国半岛地区

（1）农亚布隆盆地

农亚布隆盆地位于碧差武里省的农亚布隆地区，是一个小型孤立盆地，宽 6 公里，长 15 公里。盆地为东部和西部断层边界的地堑。盆地包括平坦区和小山，

平均海拔高度为 80-100 米。钻井数据表明盆地西部煤层被正断层抬升，这个断裂带有两个方向，即北西-南东向和北北东-南南西向。盆地内只发现一些鱼类碎片化石。

（2）坚撒盆地

坚在盆地位于素叻他尼省坚撒地区，位于帕盛（Phra Saeng）区以及庞品（Punpin）区之间。盆地宽约 15 公里，长 30 公里，南北向延伸，与南北向断层平行。盆地被考琳达（Khao Linda）山划分为两个次盆。西部次盆比东部次盆埋深大。波芒（Bo Muang）矿井、卡隆普莱德（Klong Plaikradum）、卡隆塔潘（Klong Tapan）和纳摇（Na Yao）有煤层出露地表，煤矿的实测储量为 21.9 百万吨。煤层中发现的化石主要为腹足类。

（3）仙潘盆地

仙潘盆地位于塔纳斯瑞（Tanaosri）和豪浪（Khao Luang）两个山脉之间，宽 17 千米，长 37 千米。该盆地主要沿仙潘运河分布，部分位于那空省德董艾（Tung Yai）区。根据钻孔和地球物理数据，第三纪的地层被划分为 3 个单元。单元 A 和单元 C 属于河流沉积，单元 B 属于沼泽和湖泊沉积。在其中的 5 个次盆发现了煤层，分别是邦赛（Bang Sai）次盆、宽卡巴生诺（Khuan Klang Nua）次盆、巴生太宽卡（Khuan Klang Tai）次盆和盆地南缘的农华（Nong Wa）次盆。煤炭储量约 4,400 万吨，但仅识别出一套 10 米到 13 米厚的煤层。沉积地层向盆地的中央的倾角为 10-20 度。在单元 B 中发现了一些腹足类化石。

（4）甲米盆地

甲米盆地位于甲米省的诺至（Nua Klong）运河地区和孟（Muang）地区。该盆地的走向为北-北东向，在南部和西南部向安达曼海敞开。盆地长约 30 千米，最大宽度为 14.7 千米。在沿海岸的贝壳博物馆、班兰坡（Ban Laem Phoe）、班柯瑶（Ban Ko Yao）和空他平（Khlong Thapling）等多个地区发现了露头，但迄今为止，仅在甲米矿发现了完整的剖面，该完整的剖面位于 3 个褐煤坑：班普带（Ban Pudam）、帮马克（Bang Mark）和维雷克（Wailek），这 3 个煤坑主要开采发电用煤。

甲米盆地的沉积物包括泥岩、页岩、粉砂岩、砂岩、褐煤粘土和褐煤。沉积物的总厚度约 280-710 米。在褐煤粘土和厚约 20 米的褐煤地层中发现有晚始新世的脊椎动物化石。古地磁研究取得的年龄也表明在 31-34 百万年。该层序的上覆地层为含丰富腹足动物田螺属、鱼类、双壳类珠蚌属以及树叶化石的泥岩和钙

质泥岩。但是，这些结果与从至卡龙韦勒克（Klong wai Lek）煤矿坑和班兰坡（Ban Laem Pho）获得的孢粉组合矛盾，这些孢粉组合指示的年龄为早-中中新世，并且还说明曾受到过热带地区潮湿气候条件下的海洋环境影响。

（5）贞夫盆地

贞夫盆地位于宋卡省贞夫地区的西部，并延伸到马来西亚的配利斯（Pelis）和吉打州。该盆地在泰国境内的面积约 200 平方公里，主要分布在宋卡省的贞夫、孟和海达亚（HadYai）地区。该盆地包括两个次盆：西部次盆和东部次盆。该盆地的主要沉积物为粗粒和细粒砂岩，并且在褐煤层中存在泥岩、粘土岩夹层。沉积物的总厚度约 250 米。其上为 100 米厚的第四系砾石层，两者呈不整合接触。这个盆地发现的化石主要是植物碎片和根，同时在褐煤层中的粘土里发现了少量的腹足动物残片。这个盆的的年龄尚未确定。

（6）沙巴由盆地

沙巴由盆地位于宋卡省沙巴由地区，覆盖面积 400 平方公里。EGAT（泰国发电局）的钻孔资料提供了该盆地的地层信息，该盆地的地层可以被划分为 4 个单元。最下部的单元厚 200 米，包括砂岩、泥岩和砾岩；第二个单元厚约 120 米，由灰色泥岩组成，并含有 4 套褐煤夹层，每套褐煤夹层厚约 6-9 米，探明煤炭储量约为 2.03 亿吨，而且盆地西北部的褐煤层厚度大于西南部。第三个单元厚约 250 米。最上部的单元由粘土岩组成，含砂岩和松散的砾石夹层，厚度在 175 米到 445 米之间。

4．第三纪盆地之间的关系

虽然泰国的第三纪盆地被称为孤立盆地，但仍然表现出许多共同的特点：

（1）泰国第三纪盆地的形成都受控于印度板块与欧亚板块的碰撞；

（2）主要为山间盆地或断陷盆地，呈地堑或半地堑形态，近似南北走向。大部分盆地位于南（Nan）缝合带的西部，分别以不整合与下伏的老地层和上覆的第四系沉积物接触；

（3）同一地区的盆地形成于同一时代。与北部的盆地相比，南部以及泰国湾和安达曼海的盆地形成时代相对较早。甲米盆地的形成时代不晚于晚始新世，泰国海和安达曼海盆地的形成时代为渐新世；北部的大多数盆地形成于中新世，但西北的盆地除外，通过孢子和花粉研究，这些盆地的形成时代被认为是渐新世；

（4）第三纪盆地拥有相似的主要沉积环境序列。下部和上部以冲积环境为主，中部以湖泊和沼泽环境为主。但是，从细节上分析，每个盆地都有自身独特

的沉积环境演化史。

（5）这些环境的变化可能与裂谷盆地的演化相对应。气候变化也是绝大多数湖相发展的关键因素。

（6）晚中新世，在中部平原广泛发育区域不整合，在地层中显示为从湖泊环境向上变为冲积环境。但是在北部，这次事件有所不同，以湄莫盆地为例，仅在盆地边缘有明显的不整合接触，在沉积盆地的中部过渡为整合接触。

（7）大多数第三纪盆地的地层划分都使用非正式的名称，应该将众所周知的正式名称应用到同一地区的其他盆地。

（8）粗略的统计显示，可以通过盆地的宽度推测第三纪盆地的厚度。即宽度 1 公里相当于厚 100 米的沉积物。

六、第四系

第四系覆盖了泰国总面积的三分之一。它们主要是半固结-未固结的沉积物，也包括一些快速结晶、石化的火山岩，例如玄武岩。之前，由于第四系具有厚厚的松散沉积物，已固结的岩石很少出露，以及难以获得地下地层的资料，使得对第四纪沉积物的认知很少。泰国第四系的概要特征最早由布朗（Brown）和其他学者提出。随后，亚历克西和塔卡亚（Alexeev & Takaya）（1967）以及塔卡亚（Takaya）（1967，1971，1972）描述了中央平原中第四纪沉积物的岩性、地貌特征。哈特里（Hattori）（1972）对该平原的第四系进行了地球化学分析。

从 1980 年开始，地质调查所、矿产资源部开展了针对第四纪地质的系统填图。第四纪地层的资料来自于路旁剖面、丛生的采石场、钻采、电法测井、地下水研究所的钻井记录。

对第四纪沉积物的分类基于沉积环境、岩性、地貌、地质构造和化石这几个方面。第四纪沉积物既有海相成因也有非海相成因，通常分布在低洼地、山间盆地、宽阔的峡谷、平坦的高地和海岸带。它们在泰国的各个地理区都有分布。

1. 北部和西北部地区

这两个区域的第四纪沉积物主要分布在山间盆地。这些盆地呈长条形，属于断陷盆地，其轴线和断层走向平行。盆地大小不一，如北部的清迈盆地是最大的盆地，而西部的西沙瓦（Sri Sawat）盆地和通帕蓬（Thong Phaphum）盆地则面积较小。

在这些盆地中的沉积物主要由冲积和河流作用形成。在整个第四纪，这些作用是引起这些盆地变化的主要因素。特别是北部的四条主要河流：宾（Ping）河、

旺（Wang）河、永（Yom）河、南（Nan）河，它们从北向南流，其河道的两侧都发育宽广的泛滥平原。河道的迁移和下切形成河流阶地，可分为低阶地、高阶地两类。这些阶地的形成也和该区的构造运动有关。在地势较高的丘陵地带，覆盖有崩积层和冲积扇。

山间盆地中的沉积物主要是砂、粉砂质粘土和砾石。砾石大小不一，从细砾至粗砾和巨砾均有。在主要河流的泛滥平原分布着细粒沉积物：粉砂、细砂、粘土，并含砾石夹层。在河岸可见河道滞留砾石。沿盆地的两个边缘，砾石和粘土质砂沉积在河流阶地较厚，阶地海拔 200-500 米。

通常，通过地层对比来确定冲积物和河成沉积物的年龄。从地层特征来看，在北部和西北部的盆地，阶地之中的砾石层被认为形成于更新世，而处于冲积层之上的泛滥平原及其沉积物被推断形成于全新世。另外，在南邦盆地，玄武岩盖在湄昌（Mae Chang）河的砾石层之上，K/Ar 定年方法给出该玄武岩的年龄为距今 600000±200000 年。

2．中央平原

在中央平原的边缘及其内部，第四系均有发育。中央平原的边缘指山脉和平原相接的部位，它们以丘陵和海拔低于 100 米的山坡为特征。一些土丘和孤山散布在平原的边缘。这些边缘可以分成东、西两部分。

中央盆地的东部边缘包括素可泰府并向下延至北柳府区域。第四纪沉积物主要是崩积物和基岩就地风化的产物，如细砾和巨砾。冲积扇主要由砂砾和粗砾组成，在山脚处覆盖在砂质粘土层之上。

东部边缘的这些松散沉积物中没有化石可以用来确定其年龄，但因上覆全新世的海相沉积物，所以将这些沉积物的时代定为更新世。

西部边缘区包括那空沙旺府、乌泰他民府、叻武里府和那空拍侬府区域。除了该区具有大型冲积扇外，其第四纪地质特征和东部边缘非常相似。冲积扇在夜功（Mae Khlong）河、帕（Phask）河以及它们的支流发育，由粗砂及厚层状砂和粉砂质粘土的夹层组成。它们在甘烹色府和那空拍侬府的砂矿坑出露最好，所见砂层的厚度超过 40 米，并呈现向上变粗的特征。

西部边缘地层的时代参照鹿角和动物骨骼的研究成果，这些化石采自砂矿坑。对其研究表明大型冲积扇的沉积从更新世持续至现在。

泰国的中央平原呈向南倾斜的特征，可分为北中央平原和南中央平原。北中央平原包括了宾河、旺河、永河和南河的泛滥平原。这四条河从南向北流，在巴

难蓬（Pak Nam Pho）地区、那空沙旺府汇合形成湄南（Chao Phraya）河。受每个区域河道体系的控制，平原地貌由泛滥平原、河流阶地、沼泽组成，该地貌由河流的迁移所致。

北中央平原的沉积物主要是位于基岩之上的冲积物和河成沉积物，由砾石、粗砂和粘土组成。通常这些沉积物呈互层产出，有些呈透镜体状。因北中央平原的基岩埋深浅，所以其第四系的厚度比南中央平原第四系的厚度要薄。

南中央平原，也称湄南盆地，始于猜纳府，该府内的湄南河向南流经一片平坦的、没有特色的平原，在北榄府注入泰国湾，延伸大约 200 千米。该平原较为宽阔的部分东西长 180 千米，总面积大约 36,000 平方千米。上新世晚期至更新世的断块作用致使南中央平原的基底形成地垒和深地堑，由此使得其岩土覆厚的第四纪沉积物。这些第四纪沉积物可以分为更新统和全新统。

更新统主要源自冲积和河流作用，由砾石、砂、粉砂及粘土的互层组成。通常，上部为带有黄、红斑杂色的硬粘土。可以见到铁锰结核分散在粘土基质中。在一些地区，其上部层序中出现红土和红土质土壤。这些更新世沉积物沉形成于氧化环境，并且表层鲜有植被，处于现今地表之下 10-20 米的深度。

另外，沿着北泰国湾，一些海相贝壳碎片沉积在硬粘土中，由现今海岸线向陆方向延伸约 2 千米。这些贝壳碎片给出的年龄为距今 45,620-43,480 年，同时它们被全新世海相沉积物不整合覆盖，所以此年龄代表了一个海平面上升的时期，属于更新世晚期。

南中央平原的全新世沉积主要与冰期过后的海平面变化有关，此冰期发生在更新世晚期。平原中的平坦高地受到全新世海进和海退作用的影响。在湄南河与海水交汇的区域，河水流速减慢，导致其所携带的沉积物迅速沉积，形成巨大的三角洲，称为湄南三角洲。平原的地貌和岩性特征表明该区处于潮汐为主的沉积环境。在河道、泛滥平原，潮汐沉积物在纵向及横向上都广泛分布。

海相沉积序列由软粘土和粉砂组成，在一些薄层中夹有少量细砂，呈绿-绿灰色。人们称它们为海相粘土或者曼谷粘土。这类粘土下伏潮间坪沉积物和微咸的泛滥平原沉积物。潮间坪沉积物和海相粘土的厚度变化较大，从平原边缘的 2 米可变化至盆地和海岸处的 15-20 米。通过对地层序列中的底部泥炭、泥炭夹层、海相动物群进行 C^{14} 测定来识别沉积物的年龄，结果为距今 7,800±40 年至距今 2,250±140 年。

3．东部地区

东部地区的地貌由北部的山脉、中部的丘陵以及南部的海岸带组成。

对东部地区第四纪地层的研究表明，通常在山坡位置发育基岩的侵蚀面和残积物。崩积物出现在该区的北部，冲积物和河成沉积物也分布在地势高的地区。

丘陵地带覆盖有主要河流的泛滥平原沉积物，这些河流流经海岸带并注入泰国湾。

海岸沉积物是波浪作用为主的沉积序列，包括海滩砂、泻湖和沙坝。这类沉积物主要分布在春武里府和罗勇府。而潮汐作用为主的沉积物如潮坪和沼泽沉积物则主要出现在庄他武里府和达叻府。基于对泥炭、贝壳碎片和泰国其他地方松散海相沉积物的年龄测定，认为这些海相沉积物沉积于全新世。同时，它们下伏更新世的残积物、崩积物和冲积物。

4．东北部地区

东北部地区的面积为 168,800km^2，约占该国总面积的 1/3。该区显著的地理特征为呵叻高原。北西-南东向的普潘（Phu Phan）山脉将呵叻高原分成两个盆地，即呵叻盆地和沙功那空盆地。

沙功那空盆地的面积约为 1,000 km^2。盆地中的第四系沿沙功那空府和那空拍侬府内的冲积平原分布。根据地理特征、沉积环境和岩性特征将第四纪的沉积序列进行了细分。年龄最老的单元即残积物分布在山脉附近的丘陵，由混合了砂、粉砂的基岩碎石组成。第二个单元—高阶地沉积物，发育在空（Kong）河高阶地的平台上，该阶地超出水位 18 米。该单元的沉积物由以砂质粘土为基质、磨圆好的砾石层组成。在高出空河水位 13 米位置发育中阶地沉积物，由磨圆好的砾石并混合砂或粉砂、粘土组成。高于空河水位 8 米处的低阶地沉积砂、粉砂，并混有粘土。谷底沉积物沿着支流分布，在之后年轻泛滥平原发育的区域，切开先前的沉积单元。该沉积单元主要由粘土组成，并混有分选较差的砂。最年轻的沉积单元为泛滥平原沉积物，它们沿着该盆地的主要河流发育，由砂或粉砂混合粘土层组成，上覆砂质粘土层和含砾砂层。

在沙功那空府，第四系的沉积环境主要是河流环境，伴随自更新世开始的构造抬升作用。在沙功那空盆地的高阶地沉积物中发现玻璃陨石，该陨石被认为和澳大利亚及南亚的玻璃陨石在同一事件中产生，而后两者的测年结果为距今 600,000-700,000 年，由此推断构造抬升作用开始于更新世。

呵叻盆地面积约 33,000 km^2，区内有两条主要河流-月亮（Moon）河和社（Shee）河。继第三纪-第四纪早期一段长时间的风化和侵蚀后，第四纪的沉积

作用过程开始，盆地边缘被下切出河流阶地。该沉积作用过程在第四纪连续进行，沉积层序的变化取决于气候变化和现存的的地貌特征。呵叻盆地的地层层序，按由老至新，首先是残积物，由砂、粘土质砂组成，母岩为呵叻群的砂岩、粉砂岩。在某些地区，玄武岩覆盖在此沉积层上，玄武岩的年龄为距今 920,000 年。因残积物的年龄老于玄武岩，所以认为残积物属于早更新世。

阶地沉积是呵叻盆地的另一种沉积类型。阶地可以分为高、低两种。高阶地沉积物包括砂、砾石以及被包裹、呈半固结状态的硅化木碎片。与下伏基岩呈不整合接触关系。低阶地沉积物主要为以砂、粉砂为基质的砾石，上部为坚硬的红土层。通常，砾石中含有玻璃陨石，和泰国东北部其他地方的玻璃陨石年龄一致，由此推断沉积作用发生在距今 700,000 年以内。

另一沉积单元为含有机质砂层，仅分布在童圭隆（Thung Kula Ronghai）地区的洼地，主要为含有大量有机质和泥炭的细砂层。通过 C^{14} 测定给出的年龄为距今 5,400-5,200 年。而且，最新的泛滥平原沉积物和河成沉积物也被认为是全新世沉积。该区存在的黄土和砂丘还有疑问，对于这些沉积物的起源存在争议。

5．西南部和南部地区

西南部地区和南部地区通过沿泰国西部边境延伸的塔侬西（Tanow Sri）山脉相连。这两个地区第四纪的沉积环境都不单一。在西南部地区，众多的山脉和小山间盆地构成其主要地貌，因此，该区第四纪的沉积主要受冲积和河流作用影响。某一区域的沉积物类型取决于提供物质来源的母岩。崩积物沿山麓分布，主要由风化和侵蚀作用的产物组成。在各盆地中的沉积物主要是阶地、冲积和河流沉积物，成分包括砾石、砂、粉砂、粘土。

这些沉积物的时代参照北碧府博帕劳盆地中冲积物和河成沉积物的年龄。在该盆地中，泥炭和树木碎片从深 16 米的位置堆积至深 14 米的位置。通过 C^{14} 的方法对其测年，给出的年龄为距今 33,450±4,200 年至 24,600±3,500 年。其上部沉积较厚的洪泛沉积物，推测沉积时代为全新世。

南部地区，或称南部半岛，中部为山脉，由山脉向两侧地势降低，直至半岛边部的海岸平原。两个海岸分别沿泰国湾、安达曼海延伸约 1,878 千米和 937 千米。沿这两个海岸平原都呈现多样的地貌特征，也使得南部地区出现多种沉积物。

泰国湾海岸可以分出四个主要的地貌区，包括宋卡府、北大年府和那拉提瓦府的沿岸砂坝，那空是贪玛叻府的宽阔潮坪和滩脊，素叻他尼府和碧差汶府的三角洲平原，春蓬府和素叻他尼府的狭窄海湾和峭壁。

沿东海岸分布有第四纪沉积物，其沉积环境与母岩、地貌特征和各时期的气候相关。一般地，在第三纪-第四纪早期阶段，长时期的风化、侵蚀以及交替进行的河流搬运作用促进了更新世冲积物和河成沉积物的形成。贝壳层记录了更新世晚期的海侵作用，其年龄为距今 30950±620 年，在宋卡府沿岸，贝壳层之上覆盖了硬粘土层。更新世晚期-全新世早期，全球气候变暖，导致向那空是贪玛叻府的高地遭受海侵，最远海侵了 40 千米，当时海平面比如今的平均海平面高出 4-5 米。全新世中期之后，开始发生海退，海岸平原向海的方向加积。此平原上的海岸沉积物，下部为海进序列，上部为海退序列。

安达曼海岸沿泰国半岛的西部发育，涉及拉廊府、攀牙府、普吉府、甲米府、董里府和沙敦府。两条主断层：拉廊（Ranong）断层和孔迈（Khong Marui）断层，导致此海岸带的地貌形成，即陡崖海岸、巨大的红树林沼泽以及处在两种中间的短、窄沿岸沙坝。基于地貌、岩性特征、古生物学证据，分出两个主要的第四纪地层序列。

更新统沿山麓（即丘陵和陡崖海岸）分布，由残积物、崩积物组成。在安达曼海岸可以观察到由风化岩至腐泥土和红土的完整序列。崩积物覆盖在和海岸平原相连的高地上，由母岩的粗砾石组成。对普吉矿区硬粘土单元中的泥炭和树木碎片进行 C^{14} 测年，结果为距今 31050±280 年。攀牙府的泥炭样品给出的年龄为距今 30430±1160 年。该硬粘土单元在安达曼海岸区域广泛分布，通常上覆全新世地层。

全新统主要是海相成因，根据地貌证据可以分为潮坪沉积物和海滩沉积物两类。对潮坪沉积物中的泥炭和贝壳碎片进行 C^{14} 定年，结果表明海相粘土自距今 9000 年至现在一直沉积。海滩沉积物在距今 6000 年至距今 100 年发育，通常盖在潮坪沉积物之上。

第二节　构　造

泰国有两个大陆地体组成，即西侧的掸泰地体（包括素可泰褶皱带）和印支地体（包括黎府褶皱带），这两个地体通过难河缝合线连接在一起。这两个地体都发源于下古生界南半球冈瓦纳大陆的西北边缘。虽然这两个地体以何种方式、在何时汇聚合并目前还存在争议，但是大多数学者都倾向于碰撞汇聚发生于三叠

纪，只有海尔姆克（Helmke）认为在二叠纪就发生碰撞。

掸泰地体包括缅甸东部、泰国西部、马来西亚半岛西部和苏门答腊岛北部。地体中的岩石类型有前寒武纪花岗岩类，下伏于古生代岩层的高级变质岩石以及被石炭纪到白垩纪花岗岩侵入的中生代地层。

在接受下古生界大陆架沉积之前，前寒武纪的地体核部原来是西北澳大利亚的变质地体。该地体保留了其与冈瓦纳大陆相接触的西部边缘，一直到早石炭纪发生裂解，并漂移进入古特提斯洋。通过对微体脊椎动物和牙形石的研究，柏雷特认为掸泰地体在中泥盆世时仍然非常靠近澳大利亚。此外，基于早二叠纪冰海沉积（即岗卡章组或普吉群中的中砾泥质岩）以及地层中动物群与澳大利亚西北部冷水动物群的亲缘性，许多地质学家相信掸泰地体在石炭纪到早二叠世时依然和澳大利亚冈瓦纳大陆相连接或很靠近。但是，到了中-晚二叠世和早三叠世，动物群就显示出与华夏古陆类型和北特提斯省类型动物群的亲和性。

许多研究者提出，碰撞发生前在掸泰地体之下发生了向西的俯冲过程。得出以上结论是由于在泰国北部广泛分布有志留纪-泥盆纪和中二叠世-早三叠世的火山岩，还因为构造都向西聚敛。但是，贝肯塞尔等和库珀等认为在印支地体之下发生了向东的俯冲作用，提出这一观点的依据是出现了 S 型和 I 型侵入岩。

印度支那地体包括了泰国东部、老挝、柬埔寨和越南的部分地区。在泰国，印支地体主要由中古生界岩石和寒武系台地碳酸盐岩和深水碎屑岩构成。在黎府褶皱带，这些岩石被石炭系到白垩系的花岗岩所侵入，又被宽缓褶皱的呵叻群中生界大陆沉积地层所覆盖。

印支地体可能在古生代从冈瓦纳大陆裂解出去。尽管准确的裂解时间还未知，但是晚泥盆世-早石炭世之间存在的区域性不整合面看来支持在泥盆纪发生了裂解。

关于掸泰地体和印支地体的缝合时间有着许多不同观点，包括泥盆纪-石炭纪缝合、中-晚石炭世缝合、中二叠世缝合、晚二叠世-早三叠世缝合、早三叠世缝合和中-晚三叠世缝合，甚至是中-晚白垩世缝合。

难河-尖竹汶缝合线区代表了掸-泰地体和印支地体的边界，也被称为难河缝合线或难河-乌达拉迪（Uttaradit）缝合线。从古生代开始，该缝合线就成为了反复造山运动的活动区域，大多数研究者认为在晚三叠世发生了碰撞。

在晚二叠世，掸泰地体开始与华夏古陆的碰撞，并最终在晚三叠世基本完成了与印支地体的汇聚。I 型和 S 型花岗岩在晚三叠世到早侏罗世形成，这也支持

了在晚三叠世发生碰撞的观点。

在两个地体发生碰撞后，掸-泰地体变成了一个稳定的陆块。因此，与三叠纪相比，在侏罗纪掸泰地体较少受到构造作用的影响，在泰国形成统一地块前就发育了最年轻的内陆海相岩石（除了现今沿海区域的海相中生代地层）。有学者提出在中侏罗世曾经发生过非常轻微的造山作用。

在中生代，泰国境内的绝大多数构造特征都主要是印度-欧亚板块碰撞的结果。在印度大陆朝北向着欧亚大陆运动时，几个走滑断层发生活化，导致了红河断层的活动。此外，东南亚地壳板块发生了顺时针转动，随后被向东南方向挤出数百公里。

东南亚地壳块体的挤出和转动导致了从泰国湾一直到南中国海一系列伸展盆地的形成。这些区域的地层记录表明正断块作用开始与渐新世。

在泰国，可以识别出两套断层系统：（1）南北向正断层系统；（2）北西-南东向和北北东-南南西向共轭走滑断层系统。其中北西-南东向断层带主要包括湄平（Mae Ping）断层和三塔（Three Pagodas）断层，而北北东-南南西向断层带主要包括乌达拉迪断层、拉农（Ranong）断层和科隆马瑞（Khlong Marui）断层。

三塔断层带和湄平断层带的走滑运动也在这些断层的末端产生了南西-北东向的伸展构造区。伴随开始的挤出作用，东南亚大陆块体发生了微小的顺时针转动。

第三节　岩浆活动

泰国境内广泛分布岩浆岩，其中花岗岩占了主要部分，其次是火山岩和中性、基性及超基性的侵入岩。泰国花岗岩可划分为三个带，从东到西依次为东部花岗岩带（EBG）、中部花岗岩带（CBG）和西部花岗岩带（WBG）。这些花岗岩的侵位年龄，广义上讲由东向西递减，从东部的早三叠世到西部的晚白垩世。广泛分布的同位素年代的差异性被认为是受到多种因素的影响。如变质作用、构造变形、热液活动和简单的冷却过程。金、铜、碱金属、铁和重晶石矿是东部花岗岩带中常见的经济矿产，钨、锡和重晶石矿在中部花岗岩带较为常见，钨、锡、铌、钽及稀土元素矿物含量在西部花岗岩带中更加丰富。

辉长岩、橄榄岩、辉石岩、角闪石岩及蛇纹岩是常见的基性和超基性侵入岩

岩石组合，并且被认为是蛇绿岩套。其表现为由北向南的三条不连续的条带，帕逊（Pha som）超基性岩带（难府-程逸带（nan-uttaradit)），司拉考（sra kaeo）超基性岩带和那拉提瓦（narathiwat）超基性岩带。这些基性-超基性岩带被认为是一种古缝合带，使西部的掸邦-泰国板块（Shan-Thai Block）从泰国东部的印支板块（Indochina Block）分离出来。已报道的帕逊（Pha som）超基性岩的年龄为早二叠世（269±12Ma）及石炭纪到早二叠世（356-256Ma）。

火山岩岩石组合广泛分布于泰国大部分地区，其大概可以归为以下几类：二叠-三叠纪清迈-清莱火山岩带、二叠-三叠纪到侏罗纪及少量的晚第三纪象岛（Ko Chang）-达克（Tak）-清孔(Chiang Khong)火山岩带、晚新生代玄武岩。

一、花岗岩

1．花岗岩及相关岩石

泰国花岗岩露头为南北方向延长带，长度大于 1,800 公里，宽度大于 450 公里。这些花岗岩带在区域上向北可延伸至缅甸和中国云南，向南可延伸到马来西亚、新加坡和印度尼西亚。根据其产地、岩相学及地球化学特征，这些花岗岩可分为三个近平行的岩浆岩带或岩浆岩省（图 2-5）。

（1）东部花岗岩带（EBG：晚三叠世早期）

该带位于中生代呵叻高原的西部，包括黎府、帕府、达克（Tak）、卡宾布力（Krabin Buri）、寺拉柯韦（Srakeaw）及禅塔布力（chantaburi）的部分地区，东部花岗岩带以大大小小分带的及未分带深成岩体的基底形式出现。这个地区的特征为高度浅成，酸性到碱性的深成岩是以闪长岩、花岗闪长岩及花岗岩为主的岩石类型。火山及火山岩群组分的延伸范围与上述的深成岩一样，在该地区是一种结合体。这些花岗岩，在一些地方横切晚古生代沉积地层，在不整合上覆于中生代呵叻红层。从岩石学上看，这种花岗岩呈中-粗粒等粒状的显晶质结构，其次为斑状结构。花岗岩中含有较多的铁镁质捕虏体。花岗岩中的主要矿物有钾长石、斜长石、石英、角闪石和黑云母。磁铁矿、锆石、榍石和磷灰石是常见的副矿物。东部花岗岩带的组分介于正长花岗岩和辉长岩之间。

（2）中部花岗岩带（CBG：三叠纪）

该带主要出露于泰国的北西部，其从北部的泰国-缅甸边境一直延伸到泰国湾，并且还覆盖了半岛地区的东部。在多数情况下，该花岗岩侵入早古生代沉积地层，并且与该地区的混合岩及高级变质岩相伴产出。从岩石学上看，这些花岗岩呈粗-极粗粒的斑状结构，含有巨型（达 6-7 厘米长）钾长石斑晶，其基质中

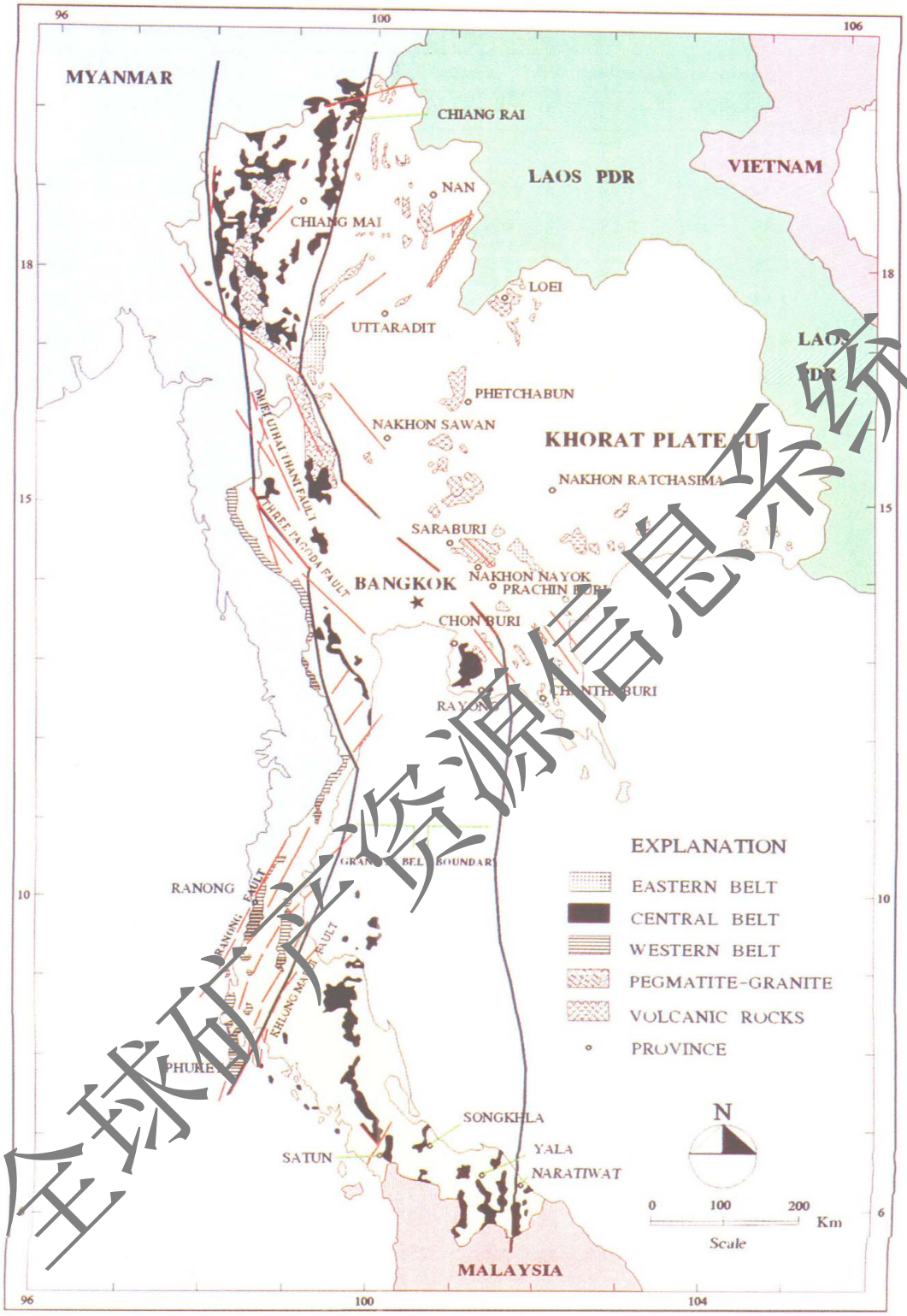

图 2-5　泰国花岗岩带分布图

的石英、钾长石、斜长石、黑云母常表现出优选方位。角闪石、榍石、锆石、磷灰石和钛铁矿是常见的副矿物。白云母和电气石主要是在岩浆分异产物中发现的。这些花岗岩属于正长花岗岩、二长花岗岩、石英正长岩和石英二长岩。

（3）西部花岗岩带（WBG：白垩纪）

该带位于中部花岗岩带的西侧，从毗邻伊梅-乌泰他尼府断裂带北端的湄拉玛（Mae Lama）岩株到泰国半岛西南部的普吉岛，沿着泰国-缅甸边境线分布。总之，西部花岗岩带中包含有压性组成范围的小到中型的岩基和深成岩体，这个压性组成范围中有一小部分是张性类型的。该类花岗深成岩体大部分侵入康科拉禅组（kangkrachan）地层的石炭二叠纪卵石岩中，也有一些例外，如湄拉玛岩株侵入到了寒武纪和奥陶纪沉积岩地层中。西部花岗岩带侵入老的中部花岗岩带中的现象并不罕见，并且前者常显示出较少的形变特征。

西部花岗岩带主要呈粗粒斑状结构，含有与中部花岗岩带相似的巨型钾长石斑晶。然而，两种长石、石英、黑云母和白云母为主要矿物，角闪石、钛铁矿、磷灰石、榍石和锆石为副矿物。与东部花岗岩带具有相似特征的深成花岗岩体数量较少，并且通常表现为较年轻的岩浆事件。西部花岗岩带含有丰富的伴生伟晶岩和细晶岩，缺失同期的火山岩系列。在三元模式图中，这些花岗岩落在了正长花岗岩、二长花岗岩、石英二长花岗岩、石英二长岩及少量二长岩、二长辉长岩的范围中。

2．花岗岩年龄

地质年代数据表明，东部花岗岩带可能反映了最老的花岗岩岩浆事件（243-200Ma），其多数有着相对较低的初始 87Sr/86Sr 比值（I.R.），为 0.705-0.715。这种相对较低的初始 87Sr/86Sr 比值及其他的 I 型特征反映这些花岗岩来源于轻微演化的源区岩石（可能是岩浆岩相关的岩石）的部分熔融（图 2-6）。

中部花岗岩带的侵位年龄在 230-200Ma，其具有多变的初始 87Sr/86Sr 比值范围，泰国北部混合相关岩套的比值为 0.725-0.730，其他岩石的比值为 0.710-0.727，其 S 型特征和高甚至极高的初始 87Sr/86Sr 比值表明该地区的花岗岩起源于演化大陆壳的部分熔融。

西部省份的花岗岩为泰国最年轻的花岗岩岩群（130-78Ma）。大部分 S 型花岗岩拥有高甚至极高的初始 87Sr/86Sr 比值，为 0.719-0.744，而 I 型花岗岩比值介于 0.704-0.714。

广泛分布的同位素年代的差异性由多种同位素测年技术确定，Rb/Sr 全岩等时线法、U/Pb 锆石法、U/Pb 独居石法、Rb/Sr 法、K/A r 法、Ar /Ar 法和裂变径迹矿物年龄法等被大量用于测试中。这些年代差异性有着以下几种共同的显著特征：（1）常见有三叠纪和晚白垩纪花岗岩，（2）在泰国西缘及泰国半岛较为显著，

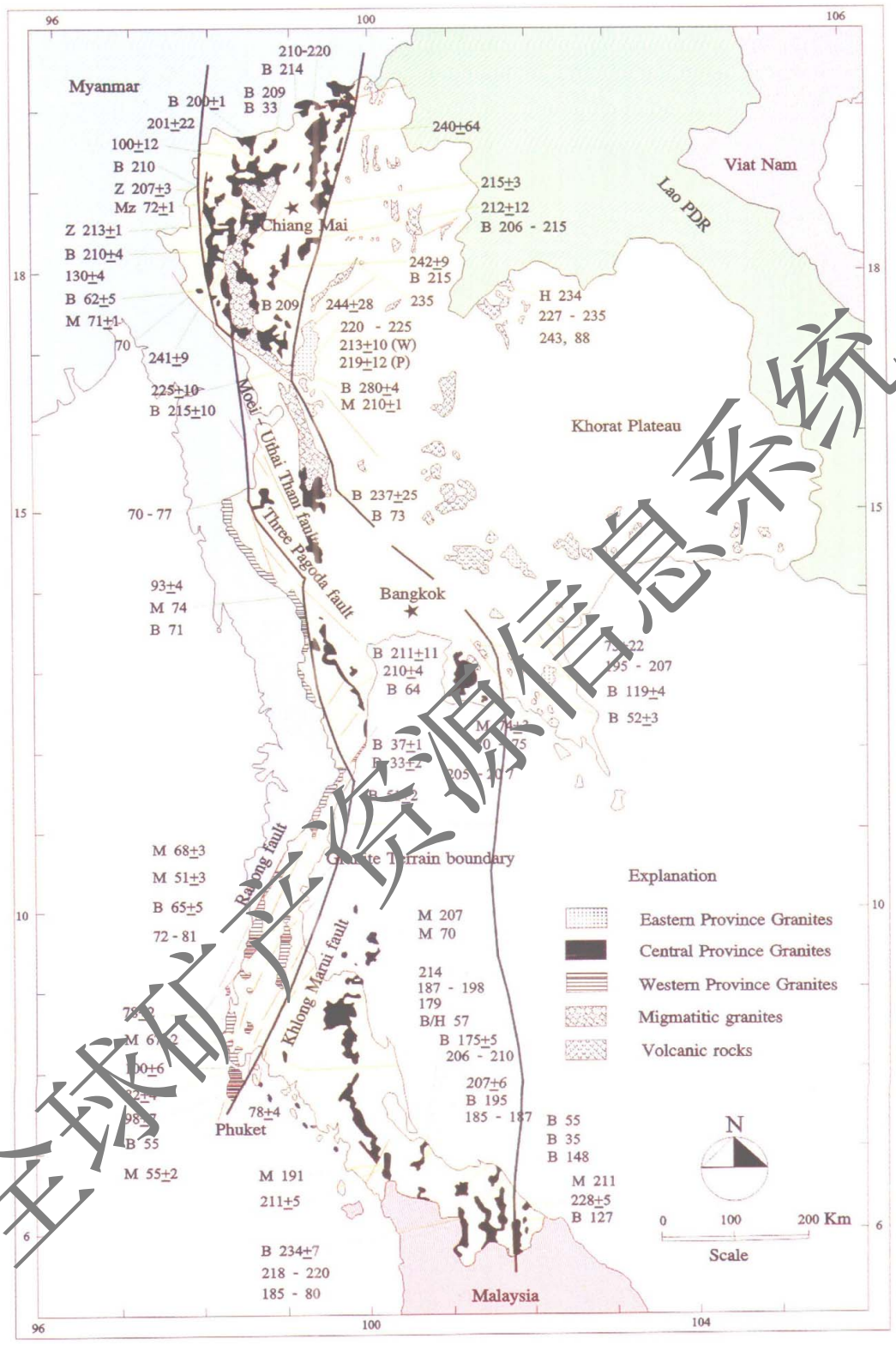

图 2-6　泰国部分花岗岩年龄

泰国北部则不明显，（3）有界的和/或仅限分布于主要的大地构造中，如北西和北东向的断层系统。断裂变形加上热液活动

和区域变质被认为是主要的机制，这种机制能解释该地区老的花岗岩的矿物年龄大量重置的原因。然而，花岗岩侵位后的缓慢冷却过程被认为是晚白垩纪西部花岗岩带新矿物年龄较年轻的原因。

3．花岗岩的矿化作用

东部花岗岩带中的矿床有钨、锑、萤石矿、铜、铅、锌、金、钼、铁和磁铁矿。中部花岗岩带地区的潜在矿床主要是钨锡矿，其次为碱金属矿床。西部花岗岩带因其锡、钨、铌、钽矿床而闻名。

中部花岗岩带和西部花岗岩带的钨锡矿化作用通常与经过高度分异的 S 型花岗岩有关，该类花岗岩的特征是具有高含量的二氧化硅、氧化钾、铷、钍、铀和锡，而氧化铁、氧化镁、氧化钙、氧化钠、钡、锶的含量和 Fe_2O_3/FeO 的比值较低。具有锡矿化的深成岩体表现为高的 $^{87}Sr/^{86}Sr$ 比值和低的磁化率。

二、基性及超基性侵入岩

基性及超基性侵入岩产于三条南北方向延伸的窄带之中，它们分别是帕逊（Pha som）超基性岩带（难府-程逸（Nan-uttaradit）带），司拉考（sra kaeo）超基性岩带和那拉提瓦（narathiwat）超基性岩带。在这些超基性岩地区中基性岩、橄榄岩、辉石岩、角闪石岩和蛇纹岩是常见的岩石组合。

1．帕逊超基性岩带

该带的一部分沿着南河分布于南府的东部和南东部分布，另一部分位于程逸府诗丽吉水（Sirikit）坝的北部和西部。辉长岩、橄榄岩、蛇纹岩、纯橄岩及少量基性岩墙是其一般的岩石组合。这些岩石受到轻微的变质作用，被称为蛇绿岩套。在蛇纹岩的基质中能观察到各种超基性岩和中二叠世灰岩岩块。地球化学证据表明，沿上述帕逊（难府-程逸）古缝合带侵入的基性岩为蛇绿辉长岩套。

2．司拉考超基性岩带

该带出露于司拉考府，并且沿着司拉考-尖竹汶（Sra Kaeo-Chanthaburi）公路（如考班派（Khao Phai）、司拉考府、班赖海姆（Ban Rakham）、邦南隆（Pong Nam Ron）区，尖竹汶向南西方向延伸到了巴晶汶里（Prachinburi）（如农华安（Nong Wa Aen）和农克拉（Nong Kra））、班凯区（Ban Khai District）和罗永府。主要的岩石类型是蛇纹岩和角闪石岩。这些超基性岩被认为是蛇绿岩带的一部分，将素可泰褶皱带西部和黎府褶皱带东部分隔开来。

3．那拉提瓦超基性岩带

该带位于泰国最南端得那拉提瓦省，接近泰国-马来西亚边境。辉长岩和橄

榄岩是两种常见的岩石类型。那拉提瓦超基性岩带可能是帕逊（南府）-司拉考-勿洞（Betong）（那拉提瓦（Narathiwat））蛇绿岩带的一部分)。

4．超基性岩年龄

帕逊超基性岩的年龄由帕逊群铁镁质片岩中阳起石的 K/Ar 年龄推断得出，该阳起石的年龄为 269±12 Ma，属于早二叠世。随后，由潘迦斯瓦特王（Panjaswatwong）和克劳福德（Crawford）认为该地区铁镁质火山岩及相关岩石的 Ar/Ar 年龄为 356～256 Ma。

三、火山岩

火山岩在泰国的大部分地区都有分布，然而泰国半岛南部火山岩的记录却很少。根据其构造背景及火山灰的分布和年龄，这些火山岩能分为以下几个带：清迈火山岩带、象岛（Ko Chang）- 达克（Tak）-清孔(Chiang Khong)火山岩带、黎府-碧差汶（petchabun）火山岩带、晚新生代玄武岩（图 2-7）。

1．清迈-清莱火山岩带

该带为碱性火山岩、玄武碎屑岩和枕状角砾岩。三卡坊（San Kamphang）碱性火山岩的化学特征表明其在成分上为拉斑玄武岩质和过渡碱质的。清莱地区碱性火山岩可能形成于俯冲环境中，而其他火山岩则形成于板内环境。有关板内玄武岩起源的解释仍存在争议，其与大陆密切相关或与大洋密切相关。据报道这些火山岩的相对年龄为晚石炭世到晚二叠世和中二叠世到二叠-三叠纪。

2．象岛-达克-清孔火山岩带

该带是泰国北部火山岩出露最多的地区。这种岩石由中性岩到酸性岩组成，如安山岩、流纹岩及火山碎屑岩。通过地层对比表明，这些火山岩的喷发发生在二叠-三叠纪时期。然而次级火山喷发可能发生在上三叠统到下侏罗统时期。

3．黎府-碧差汶火山岩带

该带是泰国主要的钙碱性岩，构成了沿着呵叻高原西缘直到泰国东部靠近缅甸边境的司拉考的南北走向的穹窿带。安山岩和流纹岩是主要的岩石类型，其次为玄武岩类。该地区早在中泥盆世就发生了多次火山喷发活动。其他火山活动发生在二叠-三叠纪和晚三叠世末期。帕考姆东（Eastern Pakchom）区流纹岩的 Rb/Sr 等时线年龄为 374±33Ma，其初始 87Sr/86Sr 比值为 0.706；细碧玄武岩（位于帕考姆（Pakchom）以南 16 公里）的 Rb/Sr 等时线年龄为 361±11Ma，其初始 87Sr/86Sr 比值为 0.70455。上述两组年龄数据证实了由地层对比得出的年龄，即早期火山

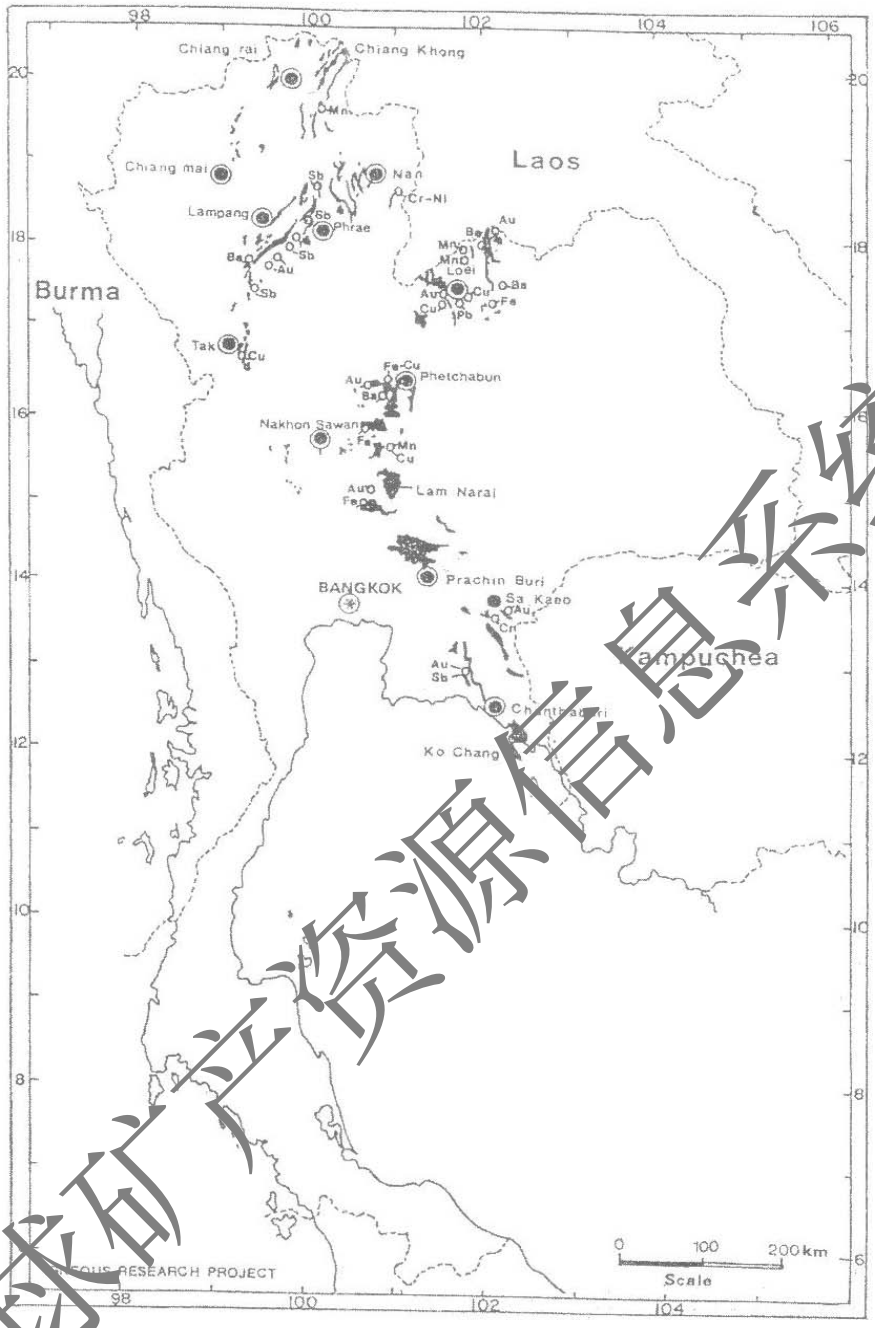

图 2-7　泰国石炭纪-第三纪火山岩分布图

事件发生在中泥盆世，晚期火山事件发生在晚泥盆世。

该火山岩带中的矿床包括金矿、铜矿、锰矿、铁矿和重晶石矿。邻近中性岩的地区发现有大量的沙金矿床。这个火山岩带中已经正在被开采的高硅流纹岩及珍珠岩含有膨润土、地开石、高岭石等工业矿物。

4．晚新生代玄武岩

晚新生代玄武岩零星分布于泰国的北部、东部和中部。这些玄武岩能被分为两种类型，含刚玉玄武岩和贫刚玉玄武岩。然而，根据其地球化学特征，该玄武

岩又能被分成玻基碧玄岩和夏威夷玄武岩。玻基碧玄岩由霞石岩、碧玄岩、霞石、夏威夷石和橄榄粗安岩组成。相比之下，夏威夷玄武岩包含碱性橄榄石玄武岩、夏威夷石和橄榄粗安岩。显而易见，刚玉在各个时代都通常与玻基碧玄岩有关。主要产出的宝石有蓝宝石、红宝石、黄玉、锆石和黑尖晶石。

第四节　变质作用

泰国的区域变质岩大致可以划分为 4 南北走向的变质带（图 2-8），从西到东依次为：阿武隈相系带、巴罗芙相系带、蓝片岩-绿片岩相系带和未分类的绿片岩相系带。

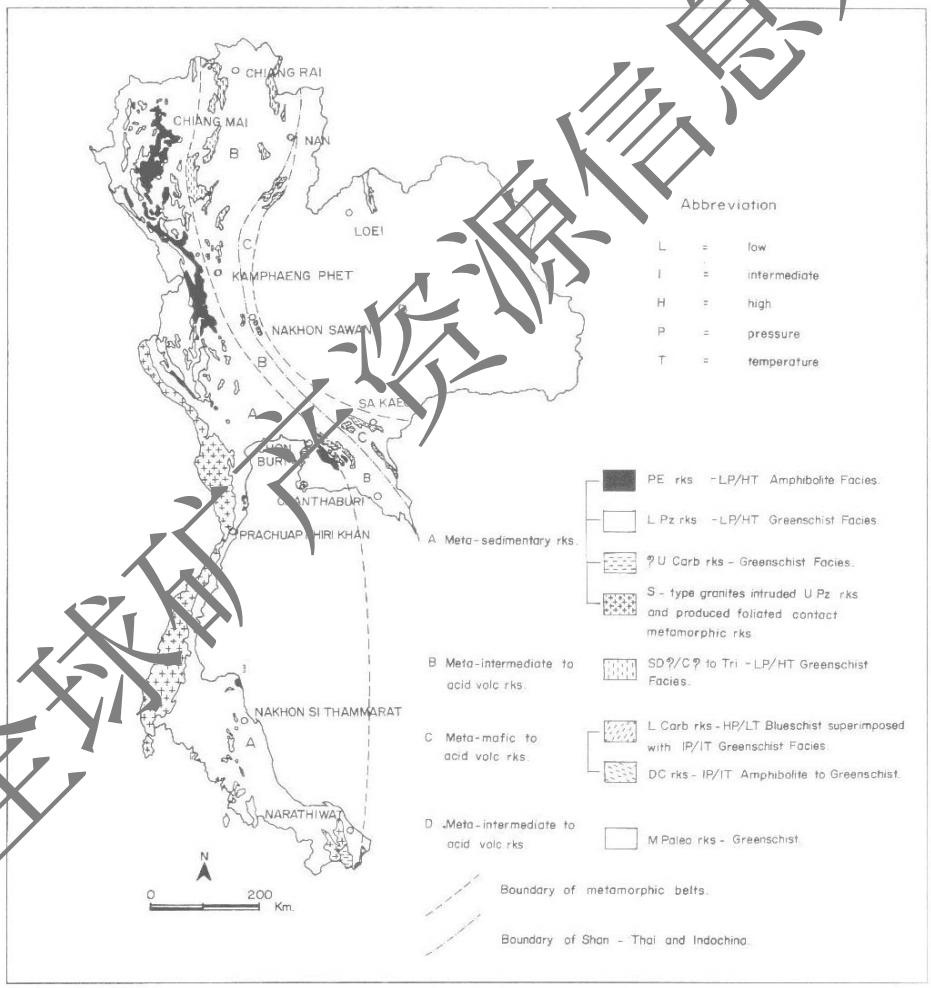

图 2-8　泰国变质岩分布图

1．阿武隈相系带

阿武隈相系带主要的特点是存在于推断的前寒武系岩石中，该套岩石在泰国

的西北部连续出露，在东南部以及南部靠近泰国和马来西亚边界地区零星出露。从岩石学特征来讲，该套变质岩包括花岗-花岗闪长片麻岩、云母-角闪石片岩和钙硅酸盐-大理石-地方石英岩，并且向东越来越富镁铁质。一般来说，他们与寒武系-奥陶系的碎屑岩和碳酸盐岩密切相关，该套沉积在志留系-泥盆系过渡为含笔石-竹节石的沉积序列。这两套岩石序列紧密接触，在该相系带的东部表现为连续的序列，但是沿西侧，一些接触边界被认为是局部的拆离面，可能本来就是一个连续的序列。由岩性和变质等级相互平行，以及向新地层单元变质程度降低的特点，可以确定从推断的前寒武系岩石到中下古生界岩石的连续过度现象。角闪岩和绿片岩之间的过渡性接触面总是与推断的前寒武系岩石和下古生界岩石的边界相对应。这两种岩石类型被认为受控于同一期变质作用（低压-高温阿武隈型相系）。

该带中同样存在志留-泥盆系的变质岩序列，这部分在图 2.8 中零星分布或没有作为填图单元。志留-泥盆系的变质岩序列包括低压-高温绿片岩相系的石英岩质片岩、片岩、石英质千枚岩、千枚岩、变燧石。该套岩层没有可靠的化石记录，根据与其他地区的岩性对比得到了估计的地层时代。该时期的同一组的岩石通常出现在巴罗芙相系带，他们原本可能是相关的，但被拆离断层分开。

该变质带的特点在最东部，特别是沿着泰国的东部和最南部进一步得到了证明。这些地区可能出露了一套上石炭系的地层，该套地层含千枚状砾岩、千枚岩、变质砂岩和板岩。砾岩全部由脉状石英鹅卵石组成，这些鹅卵石可能来源于有千枚状裂理的未知变质源岩区。该序列可能过渡为石炭-二叠纪含燧石、砂岩、页岩和局部灰岩透镜体的序列。该序列的后期，在合适的岩石中发育区域性劈理。上三叠统的 S 型花岗岩侵入其中，导致原本的劈岩升级为层状接触变质岩，如层状钙硅酸盐角页岩和石英岩质云母片岩。

泰国半岛最西部以及泰国西部的上古生界岩石也是一个特殊的裂解序列岩性带，包括硬砂岩、砂岩、多砾石的-砾岩状的泥岩、页岩、石灰岩透镜体和富石英的砂岩。该地区白垩系的 S 型花岗侵入岩使原本的劈岩升级为层状接触变质岩，如片岩和千枚岩。

2．低级绿片岩阿武隈相系

这个相系带主要包括中度变质-酸性火山岩序列。该带西缘与 S 型花岗岩及高级阿武隈相系变质岩带的东端相接，但是，其东部边界限制在南缝合带，该缝合带是禅泰和印支板块的边界。低级绿片岩阿武隈相系带与波诺帕斯（Bunopas）

定义的素可泰褶皱带大致相吻合。该褶皱带从清莱、楠、那空沙旺和打横一直延伸到那拉提瓦（Narathiwat）东部。该带的所有火山岩主要为火山碎屑、钙碱性流纹质到安山质组分，以及不断发展解理或叶理。通常这些岩石可以被命名为千枚状凝灰岩或变质凝灰岩，局部为变质砾岩，变质石灰岩或大理石透镜体、变燧石和片岩。局部发现的斑点片岩的成因归结为由 S 型花岗岩侵入造成的接触变质作用。石英岩、石英片岩或其他富含石英的岩石，原先可能是燧石层，正石英砂岩或石英泥质层。从地层对比中得出的不同露头岩层的相对年龄似乎显示向东变新的趋势。该变质作用常产生共生的低压-高温绿片岩相矿物组合特征（绿泥石-白云母-黑云母）。

该带还包括分布广泛的未变质岩石，以及年代清楚的沉积岩石，时代范围从石炭纪到三叠纪和侏罗纪。变质岩中没有化石的进行年龄鉴定，所以根据地层对比推定了变质岩的年代，基本上与该序列最老的部分相对应。该带二叠系和三叠系的岩石表现出典型的过渡性，并与侏罗系的红层以不整合接触。小部分三叠系的岩石明显的加积于该带的东侧。

该带的另一个显着特点是仅局限于低级的变质岩，类似于绿片岩相，并分布区域有限。局部地区可能观察到角闪岩相，该现象已被证明是相邻的 S 型花岗岩造成的接触变质作用的结果。每个变质范围内的解理或变质作用地层并不广泛分布，而仅限于一个狭窄而细长的带，并且互相之间没有成因关系，没有相互的影响和叠加。每个岩组的解理可能产生于岩石形成后不久。

该带中火山作用的证据并不总是一致。这可能不能反映火山作用不存在，而是由于不同作者倾向于使用不同的术语命名岩石。在空间和时间上理清火山作用的本质，将有助于更好的认识该带以及泰国的构造。目前，在该带分离和无关的变质火山碎屑岩中存在明显向东变新的趋势，这一现象可能预示着西部俯冲带在其发展过程中不断向西部增生。这些周期性出现的连续变质火山碎屑岩链可能与周期性的新生高热流和某些火山地形的高压缩应力有关。

3．蓝片岩-绿片岩相系带

该带的西部边界与禅泰和中印板块的缝合边界一致，东部边界为岩石分布歼灭线，向北下倾，向东南有扩大的趋势。来源于深部陆相岩层的火成成因，另一方面说明了低演化程度物质的参与。火山岩和次火山岩的相关酸性组合可能代表低循环岩浆或原始岩浆晚期的分化产品。

通过对南构造单元的地质年代学研究，获得了关于该构造事件年代的重要信

息。镁铁质熔岩及相关岩石提供的氩/氩年龄为 356-256Ma，相当于早石炭世至早二叠纪。最大的年龄被认为是该镁铁质熔岩或他们的初次变质年龄，而最小的年龄可能对应于镁铁质片岩中阳起石的钾/氩年龄，为 269±12Ma，相当于早二叠世，对应着二次变质作用的时间。通过对穿越该带的构造进行分析，显示构造单元的倾向向西，这就暗示了存在向西的俯冲带。

该带的另一个特点是变质类型和等级的不一致性，这不同于其他带中说明的情况。在南程逸（Nan-Uttaradit）出现的中压中温绿片岩相叠加在高压低温蓝片岩相之上的现象可能不是构造抬升的响应，而是有另一个不明的原因。南程逸的石炭二叠系蓝片岩和沙缴（Sa Kaeo）的泥盆石炭系中压中温角闪岩-绿片岩可能都形成于与俯冲有关的变质作用。很明显，它们之间的压力温度条件一定是不同的。目前还不知道温压条件的不同是否与双重极性和俯冲带的不同角度有关。

4．未分类的绿片岩相带

该带最显著的变质岩为中等变质的酸性火山岩，仅在黎府省出露。该岩石出露于北春（Pak Chom）东部，南北走向，向南部消失。在该带的北端，该岩层预计将穿越湄公河进入老挝。该岩层的火成序列和含化石灰岩的时代在上志留世到二叠纪之间。指田（Sashida）等人 1998 年通过对硅质岩中放射虫年龄的研究，提供了一个完整可用的沉积序列。该完整的序列（未考虑褶皱和断层造成的局部重复）表明了向东方向年龄增加的大致趋势，并且地层与来自流纹岩（374±33 my）和玄武岩（361±11）的选择性测年数据相符。在该序列中存在一套水平的火山变质岩，这套岩层被定义为下泥盆统和中泥盆统的分界面或者为一个早于晚志留世的断层面。

该带的变质岩的主要成因为变质火山碎屑岩，少量为已经变质到低级绿片岩相的变质长性长石。该带的变质岩由以下部分组成交替序列：变质石英质凝灰质砂岩、变质凝灰质砾岩、变燧石、变质玻屑凝灰质页岩、变质玻屑凝灰质泥岩、变质凝灰质放射虫硅质岩，或者统称为千枚状凝灰质序列和安山岩岩脉。他们的解理化程度取决于岩石的能干性。解理的发育在东部可能消失于下伏可疑的火山碎屑岩和石灰岩地层。在合适的岩石中目前仅有绢云母结晶和火山碎屑的纹理特征（如玻屑结构）仍然可以识别。该变质序列可以在地层和岩性上与上志留统到上泥盆统的序列很好的匹配，没有任何中断，除了在西部边界存在逆冲断层以外。该变质岩的年龄范围应在早-中泥盆世或早于晚志留世，并且与低级绿片岩阿武隈相系带有相似的成因机理。

第三章　区域矿产和成矿带划分

在泰国已经发现了不同种类的金属、非金属和贵金属矿床。这些矿床的形成都与构造活动、岩浆侵入和沉积作用有关。在不同的构造背景下，都会产出一套独特的成矿系统。在掸-泰地体的西部，具有被动陆缘的特征，S 型花岗岩侵入到古生代地层中。在花岗岩侵入体和太古代沉积岩的接触带中已经识别出了许多锡、钨和贵金属矿床以及相关的冲积砂矿。素可泰（Sukhothai）褶皱带和黎府（Loei）褶皱带分别是掸-泰地体和印支地体的主动陆缘，都发育有火山岩地层，在这些地层中产出矽卡岩型及热液型贱金属和贵金属矿床。在印支地体东部的呵叻高原，铀-铜矿床和大量蒸发沉积盐型矿床产出于呵叻（Khorat）群陆相红色硅质碎屑岩层。与第三纪地层相关的矿物燃料通常发育在断层限定的陆上和近海伸展盆地内。在泰国北部、西北部、西部和东南部的年轻新生代基性火山岩中发育有红宝石和蓝宝石矿床。在泰国半岛地区的攀牙省和普吉省，发现有宝石级金刚石矿床。

第一节　区域矿产

在泰国境内已经发现了许多矿床，做过地质工作或已开采的矿种有 40 多种。这其中包括锡、钨、铅、锌、铜、铌、钽、锑、铁和金，这些都是最重要的金属矿产。而萤石、重晶石、钾盐、石膏、长石、石盐、粘土和建筑原料是最重要的非金属矿床。在许多地区还有适合制作规格石料的石材。在泰国，宝石已经开采了几个世纪，泰国也是世界上最最要的红宝石和蓝宝石生产国之一（图 3-1）。

其中钾盐储量 4367 万吨，居世界第一。锡储量约 120 万吨，占世界总储量的 12%，锡矿业长期以来一直是泰国矿业的支柱性产业。油页岩储量达 187 万吨，褐煤储量约 20 亿吨，天然气储量约 16.4 万亿立方英尺，石油储量 1500 万吨。

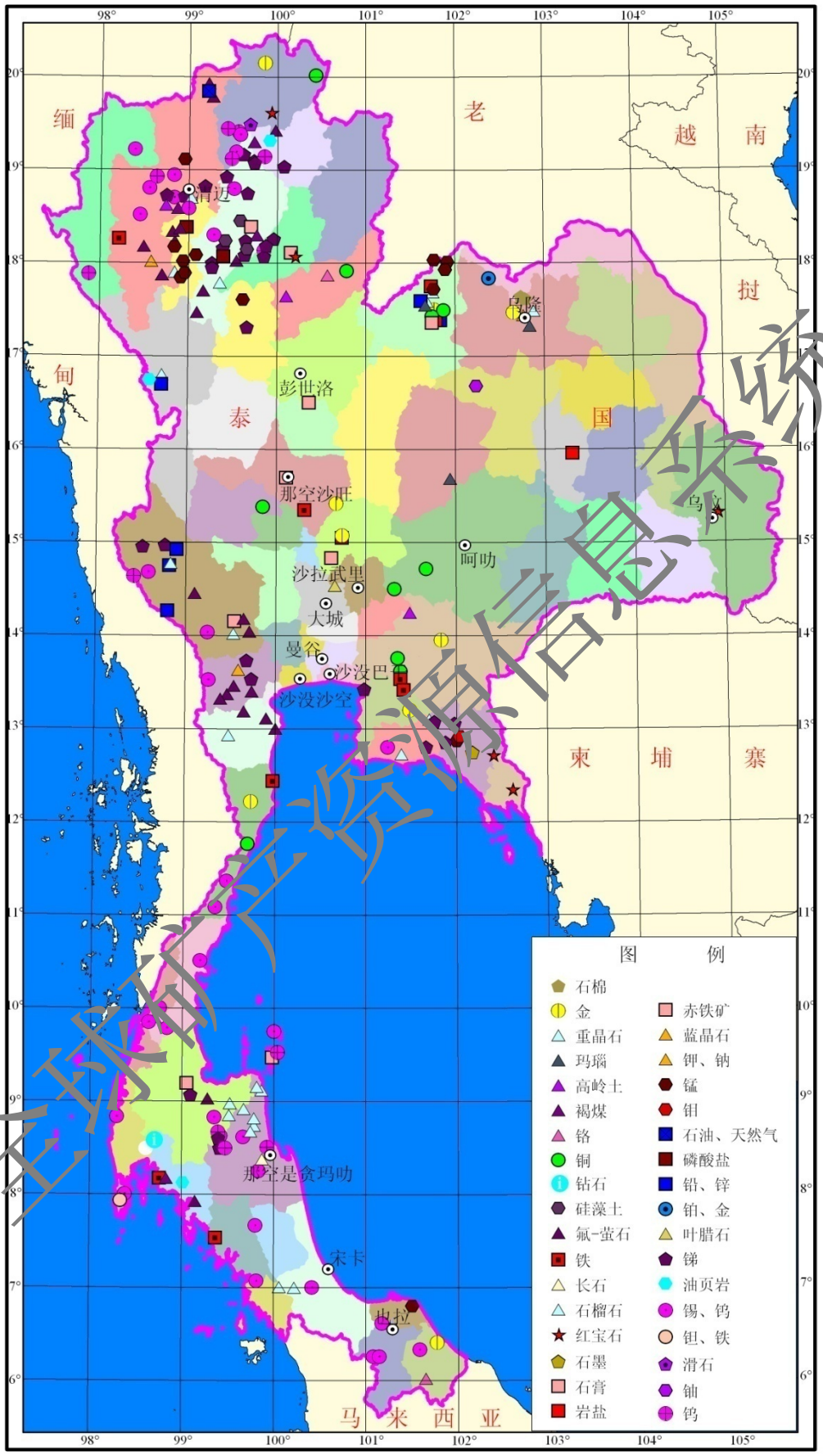

图 3-1　泰国矿产地分布图

下面按矿种对泰国矿产作个介绍：

一、锡矿

1．泰国锡矿床地质特征

泰国境内锡矿床主要与花岗岩构造密切相关，尤其是与花岗岩-变质沉积岩接触带中所发育的构造断裂紧密相关。

全国境内的锡矿产普查资料显示，黑云母花岗岩是锡矿主要的成矿母岩。根据多个不同类型锡矿田中所获得的花岗岩样品中锡含量地球化学分析结果，角闪石花岗岩中锡含量相对较低，黑云母花岗岩中含量较高，而锡含量最高的花岗岩类型则为蚀变气成花岗岩。

锡矿田中各种类型花岗岩的气成蚀变作用显示了极为相似的蚀变特征，即黑云母总含量逐渐减少，甚至在某些时候不发育黑云母，而电气石和白云母含量却逐渐增高。另外，花岗岩往往发生高岭土化，花岗岩中所含的钾长石结晶程度往往较低，比如形成微晶。尽管如此，实际上每个时期的花岗岩都赋存有一定含量的锡矿石。但是从地质年代上来说，白垩纪花岗岩是锡含量最高的花岗岩，其次是三叠纪花岗岩。在泰国境内，大部分花岗岩地区都发育和分布有三叠纪花岗岩。该时期所形成的花岗岩中往往含有锡石矿物以及与其相伴生的含钨矿物，这部分含钨矿物在北部地区主要以白钨矿形式产出，而在南部地区则以黑钨矿形式产出。

一般认为，钛铁矿系列，也就是所说 S-型花岗岩是含锡的主要花岗岩类型，而磁铁矿系列，即 I-型花岗岩相对来说锡含量较低，往往贫锡。全国范围内的野外地质工作揭示，绝大部分锡矿床产出于花岗岩岩株周围，其数量远多于以花岗岩岩基为赋矿岩体的锡矿床数量。

含锡花岗岩形成温度一般低于 600℃，并且形成温度越低，越是有利于富锡花岗岩的形成。

从泰国境内自北而南多个锡矿田中锡矿化样品的流体包裹体和矿物氧同位素分析数据可知，位于清迈省沙蒙（Samoeng）地区的一些脉型锡石矿床其形成温度一般介于 350-470℃，形成压力范围为 1-2.4kbar。而同一矿床中的角砾岩型锡石矿化其形成温度一般在 320℃左右，压力约为 600bar。而位于巴蜀省农色（Nong Sua）地区的伟晶岩型锡石矿床其形成温度范围为 600-650℃，压力范围为 3-3.5kbar。但是位于甘加那汶里省的 Pilok 矿山其锡矿石形成温度约为 400℃。位于拉差汶里省 Takua Pit Thong 矿山的交代型锡石矿床其形成温度一般介于

450-475℃。再往南，位于洛坤省的 Yod Nam 矿山其脉型锡石矿化形成温度范围为 250-500℃。矿床中采得的石英样品其流体包裹体研究结果显示，宋卡省 Thung Poh 矿山其锡矿石热液矿化以及花岗岩蚀变温度一般低于 350℃，锡矿化主要以交代浸染型为主，广泛贯通发育在整个花岗岩体中。

2．锡矿类型

泰国是世界主要的锡矿石生产国之一。泰国境内锡矿床主要分为原生和次生两大类，其中以次生锡矿床为主，该类型锡矿床是锡矿石的主要来源，尤其是砂矿型锡矿床。

泰国境内锡矿床类型主要分为 7 种，这 7 种锡矿床分别为：热液石英脉型和云英岩型、蚀变花岗岩及其围岩中的交代型锡石矿床、伟晶岩型、细晶岩型、接触交代型、残积型和砂矿型。

在此，还有另外一种锡矿床类型值得引起注意，那就是锡-铁脉型矿床，该矿床主要由锡铁氧化物脉和锡铁硫化物脉组成。

（1）热液石英脉和云英岩

含锡热液石英脉型矿床是泰国境内最为普遍的锡矿床类型。几乎每一个矿床中都可以发现石英脉交切岩体的现象。同时，锡矿脉也是冲积型锡矿床最为主要的原生矿石来源。

热液矿脉一般以裂隙充填的形式产出于专属性黑云母和/或白云母淡色花岗岩中或其附近。这些矿脉绝大部分产于花岗岩岩钟顶部结构内或者其上部，并且多侵入至岩体上覆盖层的变质沉积岩中。

在甘加那汶里省 Pilok 地区，含锡矿脉一般局限在花岗岩岩体中，而侵位于变质沉积岩单元中的岩脉一般不含锡或含量极少。

但是在宋卡省地区，侵位于岩体上部或者周边部位的变质沉积岩中的含锡石英脉其锡石含量则相当高。

各种热液石英脉中存在很多种与锡石相伴生的矿物组合，例如：

①锡石-石英矿脉；

②锡石-黑钨矿-石英矿脉；

③锡石-白钨矿-石英矿脉；

④黑钨矿-锡石-毒砂-石英矿脉；

⑤锡石-黄铜矿-黄铁矿-石英矿脉；

⑥锡石-电气石-石英矿脉；

⑦锡石-黑钨矿-电气石-黑色石英矿脉。

锡矿脉绝大部分含白色和发光石英，往往含有电气石并含有锈斑。

富锡矿脉往往是一些宽度介于 0.5-15 厘米的小型脉体，但是在裂缝或溶洞以及脉壳中往往发育有大型含锡石英脉，这些石英脉中发育有锡石。

石英脉深度一般不大，延伸深度范围一般介于 10-30 米之间。而对于那些向深部延伸达 200-350 米的石英脉，锡石矿物往往仅仅局限在石英脉上部，深度一般不会超过 80 米。泰国南部某些地区，例如洛坤省 Tha Sala 地区，往往发育有深部含锡矿脉系统。Khao Khiam 花岗岩山断裂系统中发现存在有近于直立的锡-黑钨矿石英脉，开采中段深度约为 100 米。该矿脉系统具有明显的矿化分带现象，山体顶部矿脉中上部单元往往发育黑钨矿，而在更深部位，锡石含量逐渐增多，深度越大，含量也越大。

通过对世界各地 43 个矿床进行详细的热液矿脉品位计算之后指出，世界大部分矿床其锡品位一般介于 1.25-1.5%之间。计算模型同时也显示，90%的这些矿床其锡品位至少为 0.7%，其中一半以上矿床的品位高于 1.3%，10%的矿床品位可达 2.3%甚至更高。

泰国境内的热液型锡矿脉可采品位一般约为 1%锡。

一般来说，云英岩与含锡石英脉关系极为密切，并且与晚期专属性黑云母和/或白云母花岗岩相伴生。含锡热液石英脉周边围岩基本上都经历了热液蚀变作用，蚀变程度从云英岩化至绢云母化，以石英脉鞘壳状产出。一般将这些鞘壳称之为云英岩化镶边脉体。云英岩往往发育在花岗岩类岩体顶部单元内或附近，也可以沿着花岗岩类岩体边缘分布，同时伴生有石英脉。云英岩矿物组合往往出现明显的分带现象，由各种气成矿物组成，例如黄玉、萤石、电气石，同时包括锡石、黑钨矿、辉钼矿、毒砂、辉铋矿、石英以及黄铁矿。

在宋卡省 Wang Pa 地区，黑色石英-黑钨矿矿脉往往与云英岩伴生，含有黑钨矿、锡石、辉钼矿、萤石和毒砂。

门子厄（Menzie）等 1984 年根据世界 6 个国家 11 个矿床的云英岩矿床矿化品位分析结果指出，在这 11 个矿床中有 80%的矿床锡含量介于 0.17-0.54%之间。

热液石英脉中所含有的锡石绝大部分为褐色，但是在某些情况下，石英与锡石共生时往往表现为其他颜色，例如宋卡省 Hat Yai 地区的矿床中，锡石颜色一般为黄色、黑色和红色。

（2）伟晶岩和细晶岩

细晶岩往往与伟晶岩相伴生，并作为伟晶岩的细粒组成分，在泰国境内，两者属于花岗岩类变异岩体，与锡矿床关系密切。

伟晶岩和细晶岩经常以岩墙、岩床、细脉、网脉等不规则形态产出，或者呈透镜块状体形态分布在花岗岩侵入体周边。在 Phato 锡矿田内，伟晶岩往往以岩床状整合侵位于二叠-石炭纪片状岩系层理面中。而在普吉岛 Kathu 锡矿田 Tantikovit 矿山，含锡石伟晶岩往往以透镜体形式产出，宽度可达 10 米左右。但是在 Tantikovit 矿山西南部的 Ban Nguan 矿山，地质工作者发现了一个厚达 16 米的条带状伟晶岩透镜状岩席。

在泰国境内，伟晶岩矿床是主要的锡矿床类型之一。伟晶岩系统含有少量的锡石以及伴生的含铌-钽矿物。由于往往含有一定量的铌-钽矿物，此类矿床其经济潜力不容忽视。

泰国境内卡图和普吉岛地区 4 个具备相同伟晶岩系统的矿床（分别为 Pollhawee、Pad Roid、Tantikovit 以及 Ban Nguan 矿山，这四个矿床隶属于不同的矿业公司），其总的锡矿石储量大约为 1000 万吨左右。伟晶岩矿床采矿平均品位在 0.04%Sn 左右。在世界范围内，伟晶岩一般具有低吨位、低品位的特征。

对泰国境内多个含稀土元素 Sn（-Ta-Nb-Li-W）矿床进行详细研究之后，提出了 6 类型划分方案：

①白云母-黑云母伟晶岩：主要分布在宋卡省和乌泰他尼省地区；

②电气石-白云母伟晶岩：主要分布在普吉岛、攀牙省以及拉廊省地区；

③富锂云母伟晶岩：主要分布在普吉岛、攀牙省以及拉廊省地区；

④富电气石伟晶岩：主要分布在巴蜀地区；

⑤富黑云母伟晶岩：主要分布在达克（Tak）和普吉岛地区；

⑥杂合型（富白云母和富黑云母伟晶岩）：富白云母伟晶岩主要分布在乌泰他尼和普吉岛地区，富黑云母伟晶岩主要分布在宋卡省地区。

上述 6 类伟晶岩中，第二、三和五类主要含有锡石、铌钽矿物以及稀土元素矿物，具有经济勘探价值。

在泰国境内，伟晶岩矿床分布范围极为广泛，尤其是在泰国半岛西南部地区的普吉岛和拉廊省地区。Phato 和 Takua Pa 锡矿田内散布有大量的伟晶岩系统，在普吉岛和攀牙锡矿田中也存在大量的大型伟晶岩系统，并且具有极高的经济价值。但是在拉廊锡矿田中，目前还没有发现大型的含锡伟晶岩矿体。

Khao Phra Mi 锡矿田以东的 Khao Nam Khang 矿床中发育有著名的含锡

Shone 伟晶岩矿体。该伟晶岩矿体宽约 5 米，以岩床形式侵入到石英质-钙质角岩中，含有极粗粒的锡石颗粒，锡含量约为 1-2%，同时伴生有电气石、石榴子石、磷灰石以及黄铁矿，但是该矿体伟晶岩含锡量约为 0.05%。

在 Phato 锡矿田附近的 Lug-Lag-Nai 巴松地区，地质工作者发现了大量的伟晶岩细脉，这些伟晶岩细脉切割了二叠纪-石炭纪片状岩系。锡是以浸染状形式贯穿分布于整个伟晶岩体内，含量较大。平均深度超过 30 米的伟晶岩系统每立方米岩体所含的锡总量约为 0.5-1 千克。

在普吉岛地区，具有经济价值含锡石的伟晶岩矿床可分为两类。云母电气石伟晶岩往往呈纯白色，结晶极为细粒，由石英、钠长石/奥长石、白云母、电气石和石榴子石组成，含少量锡石、钛铁矿以及黑钨矿。

大型含锡锂云母伟晶岩主要分布在攀牙锡矿田和 Phato 锡矿田内。其中在 Kalai 村 Reung Kiet 矿山的攀牙锡矿田和竹古童（Takua Thung）矿区的 Krasom 村的 Bang I Tum 矿山，地质工作者发现了世界上最大的未分带锂云母伟晶岩体。这两个伟晶岩矿体的长度都超过了 1 公里，宽度都在 20 米以上。这些大型伟晶岩矿体以及伴生的大量小型锂云母伟晶岩走向近北东-南西向或近 218-220°，平行于攀牙断层带，倾向南东，倾角很大。在 Phato 锡矿田内部的 Bang Now 地区，地质工作者发现了大型条带状或分带状锂云母伟晶岩矿脉，宽约 2 米，露头走向南北，以 45°角向东倾斜。该锡-铌-钽锂云母伟晶岩含锡品位为 0.02%锡，同时含有铌-钽矿物，包括钽烧绿石，锡含量吨位约为 250 万吨。

在泰国境内其他地区同样也发现存在有含锡伟晶岩矿体。泰国南部董里省（Trang）的 Huai Yot 锡矿田中也发育了文象含锡伟晶岩矿体。另外在清迈省 Yang Kiang 地区的 Huai U Tum 地区也发现了大量锡-铌-钽伟晶岩矿体，此外，在泰国北部的乌泰他尼省以及塔克省等地区也发现了古老的伟晶岩型锡矿床。

在观察伟晶岩特征时发现，这些伟晶岩往往在热液矿脉形成之前侵位。这种现象在巴蜀省 Nong Sue 锡矿田中较为普遍。在该矿床中，主要的锡矿母岩为电气石伟晶岩，此类电气石伟晶岩以含有锡和黑钨矿为主。伟晶岩整合侵位于片状岩系片理构造面中，其中一部分伟晶岩侵位于上部石英岩裂隙中。在切割伟晶岩的石英脉中，往往可以看到大量微红色的锡石颗粒。

（3）浸染型锡矿床

浸染型锡石矿床主要分布在蚀变花岗岩体中。在世界范围内，由蚀变花岗岩体所生成的浸染型锡石矿产其锡产量相对较少，此类型也并不多见。但是泰国则

是一个例外，因为泰国境内拥有大量的浸染型锡矿床，这种类型锡矿床在国内很多地方都已被发现和开采：

①在泰国半岛西南部地区，尤其是在拉廊-普吉等省区，例如拉廊省的 Bang Phra、Bang Non、Haad Som Pan 锡矿田以及攀牙省达柯帕矿区的 Nok Hook 和 Ku Rod 锡矿田；

②宋卡省 Haad Yai 矿区的 Thung Pho-Thung Khamin 锡矿田；

③苏拉塔尼（Surat Thani）省 Khao Luang 岩基地区的 Ban Song 锡矿床；

④董里省 Lampae-Huai Yod 锡矿田；

⑤也拉省 Khao Lumphaya 岩基地区的 Pa-Pane 矿山；

⑥拉差汶里省 Suan Phung 矿区的 Pong Nam Ron-Pong Krathing 锡矿田；

⑦南邦省 Chae-Hom 矿区的 Chae-Son 勘探远景区；

⑧青莱省 Mae Chedi 锡矿床。

在某些地区的正常锡矿脉周围，地质工作者在锡矿脉以及细脉附近的围岩中发现了浸染型的锡矿石。这些围岩含有细粒浸染型锡石。锡含量很高，但是矿化分带分布范围极为有限，一般仅局限于接触带中。

在 Na Thawi 锡矿田中，例如 Koi Saba 矿床、Muang Mark 矿床以及 Thai San 矿床，地质工作者发现锡石颗粒与电气石一同呈浸染状发育在砂岩和粉砂岩的孔隙晶洞中。所以一般认为，这些锡石颗粒很有可能来自富气相成分，这些富气相成分扩散进入到砂岩体内部的这些孔隙晶洞中，进而结晶成锡石颗粒。

（4）接触交代型矿床

接触交代型或高温交代型锡矿床一般较为少见，其典型特征是由锡石、马来亚石以及一个钙质-硅酸盐矿物组合所组成的，此类矿床往往分布在灰岩和花岗质岩体之间的接触带中，主要发育于热变质接触变质晕内部的碳酸盐岩石中。

在泰国境内，锡矿化基本上都分布在高温交代或接触交代锡矿床中的蚀变灰岩或夕卡岩中。

含锡夕卡岩矿床一般是由碳酸盐岩发育而来的，这些碳酸盐岩在由花岗质岩类演化过程中形成的晚期热液矿化介质和热源的作用下逐渐形成了夕卡岩。这些矿床分布在顶板悬挂体和包体内部的花岗质岩类高位部分，类似于 Pinyok 矿床中花岗质盐类的边缘矿床。

从矿石储量、品位、复杂程度、选矿难度以及矿床类型角度上来看，Pinyok 矿山是世界著名的矿山之一。Pinyok 矿山被认为是东南亚地区最大的接触交代型

锡矿床。该矿床位于泰国南部马来西亚交界地区附近的也拉省 Bannangstar 矿区（北纬 6°09’，东经 101°10’）。

该矿山最初是由中国矿工开采生产的，后来，也就是 1930 年晚些时候，大不列颠-美国锡矿有限公司开始对该地区进行锡矿勘探。该矿床断断续续开采至今，尽管在此期间有很多公司试图努力提高矿山生产能力，但是矿山矿石采收率依旧很低，约为 18-36%。这种低采收率问题主要来源于锡矿石较小的粒度，这些锡矿石来自矿石内的针状锡石。1941 年晚期，Pinyok 矿山开始采用 Cavaet 化学处理流程“使锡矿石经过氯化作用和汽化作用以及电解作用”进行采收。由于回转炉中的耐火砖出现了一些问题，该生产车间在投产运营之后 2-3 周便被迫关闭。

Pinyok 矿床平均矿化品位约为 1.5-2.0%Sn。1965 年月产量值在 90-120 吨左右。

Pinyok 矿床形成年龄估计约为 183-185Ma。

在 Pinyok 矿床内部，花岗岩广泛侵位于泥质岩类以及二叠纪块状灰岩地层中。接触交代矿化带从花岗岩边缘向外延伸 10-50 米不等。锡石几乎分布在整个接触带中，并与方铅矿、黄铁矿、黄铜矿、毒砂和磁铁矿共生。夕卡岩体可以划分为内外两个区带。接触带内带含有较为少量的锡石以及与其伴生的阳起石、紫苏辉石、钙铁辉石以及磁铁矿。外带主要由绿色、褐色和黄色石榴子石、透闪石、磁铁矿以及石英组成，含少量锡石。同时也可以发现针锡矿和马来亚石。

Pinyok 矿床内部存在一个大型的含锡夕卡岩体，该夕卡岩体主要由锡石、方铅矿、黄铁矿、毒砂、黄铜矿、磁铁矿、次生褐铁矿、钙铝榴石、钙铁榴石、石英以及透辉石。

1969 年晚些时候，Hosking 报告称，Pinyok 矿床同时含有锡石和马来亚石。Hosking 和 Leow 相信，马来亚石是在钙质-硅酸盐形成阶段发育生成的，而锡石则是晚期热液活动过程中形成的。而马来亚石可以在夕卡岩表生作用过程中转变为水锡石石英和方解石集合体。

Pinyok 夕卡岩矿床不仅含有可开采的锡石资源，同时还赋存有针状锡晶体，但是宽度很小。

为了提高车间生产能力以及矿石采收效率，Watanavorakitkul（1988）对 Pinyok 矿床进行了详细的矿物学研究。他发现，锡石绝大部分是以针锡矿形式存在的，大约占总量的 60%左右，纤细的晶体都互相连结在一起，孔洞均被针铁矿充填，

而这部分针铁矿表现出明显的软质土状特征。单个锡石晶体大小从 300 微米至 1 微米不等，频数最大的尺寸为 25 微米。与锡石共生的最为常见的矿物为针铁矿和石英，还有少量磁铁矿。

除了锡石以外，Pinyok 矿床中的夕卡岩还含有马来亚石、含锡石榴子石，尤其是其中所含的钙铁榴石，这些钙铁榴石所含的锡总量超过 3%，夕卡岩中还含有一定量的硫化物，包括方铅矿，这部分方铅矿在表生作用过程中绝大部分已转化为磷氯铅矿。

马来亚石是最为普遍的锡硅酸盐成分，同样也是东南亚地区目前为止所发现的唯一一种锡硅酸盐。在东南亚，只有 Pinyok 矿床中所含的马来亚石具备经济开采潜力。在矿山正式使用 Caveat 选矿技术之前，马来亚石对于锡矿产量的贡献并不大。矿山生产过程中所产生的极为庞大的废矿堆也是锡的重要来源，废矿中所含的锡总量约为 2%，相当于马来亚石中所含的锡总量。

位于 Pinyok 矿山东北 4.4 公里处的 Tham Thalu 矿山也是一个浸染型锡矿床，该矿床发育在花岗岩和灰岩的接触带上。矿床内的矿体经历了彻底的分解作用，分解成为铁帽，由细粒锡石、黄铁矿和毒砂组成，同时含有相对大量的白铅矿。

Tham Thalu 矿山的矿石处理车间月处理矿石约 24-30 吨，锡铅矿冶化验浓度分别为 25%和 37%，铅主要是以白铅矿（占 82%）形式产出，另有 13%是以硫酸铅矿形式产出，5%是以方铅矿形式产出。

Pinyok 矿山周边地区发育的夕卡岩锡矿床大大小小约有 10 多个，覆盖面积约为 10 平方公里。这些夕卡岩中存在大量的断裂裂隙，而这些裂隙中往往充填有富硫化物热液介质，这些硫化物热液介质沉淀之后形成了富磁黄铁矿-锡矿脉，同时含少量的黄铜矿及其他贱金属硫化物，包括银。这些磁黄铁矿-锡石矿脉应该就是热液交代产物。

位于 Pinyok 以北 5 公里处的欧泰矿山，其内部所产的富磁黄铁矿矿脉同时含有方铅矿-闪锌矿-银，出露宽度超过 40 米。矿脉纬向走向可能为北西-南东向。矿床下部约 35-40 米处隐伏有花岗岩和灰岩地层，其中在矿床西南部和北部地区，这部分灰岩地层已经变质成为大理岩。矿石矿物主要为方铅矿、闪锌矿、毒砂、磁黄铁矿和黄铁矿，同时含少量的锡石、白钨矿、黄铜矿、赤铁矿、石英和方解石。经过化学分析之后发现，矿床中还含有一定量的银，但是在显微镜下无法识别。锡石是以黄褐色晶体结合体形式产出的，往往与石英和方解石共生。

Laboo 矿山是 Pinyok 地区另外一个重要的夕卡岩型锡矿床，该矿山位于

Pinyok 矿山西北 4 公里处。该矿山所产的锡石主要来自交代矿体，这些矿体由硫化物锡石矿脉和/或冲积型砂矿组成。矿山范围内，花岗岩岩体侵位于石英岩、千枚岩、板岩以及附属的夹层灰岩地层中。一般来说，这些矿脉由一个主脉和一系列小型平行支脉组成，这些小型平行支脉是在沿着板岩层理面发生剪切变形过程中发育而成的。矿脉平均宽度约为 4-5 英尺，矿脉中含有石英、毒砂、黄铁矿、方铅矿、闪锌矿以及锡石。该矿山中还存在有交代型矿床，在交代型矿床中锡石一般与方解石、绢云母、黝帘石、黄铁矿和毒砂共生。

Yang Kiang 矿床是泰国北部清迈省 Omkoi 矿区新近发现的一个接触交代型锡矿床，该矿床与 Pinyok 矿床一样，都位于同一个中部花岗岩带中，但是两者相距 1000 公里左右。矿床发育在交代灰岩或钙质岩地层中，这些交代灰岩和钙质岩主要沿着花岗岩和沉积岩边界分布，也可存在于绿色夕卡岩变质沉积岩内部。矿床内部 12 个矿体中存在大量的金属矿化，这些金属矿化包括锌、铜、锡和钨，以及少量的铅和银，分散夹杂在夕卡岩中。每一个矿体都是以透镜状形态产出的，横向面积范围从 20×20 至 70×100 平方米不等，纵向厚度约为 5-10 米，分布区域宽度为 200-300 米不等，长度约为 4.5 公里，走向北北西-南南东。矿床内部存在两种类型的矿体：其一为浸染型闪锌矿和黄铜矿矿体，其二为块状硫化物矿体，块状硫化物由大量的磁黄铁矿组成，同时含有少量的黄铜矿。矿石矿物为闪锌矿、黄铜矿、磁黄铁矿、铜蓝、锡石、辉银矿以及少量辉铋矿。根据相关地质资料，夕卡岩原岩应该是寒武纪至奥陶纪时期的沉积岩。夕卡岩带露头部分主要由细粒石榴子石、绿帘石、钙铁辉石、角闪石、石英和方解石组成，同时含有少量浸染型闪锌矿、黄铜矿和白钨矿。该矿床的主要矿石为闪锌矿和黄铜矿，同时含有一定量的银（约 27 克/吨）。锡很有可能是以黄锡矿（黝锡矿）形式产出，但是目前为止未能检测获得准确资料。

（5）残积矿床

目前很少发现有残积型锡矿床。在富残积物地区，原生锡矿脉基本上都是以隐伏形式存在的，目前仍存留在地下深部。这些隐伏矿脉绝大部分属于含锡石英脉或者含锡伟晶岩岩脉。

在 Chumporn 省 Pato 矿区的 Pato 和 Pak Song 锡矿田中，原生锡伟晶岩矿床附近往往可以发现很多残积型锡矿床。

在宋卡锡矿田内部，含锡石英脉较为发育的地区也可以发现大量的残积型锡矿床，这些石英矿脉往往侵位于中生代变质沉积岩地层中，例如 Koh Saba 锡矿

床、Liwong Khuan-Grod 锡矿床以及 Muang Mark 锡矿床。

清迈省 Sa Moeng 矿区的 Mae Boh Kaew 矿床是泰国北部一个重要的残积型锡矿床。

（6）砂矿型锡矿床

砂矿型或冲积型锡矿床是泰国锡产量的重要来源。砂矿型矿床所生产的绝大部分锡采用砂砾抽取方法和直接挖掘技术开采获得的。普吉岛-攀牙-拉廊等省份是泰国最为主要的锡生产区，这些省份生产的锡总量占全国锡产量的 80%左右。该地区砂矿型锡矿床来源于规模巨大的泥质浸染型矿床，这些矿床往往发育了强烈的泥化蚀变作用，主要来自大型伟晶岩岩墙群，这些伟晶岩中发育有高含量长石成分，而这些长石成分极易遭受风化作用。一旦遭受风化形成泥质蚀变之后，原生矿体中的浸染型锡石就会被释放出来，从而在风化产物中富集，形成冲积型矿床。

泰国境内此类冲积型锡矿床一般都具备经济开采价值，锡含量平均约为 240 毫克/立方米，约合 0.012%锡。

在甘加那汶里省的 Song Kwae 和 Pilok 等地区，古老河道山间矿床都是沿着断裂带分布的，这些断裂带是锡富集成矿最为有利的构造环境。

当锡石在流水搬运作用下迁移到河谷并且在山脚盆地基底部位沉淀下来之后，便逐渐富集形成冲积型和砂矿型矿床。锡矿石搬运距离往往不会很远，在距原生矿体或者山坡较近的地区，如果地形合适便会沉积下来，但是在某些情况下，如果重力分选作用强度较大、径流水动力条件较强或者锡石颗粒较小，那么锡矿石就有可能发生远距离迁移，直至三角洲地带，例如在攀牙河三角洲地区发现的某些矿床，其矿石迁移距离在 10 公里左右，这些矿床往往可以采用挖掘方法进行开采。在山间盆地中形成的冲积型锡矿床，由于这些矿床紧邻母岩与围岩的接触带，所以其锡含量往往较一般类型矿床高很多。一般而言，冲积型锡矿床中所含的锡矿石往往局限在盆地最底部靠近基岩的沙砾层中。但是在宋卡省 Hat Yai 矿区的 Khuan Chanai 山东部地区，这些矿床却经常分布在盆地沉积层的中部层位。在泰国南部的某些矿床中，可采矿带中矿石往往被铁氧化物紧密胶结，作为锡的红土胶结层，这给采矿工业造成了一定的难度。在董里省的 Lampae 地区，此类红土型含矿泥沙中锡的含量可高达 0.21%锡。

泰国境内另一个较为有趣的现象是，假层理岩层（或者称为不规则层理岩层）中往往发育有含锡可采矿带。这些假层理岩层是由松散沉积物组成的，沉积物来

源于上游区域，在真基岩部位卸载沉积，紧接着经历锡富集成矿时期。这些假层理岩石或松散层理岩石绝大部分是在花岗岩分解过程中形成的。在这些岩石中可以发现电气石、白云母以及其他花岗质成分，同时含少量的锡石。某些假层理岩石整合覆盖在硬质基岩岩层上部，在逆冲作用推动下向上错移。所以还有相当一部分含矿带有可能隐藏在这些假层理岩层中。

冲积型锡矿床一般分布在灰岩地层区域，采矿者往往可以在灰岩落水洞或者溶洞中采收锡矿石，例如苏拉塔尼省的 Klong Sa 地区以及董里省的 Hua Yot 锡矿床。

地质工作者于 1967 年对拉廊省地区河口泥浆水中的锡含量进行了测定观察，这些泥浆水是在雨季期间，从 Haad Som Pan 河流带入的。检测结果发现，这些泥浆水中锡含量可高达 220ppm。因此可以肯定，很大一部分锡已经流失。

泰国境内很多地区的冲积型锡矿床同时还发育有金矿床，例如甘加那汶里省的 Pilok 地区，巴蜀省的 Bang Saphan 地区以及那拉提瓦省的 Tomo 地区。原生矿体的矿化成因目前还没有完全搞清楚，有待更为深入的研究。

（7）滨海矿床

泰国境内的滨海锡矿床主要分布在泰国半岛西部海域，主要集中在普吉岛周边以及攀牙省和拉廊省西部沿海地带。这些矿床的形成与沿着半岛西部海岸线平行分布的花岗岩母岩的关系极为密切。

目前，西部海域锡矿床都采用挖掘和泵吸船舶进行矿石开采，所采收的矿石量是泰国锡产量的重要组成部分。

在泰国半岛东侧，地质工作者也发现了作为锡矿母岩的花岗质岩体，但是这部分花岗质岩体的露头面积并没有西部海岸那么大。东部海岸滨海型锡矿床数量较少的原因可能就在于，泰国半岛东部海岸相对来说处于抬升过程中，而西部海岸则处于下沉过程中。但是在苏拉塔尼省的 Koh Samui 和 Koh Pangan 岛附近以及帕塔尼省的 Panare 半岛地区等滨海地带也存在类似的锡矿床。但是这些地区的滨海型锡矿床并没有西部海岸滨海矿床那么重要。

在泰国海湾北部拉勇省 Marp Ta Put 地区，各种颜色的含锡矿石（黄色、黑色以及红色等）多沿着海岸线沉积分布，在滨海区域也存在这样的锡矿石。这些锡矿石的原岩应该是石英脉，这些石英脉侵位进入沿着海岸线分布的海域黑云母花岗岩中。具有经济开采价值的滨海型锡矿床（尤其是半岛西部海岸地区）的分布区域总结如下：

1）拉廊省海域：因为这些锡矿床的含矿原岩主要是该地区陆上广泛发育的花岗质岩石，因此拉廊省滨海锡矿床一般仅局限在距海岸带较近的河口地带。

2）攀牙省滨海地区：根据自然产状特征，该地区滨海型锡矿床主要分为以下两类：

①Bang Muang 和 Tai Muang 地区之间的滨海地带。在这些地区，含锡砂矿主要来源于陆上花岗岩体，因此这些地区的滨海型锡矿床特征与拉廊省地区的滨海型锡矿床较为相似。该地区滨海型锡矿床基岩主要由含石英岩夹层的板页岩组成。含矿带顶部单元一般由粘土、砂砾和砂质层组成；

②从 Tai Muang 地区一直延伸至普吉岛的滨海区域。锡矿石主要以覆盖层形式或者斑块形式存在于滨海地带，也有一部分以残留形式存在，仅局限于海域地带花岗岩与围岩接触带中。因此，此类锡矿床中的锡主要来源于这些接触带。该地区河口湾以及海岸附近不存在锡矿石，锡矿石一般沿着海岸线纬向平行分布，与海岸线相隔约 1 公里。

3）普吉岛西侧海域：普吉岛西侧海域存在很多锡含量极高的滨海锡矿床，这些矿床主要分布在 Kamara 海湾至 Bang Thao 海湾以及 Haad Surin 之间的广泛区域内。经过详细的地质研究，相关部门确定，该地区的此类锡矿床属于残余型矿床，是在海岸带花岗岩经过风化作用之后残余富集而成的。在某些地区，锡矿石沿着花岗岩和二叠纪-石炭纪板岩片岩之间的接触带分布。可以肯定，这些地区的锡矿床来源于陆上或者海域花岗岩体，因此锡矿石可以连续分布在海岸带至滨海区域的广泛区域内。

4.）普吉岛东侧滨海区域：这些地区的锡开发潜力较大。普吉岛东南部的 Ao Khan 海湾和 Ao Thungka 海湾地区存在很多重要的滨海型锡矿床。主岛附近的基岩主要由板岩片岩和石英岩组成，远离片岩和石英岩地区则主要由灰岩、角岩和片岩组成。含矿带下部往往存在花岗岩基岩，从海岸带可一直延伸 7-8 公里，并与灰岩地层接触。锡石颗粒呈次棱角状，经常富集在距接触带不远的灰岩基岩中。该地区的锡矿石也来源于滨海花岗岩。

5）Satul 省以西 70 公里处的 La Dang 岛区域：所有的这些岛屿均由斑状黑云母花岗岩组成，这些黑云母花岗岩绝大部分都经历了气化蚀变，花岗岩中经常可见大颗粒电气石晶体集合体。在 Ladung 岛南部地区，围岩多以残山形式出露。很多河流沿岸都可见锡石颗粒，这些锡石的原岩应该就是电气石石英脉和伟晶岩，石英脉和伟晶岩往往沿着花岗岩与围岩的接触带中的裂隙分布。在 Ladang

岛南海岸地区也发现存在有滨海锡矿床。

3．锡石和伴生重矿物矿床分布

根据对锡石和伴生重矿物的分布研究，可以将泰国境内的锡矿田划分为 4 个区域：

①泰国北部地区锡矿田，包括清莱府、清迈府、南奔府、南邦府和来兴府。

②泰国中部地区锡矿田，包括乌泰他尼府、素攀府、北碧府、叻丕府和班武里府。

③泰国半岛西部锡矿田，拉农-大瓜巴-攀牙锡矿田，包括拉农府、攀牙府和大瓜巴地区；普吉锡矿田，包括普吉岛等泰国发育锡矿化的岛屿。

④泰国半岛东部锡矿田，包括素叻他尼府、那空府、董里府、宋卡府和也拉府。

二、钾盐

泰国块状盐（岩）矿床产于其北东部呵叻高原的白垩纪地层中，呵叻高原为一中新生代厚层红色碎屑岩建造，中部为普潘隆起所隔，分割成南部的呵叻盆地和北部的沙空那空盆地。钾盐层赋存于上白垩系—下第三系马哈沙拉勘建造中，分布面积 24900km^2。沙空那空和呵叻两个蒸发盐盆地发现于 1973 年，60000 多 m 的钻孔揭示出马哈沙拉勘建造包括三个蒸发盐地层，即上部、中部和下部盐层，之间被粘土岩隔开。上岩盐段厚 3-67m，平均厚 21m，夹一层厚 1.5-2.4m 的硬石膏层。中岩盐段厚 9-115m，平均 33.5m，局部顶、底有厚度<1m 的硬石膏和石膏层，岩盐段下部出现少量钾石盐和光卤石。下岩盐段赋存主要岩盐和钾盐层，最大厚度 439m，含岩盐层 354m、钾盐和光卤石层 82m，底部为厚 0.6m 的硬石膏层。岩盐-光卤石-泻晶石（镁钙盐）带产于下岩盐段上部，厚 0.9-99m，一般厚 21-49m，平均厚 41m。主要矿物光卤石含 K2O 5-10%，最富 24-30%。光卤石带之上有厚 0.9-5m 的纯岩盐层，局部厚达 60m。

呵叻盆地面积为 17000 km^2，其中钾盐层分布面积 15100km^2，呵叻盆地钾盐远景储量 87 亿 t。主要钾盐矿床分布于邦内那隆、昆敬、加拉信、暖颂、南丘克和亚索顿等地。钾盐层分布较大的地区有昆敬和邦内那隆，光卤石层最大厚度达 72m (平均 23. 29m) ，KCl 平均品位 13.6 %。其中邦内那隆矿床工作程度高，探明储量 5.7 亿 t。

沙空那空盆地面积 33000 km^2，其中钾盐层分布面积 9800km^2，沙空那空盆地跨泰、老两国，在泰国境内储量占泰国总量的 76 %，即 355 亿 t。老挝万象

平原的钾盐矿床位于沙空那空成盐盆地的西北边缘，钾盐远景储量约 167 亿 t。已探明的 C+D 级储量 13 亿 t。矿层埋深一般 150m 左右，最大埋深 331. 65m，厚 16～100m （平均 35m），KCl 平均品位 15.2 %。盆地有乌隆、廊开、哇伦等钾矿田。泰国呵叻高原大部分含钾矿物是光卤石，钾盐仅分布在几个大矿田中。

三、锑矿

泰国的锑矿床为脉型，沿沉积岩和花岗岩类岩石中的剪切和角砾化断裂带产出。矿脉形状不规则，有时呈囊状。辉锑矿和黄锑矿为常见矿石矿物。原生矿床为热液交代型矿床，通常产在花岗岩与安山岩周围的古生代和中生代岩层中。成矿时代较年轻，为晚三叠世和更新世。另一主要类型为次生残积矿床。

锑矿带位于泰国西部，南北长 1500 公里，东西宽约 200 公里，有 100 多个矿床，分为北部、东部、中西部和南部四个远景区，其中以北部和东郡远景区最为重要。原生矿床为热液交代型矿床，通常产在花岗岩与安山岩周围的古生界和中生界岩层中。成矿时代较年轻，为晚三叠世和更新世。另一主要类型为次生残积矿床。主要矿床有素叻他尼府的班宋（BangSong），帕府的堆法坎（DoiPhaKhan），南邦府的班昆（BanKaeng），和春武里府的克朗克拉塞（KlongKra-Sae）等。其中的克朗克拉塞锑矿，规模最大，估计矿石储量 10 万吨，品位大于 30%。南邦府的锑矿床，矿体呈脉状充填于断裂带中，矿石由石英、辉锑矿组成。泰国的锑矿大部分出口到比利时和巴西等国。

四、铁矿

泰国几乎各府都有铁矿，已探明的储量为 4673 万吨，有的地方铁矿已经采尽，目前主要分布在黎、北碧、差春骚、清迈、南邦、碧差汶、拉廊、甲米等府，有赤铁矿，磁铁矿和褐铁矿。

泰国的铁矿床已勘查多年，但用大规模钻探进行详细调查的只有黎府地区的少数矿床，如普扬（Phu Yang）、普昂（Phu Ang）、普勒（Phu Lek）和普夏（Phu Hia）等矿床。这些都是接触交代型矿床，铁以赤铁矿和磁铁矿形式产出，矿床内以及附近地段和钻孔中见有侵入岩。四个矿床的储量约 2720 万吨，含铁 52%。北碧以北 55km 的考温格龙（Khao Uem Kruem）矿床首次勘查于 1961 年，根据 5 年后的详细钻探数据估计，储量为 480 万吨，含铁 40%。另一个铁矿床是华富里府的考塔圭（Khao Thab Kwai）铁矿床，是该区最老的铁矿山，储量约 760 万吨，估计含铁 44.4%。

五、锰矿

泰国已经发现的锰矿床达 50 处，主要的有 19 处，均分布于北纬 17° 以北的北部和西部地区，其中 18 个集中于南奔和黎府两府内，还有一个位于清迈府。锰矿的形成大多与古生代和中生代海相沉积岩有关。矿床规模一般不大，矿石品位 5-65%，大部分矿床矿石品位较高。主要矿床有南奔的王迈周（BanMaejong）锰矿和清迈的夜塔（Maetaeng）锰矿。

六、铅锌矿

泰国的铅锌矿床主要分布在北部的帕府、达府，东北部的黎府，西部的北碧。已发现石英－硫化物脉型、层控型和矽卡岩型三类矿床，但是有经济潜力的主要矿床是奥陶纪碳酸盐岩中的层控型铅锌矿床，在侏罗纪碳酸盐岩中只发现少数几个矿床。常见成矿元素组合有铅、锌、铜、银和少量重晶石。泰国主要的铅锌矿床有达府的夜速（Mae Sod）铅锌矿、清迈府的帕达因（Pa Daeng）锌矿、北碧府的松多（Song Tho）铅矿夜、丰颂府迈萨良（Mae Sariang）地区的湄霍（Mae Ho）矿床、清迈府湄东（Mae Toeng）地区的班瓜吉（Ban Muang Gid）矿床、帕府隆县地区的博善格劳（Bo Sam Klaw）矿床，拉府班南沙达（Bannang Sata）地区著名的坦达卢（Tham Talu）矿床和北碧府通帕蓬（Thong Pha Phum）地区中奥陶世石灰岩中约 100 km 长的 NNW-SSE 向层控型铅锌矿化带。

帕达恩锌矿床是泰国最大、最富和唯一开采的锌矿床。矿床产在三叠系灰岩层中，灰岩具鲕状结构，间夹砂岩、白云岩，围岩有漂白和铁染。矿床除了可以证实是围岩固结之后形成以外，别无其它年龄资料。矿体部位又具明显负地形特点，说明矿体有可能为原生硫化物矿床完全氧化后经淋滤交代形成。

夜速矿床为风化残余型矿床，锌矿石储量 377.7 万吨，品位 26.56%，个别地段高达 42%，是世界上质量最好的锌矿床之一。

七、金矿

金矿资源主要分布在呵叻高原西部、北部和西部边境地区。主要矿床类型为矽卡岩型和热液脉型。据泰国官方报道，泰国已探明金资源量达到 200 多吨。

现有证据表明，泰国至少有三个重要的金矿化潜力区带，其中的两个与二叠纪－三叠纪火山活动密切相关。火山岩主要是流纹岩、安山岩、凝灰岩和集块岩，其中含众多具酸性－中性成分的小型斑岩体和次火山岩侵入体。以斑岩矿化为主，矿床类型取决于所侵入的容矿岩石和剥蚀水平。容矿地层中大量的石灰岩，特别是二叠纪的石灰岩，导致了众多矽卡岩型矿床的形成。第三个区带与侵入到

志留纪－泥盆纪变质沉积岩地层中的酸性侵入岩密切相关。这类金矿化与含锡花岗岩带密切相关，并形成了热液脉型、变质热液脉型和热液角砾岩型矿床。这些矿床常常受断裂和剪切带等构造控制。

在已圈定的三个含金高潜力区带当中，第一个带呈弧形，沿呵叻高原西部边缘分布。该带的矿化类型有矽卡岩型和热液脉型两种。矽卡岩型矿化与石英二长岩至闪长岩成分的次火山侵入斑岩密切相关，自然金和银金矿呈浸染状产于矽卡岩的裂隙和孔隙内，还见于石英脉和网脉之中。伴生矿物因地而异，金常与铜、铅、锌和砷密切相关，硫化物总含量高。贱金属和硫化物富集程度沿此带方向呈降低趋势，但矽卡岩和接触交代矿化仍很发育。据泰国矿产资源局对这些矿化的试金分析，基岩样品中金含量 0.8～16.0g/t，最高达 90g/t。热液脉型矿床总硫化物含量通常很低，金含量 0.6～43.0g/t。由该带的原生矿床派生的次生金已被当地居民开采，对其品位尚未进行评价，但有些地段金含量很高。

第二个带位于泰国北部，已知矿点沿北东向的晚二叠世－早三叠世火山岩展布。该区的主要断裂构造仍在活动，主要断裂形成一个 NNW 向的走滑断裂带，其他断裂呈 NW－SE 和 NE－SW 向，这种条件使这套层序中裂隙高度发育，有利于含金矿液的定位。该带中有一些较著名的金矿床，其中，会甘温（Huai Kam On）金矿床的含金品位 0.03～76.0g/t，最高达 600g/t。含金石英矿脉产于火山岩地层中。门坤甘（Mon Khum Kam）金矿位于会甘温矿床的北西方向，矿化受断裂控制，具固化和绿泥石化蚀变带，金品位 0.03～6.6g/t。其他矿床显示出几乎一致的矿化类型，其品位尚未确定，但可以预料较高金成矿潜力较高。

第三个带紧靠泰国的西部边界。花岗岩侵位于志留纪－泥盆纪沉积地层中，该带的矿化类型尚不清楚，但有迹象表明其矿化与含锡花岗岩带的脉状矿化系统具有明显关系。

截止 2009 年底，泰国地质资源厅在泰国 31 个府共发现 76 个金矿资源，预计总含量达 700 吨，以黄金单位计达 4500 万铢，价值 9100 亿泰铢。

八、铜矿

泰国的铜矿不是优势矿种，主要分布在柯叻、程逸、黎和孔敬四府，有黄铜矿、蓝铜矿、孔雀石、赤铜矿，主要为班岩型铜矿。

斑岩铜矿床位于黎府的普通登和普辛勒费两地，其发现显示出泰国具有较高的铜资源潜力。钻探提高了矿床研究的详细程度。在普辛勒费地区的地表发现了磁铁矿和铁帽，在探槽所揭露的蚀变闪长斑岩中可以追踪到孔雀石矿化现象。矿

床概略储量为 1500 万吨，含铜约 1%，远景储量约 5000 万吨。同期，对普通登地区也进行了详细调查，包括地质填图、地球化学和地球物理调查、坑探、槽探和钻探。在地表见有铁帽、蚀变凝灰岩和砂岩出露。钻孔岩芯显示，大量硫化物矿物，主要是黄铁矿和一些黄铜矿作为浸染矿石出现于凝灰岩和斑岩中。普通登铜矿床的证实和概略储量估计为 100 万吨，远景储量约为 1200 万吨，含铜约 1%。位于湄公河附近的廊开府的安特普隆（Anther Phu Lon）铜矿床具有较高的铜、金资源潜力。具孔雀石染色的铁帽露头在地表清晰可见，还可见一些古老的铜矿采坑。该区也进行了与以上地区类似的详细勘查。据 Muenlek 等（1988）估计铜矿石，储量约为 1850 万吨，含铜品位大于 1%，伴生的金、银品位分别为 Au 0.3～1.2g/t，Ag 4～5g/t。

九、钽

泰国钽资源比较丰富，主要分布在南部和中部，钽通常以钽铁矿和钽金红石的形式产在原生锡矿床、伟晶岩和与火成岩的接触带内，或在风化、残积、冲积及滨海砂矿中与锡石一起共生。因此，大多作为开采锡矿的副产品被回收。

十、褐煤

泰国煤炭主要是褐煤和烟煤，总储量 15 亿多吨，其中证实的储量 8.6 亿吨，可能储量 6.8 亿吨。煤炭资源大约 80%分布在北部的清迈、南奔、达府、帕府和程逸一带，其余分布在南部的素叻他尼、董里、甲米和东北部的柯叻、加拉信府。

十一、重晶石

重晶石是泰国比较丰富的矿产资源之一，矿床主要分布在北部的清迈府、达府、帕府；东北部的黎府和乌隆符；西部的碧武里府和北碧府，南部的那空是贪玛叻府和宋卡府。主要矿床有：清迈府的富迈蒙（Phu Mai Mong）、黎府的班可考（Ban Hin Khao）、那空是贪玛叻府的考普莱（Lhao Phlao）等矿床。矿床的重晶石含量很高，含 $BaSO_4$ 高达 80-90%，矿床通常为脉状和交代状矿床；西北部和中西部的矿床与石灰岩中的铅锌矿化作用有关；有的可能是火山作用的产物。

十二、宝石

泰国种类很多，其中较为著名的是红宝石和蓝宝石，红宝石和蓝宝石分布在该国的东部、西中部、北部和中部，主要见于与玄武岩流有关的冲积层、残积层中。重要的产地是北碧府、庄他武里府和达叻府，其它还有四色菊府、帕府、素可泰府和乌纹府等地。除红宝石、蓝宝石外，还有金刚石、水晶、玛瑙、玉髓、玻陨石、普遍蛋白质和绿柱石。

第二节　成矿带划分

根据布诺帕斯提出的构造模型，泰国境内的矿床可以分为三个成矿省，即西部成矿省、中部成矿省和东北部成矿省，以上成矿省分别对应了掸-泰地体的西部，素可泰褶皱带和黎府褶皱带以及印支地体的东部。每一成矿省都有自己独特的特征。

一、掸-泰地体西部及矿床

除了掸-泰地体的东南部以外，该地体的其余部分主要分布有与花岗岩相关的大规模矿化，如锡-钨矿化。除此之外，伴生的钛铁矿化和铌铁矿化，大量萤石和长石矿床（不同 K_2O 和 N_2O 含量的组合）在这一成矿省内也非常常见。也有报道指出在花岗岩和寒武纪-奥陶纪变质沉积岩的接触边界上，由于接触交代作用发育了一系列铜-铅-锌-银矿床。掸-泰地体内其他与花岗岩相关的矿床还包括铁矿、辉锑矿、重晶石矿、锰矿、金矿和锌硫化物矿床，这一锌矿床被认为是巴东地区次生锌矿床的原生矿石源区。北碧府奥陶系灰岩中的铅-银交代矿石既可能是热液矿床也可能是沉积矿床。

与掸-泰地体内的其他地区相比，泰国东南部掸-泰地体内的矿床相对较少。已知的一些矿产资源包括铁矿、金矿和重砂矿床以及少量长石矿床和矽线石矿床。

二、素可泰褶皱带及矿床

素可泰褶皱带根据其特征也被称为火山岩区，绝大多数重要的矿化通常都与花岗岩和火山岩相关。该区域内的花岗岩体数量有限，单个岩体的规模也有限。二叠纪-三叠纪 I 型花岗岩呈较小的侵入体产出，随机分布在该区域内。钨-锡矿化、辉锑矿矿化和萤石矿床都与 S 型花岗岩相邻，这表明这两者密切相关，也是该区域最为重要的矿化类型，而在达府岩基这一 I 型花岗岩中或其附近地区，截至目前只有一处将钠长石作为工业矿物开采。其余的 I 型花岗岩被认为与二叠纪-三叠纪火山作用相关。它们是一系列矿床的母岩，如：金、铜、重晶石、铁、钨、锑、锰和其他工业矿物。该区域内的三叠纪-侏罗纪和第三纪火山岩不含金属矿化，但赋存一些工业石材和矿物，例如：珍珠岩、浮石、火山灰和膨润土。在南河缝合线地区，记录有铬、镁和铂族矿物产出。

在素可泰褶皱带东南部地区，没有优势性矿床，在二叠纪-三叠纪火山岩中有金矿产出，在前寒武地层和寒武纪-三叠纪变质凝灰岩中都有铁矿产出，在火

山岩区有锑矿产出。在该区域内发现的其他矿产资源还有方铅矿、萤石、锰矿、辉钼矿和含矽线石的石英云母片岩。

三、黎府褶皱带及矿床

黎府褶皱带内的矿床类型通常与素可泰褶皱带相似。二叠纪-三叠纪火山岩和深成侵入体是各种矿床的母岩。这些火成岩都属于I型，在印支地体真正的花岗质地壳前端有一块较薄的增生地壳，而I型火成岩就形成于这种增生地壳之下，相同的情况也发生在素可泰褶皱带中。区别在于印支地体的黎府褶皱带中，金、铜、铅和锌的矿化发育相当普遍，该地体内的其他矿床还包括锰、重晶石、金刚砂和铁矿。产自火山灰流凝灰岩中的地开石是该地体中的特有矿产。

在印支地体的东南扩展部位，在过去曾经仅仅规模开采过金和沉积型锰矿。就其产出情况而言，基本认为铁、铬、镁、锑和萤石的矿化较为次要。

四、印支地体东部及矿床

泰国的这一部分地区属于呵叻高原，其南部地区被呵叻群含玄武岩陆相红色硅质碎屑岩所覆盖。铀-铜矿化产出在坤敬省萨卡组岩层中，蒸发盐沉积与呵叻群地层有着非常好的联系性。白垩系马哈沙拉堪组地层中的蒸发盐沉积、钾盐和岩盐在沙功那空盆地和呵叻盆地中都有产出，延伸面积超过50,000平方公里。

呵叻成矿带主要是沉积矿产，盐类资源十分丰富，钾盐层分布面积达24900km^2。呵叻盆地有那隆、孔敬、暖颂及南丘克等钾矿田、沙空那空盆地有乌隆、廊开等钾矿田，资源总量达270亿吨。此外砂岩型铜矿及砂岩铀矿也有找矿前景。

第三节　成矿远景区划分

根据各类矿产的矿床模式及其与已知同类矿床模式的品位和吨位模型的比较，分析成矿地质条件，已知矿床（点）的数量、规模、资源潜力，矿化信息的丰富程度，地质矿产工作程度，划分出如下成矿远景区（据“东南亚地区地质矿产对比研究”成果）。

一、泰国巴蜀－普吉锡钨成矿远景区

位于纵贯缅、泰世界最长、最主要茂奇—德林达依锡钨成矿带的南段。有模式28砂锡（钨）矿、模式11石英脉型锡钨矿以及模式9矽卡岩型白钨矿等类型。

受控于巴蜀－普吉花岗岩带，锡钨矿主要产于岩体与围岩的接触带。已知锡钨矿产 18 处，其中，大型锡（钨）矿 4 处、中型锡矿 2 处、小型锡钨矿床及矿点 12 处，多属模式 11 锡石-黑钨矿-石英脉型锡钨矿和模式 28 砂锡（钨）矿，但大、中型锡矿均为模式 28 砂锡矿。此外，还有模式 30 砂金铂矿产地 1 处，铁矿产地 1 处。

二、泰国呵叻盆地钾岩盐成矿远景区

位于万象-呵叻钾（岩）盐成矿带。属模式 24 晚白垩世－古新世岩盐－钾盐－石膏矿床，分布于泰国中生代沉积呵叻盆地，该盆地面积 15100 平方公里。含盐层呈平伏状分布于盆地内，上、中、下三个岩盐段，以岩盐为主，夹石膏，中岩盐段下部有少量光卤石和钾石盐，下岩盐段上部为主要的含钾的岩盐段。已知班勒纳荣（Bamnet Narong）大型钾（岩）盐矿位于呵叻城北猜也蓬府。远景巨大。

三、泰国湄索－北碧铅锌银成矿远景区

位于达府－北碧铅、锌成矿带。已知铅锌（银）矿产地 12 处，有模式 19 碳酸盐岩层控铅锌（银）矿床和模式 20 碳酸盐岩交代铅锌矿床两类。矿床规模可达大、中型。模式 19 铅锌（银）矿受控于奥陶系碳酸盐岩，铅锌矿中有伴生银矿产出，如松多中型铅锌矿和农帕、波南小型铅锌矿床中均有较高含量的银矿伴生。模式 20 铅锌矿受控于石炭纪-二叠纪或三叠纪碳酸盐岩及其中的断裂。本区为重要的与碳酸盐岩有关的铅锌（银）矿远景区。

四、泰国那空是贪玛叻—沙敦锡钨成矿远景区

位于那空是贪玛叻锡、锑、金、铁成矿带。已知锡钨矿产地 7 处，含模式 28 砂锡矿大、中型各 1 处，模式 10 锡石－硫化物型锡矿小型矿床 1 处，模式 11 黑钨矿－石英脉型小型钨矿床 2，锡矿点 1 处。受控于清迈－北碧－那空是贪玛叻花岗岩带南段，原生矿多产于花岗岩体边缘。以模式 28 砂锡矿、模式 10 锡石－硫化物型锡矿和模式 12 低温热液钨铁矿为主，是寻找大、中型锡钨矿的重要地区。

五、泰国南奔锰成矿远景区

位于景栋－南奔锰成矿带。已知锰帽型锰矿小型矿床 5 处、矿点 1 处。属于石炭系含锰页岩经风化、淋滤富集而成。为锰帽型锰矿的主要产地。

六、泰国渊巴宝锡钨成矿远景区

位于清迈锡钨成矿带。成矿带的形成与泰国中花岗岩带的岩浆活动有关。区

内已知钨、锡矿产地 9 处，含中型矽卡岩型白钨矿床 1 处（莫克山）、小型钨锡矿床和钨矿床各 1 处，锡钨矿点 3 处，小型砂锡矿床 3 处。还有小型热液型锑 2 处。区内对锡钨矿有一定的前景。

七、泰国也拉锡（钨）成矿远景区

位于那空是贪玛叻锡、锑、金、铁成矿带的南站。出露地层为志留—泥盆系、石炭系、三叠系，以上古生界为主。锡矿的形成与泰国中花岗岩带南部也拉—巴东中生代花岗岩有关，位于较小岩体与石炭系碎屑岩及二叠系灰岩接触带附近的构造裂隙中。已知有中型锡矿床 1 处，小型锡矿床 2 处。

八、泰国黎府铜金锰铁成矿远景区

位于黎府－华富里－波索竹－罗文真金、铜、铁成矿带的北西段。区内已知中型铜矿床 1 处，小型铜矿床 2 处，斑岩铜矿受控于三叠纪闪长斑岩和石英二长斑岩。斑岩铜矿中有银伴生，如普龙铜矿含 Ag 4-5 g/t。已知锰帽型锰矿小型矿床和矿点各 2 处，成矿特征与景栋－南奔成矿带相似。已知模式 25 含金石英脉小型矿床 1 处，矿点 4 处；模式 30 砂金铂矿小型矿床 1 处，砂金矿点 5 处。砂金铂矿可能来源于基性超基性岩。此外，还有铁矿、铅锌矿床、矿点产出。黎府成矿区是寻找大、中型斑岩铜矿的重要地区。

九、泰国华富里金铁成矿远景区

位于泰国黎府－华富里－波索竹－罗文真金、铜、铁成矿带的西段。华富里成矿区已知模式 15 浅成低温热液金银矿床大型 1 处（切垂），模式 25 含金石英脉矿床中型 1 处。切垂大型矿床含 Ag 14g/t，银储量 5 万盎司。已知小型铁矿床 1 处，矿点 2 处。本区是寻找金矿较重要的远景区。

十、泰国清迈锡钨成矿远景区

位于清迈锡、钨成矿带的西侧。已知锡钨矿产地 5 处，主要为模式 28 中、小型矽钨锡矿床，受控于清迈－北碧－那空是贪玛叻花岗岩带北段，原生矿多产于花岗岩体边缘。以模式 28 矽锡钨矿和模式 9 矽卡岩型白钨矿为主，是寻找中、小型钨锡矿的地区。

十一、泰国南邦锑金成矿远景区

地处南邦－庄他武里锑、金成矿带的北段。南邦成矿区已知模式 14 石英－辉锑矿中型矿床 3 处、小型矿床 5 处。受控于三叠系砂页岩中的构造角砾岩带，是寻找中、小型锑矿的重要地区。已知模式 25 含金石英脉矿点 6 处，多产于三叠系及其以下变质岩系的断裂构造附近。本区为寻找中小型锑、金矿的有利地区。

十二、泰国庄地武里锑金成矿远景区

地处南邦－庄他武里锑、金成矿带的南段。已知模式 14 石英－辉锑矿小型矿床 4 处、矿点 1 处，中型残留型砂锑矿床 1 处。受控于石炭系灰岩中的构造裂隙，是寻找小型锑矿床的地区。已知模式 25 含金石英脉中型矿床 1 处，产于二叠系灰岩的构造裂隙中。本区为寻找中小型锑矿、金矿的有利地区。

第四章　矿产勘查和矿业开发

第一节　矿业开发现状

泰国目前已经开采矿产有 40 多种。主要包括：石油、天然气、褐煤、锡、钽、钨、锑、铁矿石、金、锰、银、锌、重晶石、石膏、萤石、高岭土、长石、石灰石、珍珠岩、盐、滑石、叶腊石和硅藻土等。泰国是全球最大的水泥、长石、石膏和锡生产商之一，矿产品主要包括铁，工业矿物和矿物燃料。

表 5-1-1　泰国主要矿产品的产量 (单位：吨，除特别注明外)

	单位	2004 年	2005 年	2006 年	2007 年	2008 年
锑 矿石 总量		100	735	2,980	--	--
锑含量		52	347	1,409	--	--
金属，冶炼量		2	46[1]	544	271	422
铜，金属，精炼铜，初级 e		12,100[2]	3,700	25,300	11,900	--
次级 e		19,100[2]	2100	1,750	814	438
合计		20,00	15,800	27,050	12,714	438
金	公斤	4,500	4,400	4,300	3,401[r]	2,721
铁矿石和钢铁 铁矿石：总量		135,580	230,946	264,289	1,554,860	1,709,750
铁矿石和钢铁 铁矿石：铁含量 e		68,000	116,000	132,000	779,000	855,000
粗钢	千吨	4,533	5,161	4,914[r]	5,565[r]	5,211
铅，金属，精炼，次级		57,500	61,100	61,160	73,159	73,303
锰矿，冶金级，毛重，46%至 50%二氧化锰		4,550	88,500	--	9,500	111,000
锰含量		2,180	42,400	--	4,550	52,700
银	公斤	10,700	14,100	11,800	7,727	5,465
钽，金属和氧化物粉末		317	150	230	142	158
锡，精炼，总重		724	188	225	149	235
锡含量		586	158[e]	190[e]	122	169
金属，初级		20,800	31,600	27,540	23,104	21,86
钨，浓缩钨，总重		337	622	546	923 [r]	1,112
钨含量 e		187	345	303	512 [r]	778

	单位	2004 年	2005 年	2006 年	2007 年	2008 年
锌，矿石，总重		199,477	203,810	214,023	176,042	118,739
锌含量		43,400[e]	30,572	32,100[e]	32,921	17,811
金属，初级		68,300	60,866	94,779[r]	99,337[r]	107,753
合金，锌含量		46,800	40,320	61,600[r]	64,600[r]	70,000
工业矿物						
重晶石		115,100	101,186	96,469	8,631[r]	9,180
	单位	2004 年	2005 年	2006 年	2007 年	2008 年
水泥，	千吨	35,626	37,872	39,408	35,668	35,668
球粘土		610,193	393,935	1,003,267	563,353	1,499,603
硅藻土		1,372	990	1,344	1,260	1,075
长石		1,001,053	1,149,717	1,067,684	684,608	670,618
萤石，天然的，冶金级		2,375	295	3,240	1,820	29,529
宝石	万克拉	911	699	81	102	32
石膏 千吨	万吨	7,169	7,113	8,355	8,643	8,500
珍珠岩		6,000[e]	5,500[e]	22,000	6,400	7,000
磷矿粉，天然的		2,580	3,020	900	3,550	3,675
	单位	2004 年	2005 年	2006 年	2007 年	2008 年
盐，岩盐		1,031,200	1,074,214	1,008,251	1,134,931	1,211,581
其它[e]		100,000	100,000	100,000	100,000	100,000
砂，石英，玻璃		587,655	718,320	861,847	844,071	495,848
石：方解石		436,628	693,850	625,950	672,580	823,706
白云石		992,907	795,466	899,512	1,108,425[r]	1,353,763
花岗岩石材	立方米	10,000[e]	9,500[e]	8,321	10,515	10,579
工业岩石	千吨	3,500[e]	3,000[e]	4,463	5,229[r]	5,190
石灰石：石材	千吨	--	--	201	233	233
专用于水泥生产	千吨	63,196	55,584	61,583	63,799	54,885
建筑及其它用途	千吨	70,000	75,000[e]	87,887	87,402	87,000
大理石，石材及碎块	立方米	236,643	267,797	547,582	848,806	664,930
泥灰用于生产水泥		184,750	196,500	68,700	31,750	41,720
石英		19,216	2,604	2,897	4,924	3,290
页岩用于水泥生产	千吨	3,622	3,695	5,590	4,769	4,026
石灰华		--	--	3,316	3,490	3,640
滑石粉和相关材料：叶蜡石		108,691	177,684	131,843	415,420	106,600
滑石		12,592	10,270	4,374	3,508	3,264
锆		--	--	--	1023	--
矿物燃料和相关材料:						
煤，褐煤	千吨	20,038	21,429	19,071	18,239	18,095
天然气 生产总量	百万立方米	22,360	23,689	24,317	25,400	25,400

	单位	2004 年	2005 年	2006 年	2007 年	2008 年
石油：原油	加仑桶	31,299	41,570	47,067	48,745[r]	53,151
天然气凝析油	加仑桶	24,963	25,363	27,466	28,778[r]	31,340
提炼后产品 ：液化石油气		41,520	45,241	45,475	48,759[r]	53,842
汽油		56,339	58,072	57,172	54,739[r]	53,142
	单位	2004 年	2005 年	2006 年	2007 年	2008 年
喷气燃料		29,127	30,421	35,240	33,478[r]	37,750
煤油		7,041	6,395	6,548	776[r]	1,216
馏分燃料油		42,277	38,740	39,681	40,581[r]	3,231
残余燃料油 [e]		24,000	25,000	26,000	27,109[r]	28,500
未指定的 [e,3]		3,600	3,600	3,600	3,626[r]	3,600
总计 [e,4]		204,000	207,000	214,000	209,000	219,000

注：e 表示估计值，有效数字不多余三位； r 表示修订值,--零

1 、包括 2009 年 12 月 4 日得到的数字。

2、据报道数字。

3、包括炼油厂燃料和炼油厂的收益或损失。

4、四舍五入到 3 位有效数字，可能不加入总数所示。

数据来源:，泰国矿产统计处，矿产资源处；;初级工业和矿业部；能源部，能源政策和规划办公室和美国地质调查局矿产调查问卷，2004-2008。

一、金属类

1. 锡

锡是泰国最重要的矿产之一，是泰国的支柱产业之一，占世界总储量的2.8%，列世界第八位。矿床主要分布在南部地区，包括攀牙、普吉、那空是贪玛叻和拉廊等地区。在北部和中部地区也有少量分布。在泰国锡矿的开采，主要由一些小公司完成，泰国冶炼及精炼有限公司（Thaisarco）是泰国唯一的锡冶炼厂，由英国联合金属管理公司（PLC）管理。 2008 年，为了满足亚洲客户群的需求，Thaisarco 进口 22569 吨锡。受全球 2008 年底经济衰退的影响，预计 2009 的生产和销售将下降 15%，降至 18500 吨。Thaisarco 在海外还有一个锡勘探项目，也一度受到锡价格降低的影响而减产。2010 年 3 月，泰国调低了锡的权利金，该项措施有利于提升泰国锡开采行业的复苏。

2. 钨

泰国是黑钨矿的全球产地之一，曾经是世界上主要的钨生产国之一。泰国有钨矿床 25 处，大体沿西部边境分布，从清莱府经夜丰颂府、北碧府至那空是贪玛叻府。类型以伴晶岩脉和热液脉型为主，还有与锡石共生的冲积砂矿。比较重要的矿床有那空是贪玛叻府的考松(KhaoSoon)黑钨矿矿床(1970 年发现)，帕府的

贡山(DoiNgoem)矿床，和清莱府的莫山(DoiMok)白钨矿矿床(1970 年发现，属接触交代型)。

40、50 年代钨矿在矿业中的地位仅次于锡，但到 80 年代它在金属矿业中的地位已在锡、锌、铅之后。迄今为止开采得最多的是南部那空是贪吗叻府的考松(KhaoSoon)黑钨矿矿床，其开采量在 70 年代后半期占全国的 75%，现在因最富的地段已采完而关闭。1980 年，帕府的贡山(DoiNgoem)成为钨的最大来源，产量约占全国一半左右。泰国的钨矿 2008 年产量 778 吨。

2008 年 5 月 21 日，Amanta 资源有限公司宣称已与全球勘探和咨询公司（泰国一家矿业服务公司）签订了一份协议。 Amanta 的目标是启动前 Mae Lama 在泰国北部钨矿的复苏工作，以及开发 0.5 到 1 万吨的可开采钨矿资源。前 Mae Lama 营运期间所报道的等级是 2%的三氧化钨。此方案的目的旨在验证这一等级为预期的平均矿石等级以便在此矿重新开始生产钨（Amanta 资源有限公司，2008 年）。

3. 锑

泰国也是世界上锑矿资源最丰富的国家之一，2009 年储量基础为 45 万吨，居世界第二位，2008 年产量 422 吨。

4. 铅 锌

泰国的铅锌矿床共有 11 处，分布在北部的帕府、达府，东北部的黎府，西部的北碧。主要矿床有达府的夜速(MaeSod)铅锌矿，清迈府的帕达因(PaDaeng)锌矿和北碧府的松多(SongTho)铅矿。其中夜速矿床是世界上质量最好的锌矿床之一。铅矿床以北碧府的最重要，90%以上的铅产自北碧府，最大的矿山是松多(SongTho)矿山。泰国的铅锌矿主要用于出口，不足 10%的铅矿石产量用于国内消费，主要用于生产蓄电池。

泰国国内 2008 年锌消费总量达 112005 吨，与上年相比增长了 4.7%。泰国巴丹工业公司(Padaeng Industry Public Co，PDI)经营泰国唯一的锌冶炼厂和一个锌矿，年产量 11.50 万吨左右，并在泰国和周边国家开展锌矿石勘探活动。公司总部位于曼谷。PDI 的主要控股权由巴厘创投有限公司（21.7%），财政部（13.81%），和阿联酋哈伊马角矿产金属投资（12.5%）掌握。PDI 公布 2008 年锌金属产量为 104134 吨，锌销售总量为 103719 吨，其中出口为 19350 吨。此外，PDI 还从澳大利亚和秘鲁进口了锌精矿（硫化锌）。然而，全球经济衰退使得锌的价格下降了 50%，矿石运输（尤其是南美洲和泰国之间）的高运费，以及 6

个多月的采矿中断，这一切造成该公司2008年的收入较2007相比减少了约33%。4 月 8 日，PDI 将 Mae Sot Mine 采矿租赁期重新延长了 15 年，并恢复了这一地区的锌开采活动（采矿杂志，2009 年，p17; Padaeng Industry Public Company Ltd., 2009 年）。

5. 铁矿石和钢铁

泰国几乎各府都有铁矿，已探明的储量为 4673 万吨，有的地方铁矿已经采尽，目前主要分布在北碧、差春骚、清迈、南邦、碧差汶、拉廊、甲米等府，有赤铁矿，磁铁矿和褐铁矿。90%以上的铁矿石产量来自华富里和那空素旺两府，不足以满足国内需求。2008 年，泰国的铁矿石产量增长了约 6%，由 2007 年的 1.6 万吨增至 1.7 万吨；粗钢产量下降约 7%，由 5.6 万吨降至 5.2 万吨，钢铁半成品下降约 4%，从 2007 年的 7.8 万吨降至 7.6 万吨。由于用于汽车零部件生产的热轧钢卷的积压，国内钢铁产品的进口增加。同时，世界市场中的销售萎缩使得钢铁出口锐减。2008 年，泰国消耗 0.7 万吨铁，5.3 万吨废钢铁，占东南亚地区废钢铁消耗总量的 37%（东南亚钢铁协会，2009，世界钢铁协会，2009）。

6. 锰

泰国锰矿床有近 50 处，有 19 个矿床均位于北纬 17 度以北的北部地区，其中 18 个集中分布在南奔和黎府两处，还有一个位于清迈府。锰矿的形成大多与古生代和中生代海相沉积岩有关。矿床规模一般不大，氧化锰矿石品位 5-65%，大部分矿床矿石品位较高。主要矿床有南奔的王迈周(BanMaejong)锰矿和清迈的夜塔(Maetaeng)锰矿。

7. 铜

泰国铜矿资源有限，也没有得到很好的开发。位于泰国北部地区的普西普（Puthep）铜勘探项目，是泰国尚未开发的最大铜矿项目，目前由泰国 Padaeng 产业公共有限公司（PDI）和 Pan 澳大利亚资源有限公司（PanAust）的合资企业运营。截至 2008 年 12 月 31 日，PanAust 持有了该项目 33.17%的股份，并预计通过完成可行性研究将其股份提升至 51%；在此之后，仍有望进一步升至 60%到 70%。 Padaeng 行业上市公司拥有该项目中的所有剩余股份。Puthep 铜矿项目是位于泰国东北部的黎府省城中心附近。2007 年初开始的可行性研究，预计将于 2009 年底完成，2010 年初揭晓，该矿的设想储量和推测储量是 52 万吨铜。其生产潜力是年生产 2．5 万吨阴极铜，其生产成本将是 1．12 美元/公斤。（Pan 澳大利亚资源有限公司，2009）。

泰国铜工业公共有限公司（TCI 公司）成立于 1994 年 7 月。公司拥有一个年生产量可达 165,000 吨电解铜的铜冶炼厂。该冶炼厂 1995 年 10 月始建于罗勇（Rayong）工业园，亚洲经济危机使得修建工作在 1998 年 2 月一度搁浅。2003 年 1 月复工，2004 年 7 月开始生产冶铜和精炼铜。该厂为国内市场生产纯度高达 99.99%的精铜和电解铜。TCI 的目标客户包括电线和漆包线工业部门。2005 年 9 月到 2006 年 12 月，该冶炼厂全面停工检修。TCI 于 2007 年 4 月彻底关闭；2008 年不再生产铜(Thai Copper Industries, 2007).

8. 金

目前泰国年产黄金为 2700 公斤左右，主要由阿卡拉矿业有限公司(Akara Mining Ltd.)公司生产。

澳大利亚金斯盖特联合有限公司（金斯盖特,Kingsgate）通过其全资子公司阿卡拉矿业有限公司(Akara Mining Ltd.)经营在泰国中部的切特里金矿。该金矿位于曼谷以北 280 公里，年产黄金 5,000 公斤。2008 年，金斯盖特向加工厂供应的矿石平均每吨含金量仅为 1.1 克，这是黄金产量锐减的主要原因。

加拿大 Amanta 资源公司在 2008 年保留了其在兰古庄园初始黄金钻探计划。兰古庄园位于泰国南部沙敦省，包括四个特别勘探许可证。

9. 铝

泰国铝土矿资源丰富，但是精炼铝紧缺。2008 年，泰国消耗了 40 万吨的精炼铝，进口 40 万吨铝和 20 万吨铝合金半成品，出口铝 3 万吨。泰国主要的铝及铝合金供应商有澳大利亚（占 49%），阿拉伯联合酋长国（占 13%），俄罗斯（10%），中国（8%）和南非（7%）。其铝及铝合金出口地区主要包括印尼（17%），香港（5%），以及日本（4%）（世界金属统计局，2009，9-13 页）。

二、工业矿物与矿物燃料

在工业矿物中，沙、石英和玻璃的产量下跌了 41%，大理石、石材以及碎石的产量下降了 22%，以及叶蜡石降了 74%。球粘土的产量增长了 166%，从 2007 年的 563353 吨增至 1499993 吨。方解石和白云石分别增长了 22%；原油增长 9%，由 2007 年的 48745 桶增至 53151 桶。天然气凝析油从 2007 年的 28778 桶增加到 31340 桶，增长率 9%（见表 5-1-1）。

1. 钾盐

泰国钾盐资源丰富，但还没有得到正式开采。目前进行的主要项目是沙空那空盆地的乌隆(Udon Thani)钾盐开发项目。该项目是泰国与加拿大亚太资源公司

（APR）的合资项目，双方组建亚太钾盐有限公司（APPC）共同开发乌隆钾盐矿。最初加方占 62.5%的股份，泰国中心化学公司占 27.5%，泰国政府占 10%。此后该项目股权比例有过小幅度变化，2006 年加拿大亚太资源公司对乌隆项目的权益为 75%。合资公司所持许可证的有效范围是 2333 平方公里。该项目的调研工作在上世纪 90 年代中期就已开始，加拿大亚太资源公司（APR）对乌隆东南约 Somboon 地区(面积约 46.7 平方公里)进行了较详细的勘探，钻探资料已确定了至少 7200 万多吨的钾盐储量，矿体位于地下 300 米处，矿层平均厚度 4.1 米，氯化钾的平均品位 24%。预计矿山投产后可在 20 年内每年提供 109 万吨的钾盐。该项目的可行性研究工作已经完成，相关环境评估工作也已经进行。但后来由于多种原因项目停顿下来。2006 年加拿大亚太资源公司宣布与 SRMT Holdings Ltd （Italian-Thai Development Public Co.Ltd. of Thailand 的一个子公司）达成协议，由 SRMT Holdings Ltd 接手投资继续推进这一钾盐项目。2006 年 6 月 SRMT Holdings Ltd 宣布已经完成对加拿大亚太资源公司的接管。目前该项目的其他参与者是 Wildemere Ltd（15%）和泰国政府（10%）。

2. 石膏

泰国是世界上主要的石膏生产国之一，2008年产量为800万吨，列世界第5位。主要的生产商是Vanich Gypsum Co. Ltd 和Lotus Mines Co. Ltd.，以及General Mining and Trading Co. Ltd. 这三家公司。

Vanich Gypsum Co. Ltd 在洛坤府和素叻府经营着Khlong Prap、Mai Riang和Thoong Yai Mai三矿山，年产量为800万吨左右；Lotus Mines Co. Ltd.和General Mining and Trading Co. Ltd.分别经营着Nakornsawan 矿山和Talad,Muangk矿山。

3. 煤

煤炭是泰国的重要能源之一泰国生产的煤炭主要是褐煤，每年产量在2000万吨上下，2008年产量为1809.5万吨，比上一年减少近7%。最大的煤炭生产商是国有的泰国电力总公司（EGAT），年产褐煤2000万吨左右。该公司在泰国北部南邦府经营的Mae Moh煤矿是国内最大的生产煤矿，少量煤炭产量来自南部地区甲米府的甲米矿。兰娜资源有限公司（Lanna Lignite Public Co. Ltd.）是泰国第二大煤炭生产商，经营着南奔府的 Ban Pakha煤矿，其产能约为100万吨煤/年。

第二节　矿业开发政策

在矿业政策方面，泰国在矿业领域的法制比较健全，在鼓励吸引外资方面有明确的规定。在 1967 年出台了《矿业法》，后经多次修改，不断完善有利于固体矿业投资的规章制度，改善投资环境，大力吸引外资。在 1986 年 12 月建立了国家矿产资源政策委员会，指导和协调一切有关事务，解决影响私人投资的各种问题。同时，泰国注意按国内外消费市场的需求调节矿业生产。如在 1983 年成立的锡生产协会，规定锡生产限额和出口限额，建立锡矿的国际市场调节性储备。其矿业开发政策特点如下：

一、固体矿产矿业权管理

泰国固体矿产矿业权管理的法律依据主要是四部矿业法、1967 年的矿产法和 1966 年的矿产权利金税率法，以及 1992 年的国家环境保护与促进法、1977 年的投资促进法。矿业法涉及以下活动的管理：矿产勘查、勘探、开采、加工、冶炼、贸易、权利金的支付和矿产品的进出口。

1967 年矿产法分别在 1973 年、1975 年、1991 年和 2002 年做过部分修改。泰国的矿业权和地表权两权分离，土地所有者不拥有地下矿产。一切矿产为政府所有。矿业的主管部门是工业部。任何公司或个人在进行矿勘查和开发活动之前，必须先得到政府颁发的矿权。主要矿权包括：

1）独占勘查许可证（EPL）。它给持证者在规定区内对指定矿产的勘查有独占性的权力。最大面积为 500 英亩，期限 1 年，不可以延期。由工业部部长颁发，不可转让。

2）特殊勘查许可证（SPL）。申请人在提出的勘查计划需要大量的资金和专门技术时应申请特殊勘查许可证。申请人必须详细说明在许可证有效期内，每年的勘查费用和在这项活动中国家可得到哪些特别的利益。该许可证的最大使用面积为 4000 英亩，有效期为 5 年。不可延期。由工业部部长颁发，不可以转让。上述两种勘查许可证在勘查工作进行之前需得到地表权所有者的许可

3）采矿许可证

获得勘查许可证的公司或个人，经勘查发现有经济价值的矿床之后，可以申请采矿许可证。持证人享有在规定地区内开采指定矿产的专属权。一个采矿许可证的最大面积为 120 英亩，有效期最长为 25 年。由工业部部长颁发。申请人必须说明在这项活动中可以给国家提供哪些特别的利益。

在矿产勘查与开发活动和管理中，环境部门也有相当大的权力。勘查和采矿许可证的持有者在开展工作前还必须得到有关环境部门和许可。因此从某种意义上讲，工业部并不是决定矿产勘探和开发风险活动实施的最终机构。最终结果往往取决于环境管理机构：科学技术环境部或其他土地森林管理机构。

二、油气矿业权管理

石油和天然气管理的主要法律有两个，1971 年颁布的石油法和石油所得税法。以后进行了几次大的修改。石油法与矿业权有关的主要条款包括：

1）期限：勘探期限 6 年，可延期 1 次，不超过 3 年。如果最初申请的勘探期不超过 3 年，则无权申请延长期。石油生产期限最长 20 年，包括勘探阶段内的石油生产。

2）面积：每个勘探区块不超过 4000 平方公里，每个合同者拥有的区块不能超过 4 个。勘探期开始后第四年末，合同者有义务归还部分勘探区块，通常为原有面积的 50%，水深大于 200 米的海上区块为 35%。

3）转让：对于生产区或保留区，合同者无须批准有权转让全部或部分勘探区块。

三、矿业税费

泰国与矿业开发有关的税费主要包括：公司所得税、权利金和矿地租金等。通常情况下，公司所得税率为 30%。石油生产的公司所得税为 50%。大多数矿产的权利金费率为 5%。金矿为 2.5%，石油生产的权利金采用累进税率。勘查阶段的矿地租金为 6 泰铢/泰亩，采矿阶段的矿地租金为 20 泰铢/泰亩。

（1）公司所得税

所得税（利润税）是世界上几乎所有国家都征收的最主要的税收形式，一般按应税所得（销售收入扣除经营成本、权利金、固定资产折旧及其他法定可扣除项目后的余额）的一定百分比（所得税税率）计征。

在某个特定的国家，矿业与其他行业的所得税税率相同，但对矿山企业征收所得税的应税所得的确定普遍采取优惠政策，如允许固定资产加速折旧，允许矿业研究与开发费用加倍摊销，允许在应税所得中扣除资源耗竭补贴（Depletion allowance）等。不同国家所得税的税基（即应税所得）的确定方法不同。不同国家的所得税税率各不相同。如澳大利亚为 36%（1991 年以前为 39%），智利为 17%，加纳为 45%，马来西亚为 30%，免税期为 5 年，泰国为 35%，印度尼西亚为：利润在 500 万美元以下的，税率为 15%；利润为 500—3000 万美元的，

税率为 25%；利润在 3000 万美元以上的，税率为 30%。我国为 33%。由此可以看出，泰国的所得税还是比较高的。

（2）2010 年 3 月下调锡矿开采税

泰国工业部(Ministry of Industry)宣布调整黄金和锡矿等多种金属的开采税，其中黄金开采税从 2.5%大幅上调至 20%，以目前金价计算，矿产企业的开采税缴纳额将增加一倍。不过锡矿开采税从 60%下调至与黄金开采税相差无几的水平，可能使锡矿开采投资更具吸引力。

(3) 土地使用费

勘查阶段的矿地租金为 6 泰铢/泰亩，采矿阶段的矿地租金为 20 泰铢/泰亩。

第五章　认识和建议

第一节　在泰国从事矿产勘查的有利条件与不利因素

一、有利条件

具有一定的投资吸引力。泰国的竞争优势有七个方面：社会总体较稳定，对华友好；经济增长前景良好；市场潜力较大；地理位置优越，位于东南亚地理中心；工资成本低于发达国家；政策透明度较高，贸易自由化程度较高。

世界经济论坛《2000-2010 年全球竞争力报告》显示，泰国在 139 国中排名第 38 位，比去年比下滑 2 位，因为受政治问题影响，此外卫生及教育方面也较为落后。

泰国钾盐、锡、锌等矿产资源丰富，与中国形成资源互补。

泰国政府制定了优惠政策，吸引外国企业投资。

泰国促进投资委员会（BOI）表示，将开发国内市场自由贸易竞争，出尽并提高投资的便利性。泰国自由贸易协议考虑提高东盟投资泰国矿产业的持股比例，从之前的 49%增加到 60%。

社会环境，总体上是好的。特别是泰国人民友善，特别对中国友好

首先泰国在政治上一直保持稳定，虽政府时有更迭，但根本政策始终不变。

5.在经济上近十几年来连续较高速发展，特别是东盟协自由贸易区(AFTA)成立以后，泰国成为东盟各国投资首选国之一。

二、不利条件

基础设施较差。铁路系统相对落后，铁路网里程共 5334 公里，均为窄轨。公路运输网络共 16 万公里。自身所发电力不能满足国内需求，需从老挝和缅甸等周边国家进口。

劳动力成本较高，专业人才缺乏。根据各地经济发展水平高低，泰国最低工资范围在每天 148 铢至 203 铢之间（100 泰国铢=3.25 美元），曼谷及周边地区最高。部门经理及工厂厂长月薪为 2000-3000 美元，工程师约 1500-2000 美元，勤杂工、司机约 300-500 美元。具有高中以上学历的劳动力缺乏，高级技术管理人

才供不应求。

土地占用问题复杂。因其私有，政府没有强制的约束力。要解决好这个问题必须处理好与农民的关系。据说目前有一个 NGO 组织对此具有影响力。

腐败问题比较严重。国际反腐败组织“透明国际（CPI）”在 2009 年公布的数据中指出，泰国在全球 180 个国家中排名 84 位，为腐败比较严重的国家。

中泰矿业方面的合作还处于初始阶段，许多条件还不够成熟。近两年泰国的政局不够稳定，对矿业投资有较大负面影响。将来最具合作潜力的是钾盐的勘探和开发。其他的合作项目还有待进一步的挖掘。

第二节　建　议

泰国是东南亚五国中矿产资源较为丰富的国家。泰国矿产资源开发政策近年来有所改变，由过去的以出口为主转变为以满足国内经济需求为主，确定的主要勘探和开发的矿产有水泥和陶瓷工业所需矿产、装饰石材、肥料矿物、金、宝石、固体燃料矿物和贱金属。钾盐将是未来十年的主要开发对象。重要的矿产资源勘察开发/靶区有：

(1) 普龙铜矿：位于廊开西湄公河南岸。属石英二长斑岩铜矿。已详细勘探，打了 12 个钻孔。I 号矿体铜矿石储量 500 万吨，平均含 Cu 2.43%，Au 0.64g/t;，II 号矿体铜矿石储量 5,300 万吨，平均含 Cu 1.7%,Au 0.47g/t。折合铜金属总储量 102 万吨。

(2) 普欣勒菲铜矿：位于黎府东 15km，属闪长斑岩型铜矿。1963-1966 年美国地调队勘探。探明及可期铜矿石储量 1,500 万吨，含 Cu 1%，折合 Cu 金属量 15 万吨；可能铜矿石储量 5,000 万吨。伴生自然金。

(3) 普桐达埃铜矿：位于黎府东南 10km。属斑岩型铜矿。1963-1969 年美国地调队勘探。探明及可期铜矿石储量 100 万吨，可能储量 1200 万吨，含 Cu 1%，伴生自然金。

(4) 切垂金银矿：位于碧差汶西南，属浅成低温热液金银矿。已钻探。 Akara Mining Limited 公司 2001 年开始露天开采。矿石储量 1450 万吨，含 Au 2.6g/t、Ag 14g/t，折合金储量 37.32 吨，银储量 167.96 吨。

(5) 帕达恩锌矿：位于达府湄索县南东东 12km。属三叠系碳酸盐岩铅锌交

代矿床。1966-1967 年勘探，1974 年始采。探明矿石储量 450 万吨，含 Zn 24%，伴生 Pb、Cd。为泰国最大锌矿山。

(6) 松多铅锌矿：位于北碧西北 110km。属中奥陶统碳酸盐岩层控铅锌矿床。北碧勘探和采矿有限公司（KEMCO）近年勘探。估计矿石储量 180 万吨，含铅 10%，折合 Pb 金属储量 18 万吨，伴生 Ag。为泰国最大铅矿山。

(7) 比劳克锡钨矿群（见图 6-23A、B 和 C）：位于北碧西北泰、缅边界东侧。现有 36 个矿山开采，主要为锡石-黑钨矿-石英脉型，少数为碳酸盐交代矽卡岩型。矿床规模可达大型。

(8) 攀牙湾锡矿：位于普吉东北 30km。属滨外砂锡矿床。已经钻探。含锡石层厚 1-9m，锡石品位 0.4kg/m^3，个别达 200 kg/m^3，边界品位 0.15-0.25 kg/m^3。大型掘泥船开采。

(9)~ (10) 沙功那空盆地及呵叻盆地钾（岩）盐：属晚白垩世沉积的岩盐-钾盐-光卤石建造。自 1973 年以来已钻探 60000 余米。两盆地总资源量：光卤石 2400 亿吨，钾盐 70 亿吨，岩盐 18 万亿吨。已发现猜也蓬的班勒拉荣和恰土软、乌隆他尼的木安、坤敬的木安、呵叻的龙森、马哈沙拉堪的那劝等 6 处高钾地区，可作为开发的重点靶区。

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Minerals Act B.E. 2510

and the related

Ministerial Regulations

Department of Primary Industries and Mines

Ministry of Industry

Forward

This publication of the Minerals Act B.E.2510 and the selected Ministerial Regulations has been produced by the Department of Primary Industries and Mines in an effort to inform and facilitate foreign investors of the indispensable legal issues concerning mineral business, with a particular emphasis to promote the mining investment to go about its operation in a sound and perceptive manner. As the operations of mining and mineral businesses in Thailand require perception and understanding of Thai legal issues regarding minerals, the department has foreseen the importance of documentation, translation, and publication of these related laws and regulations.

The texts in this book document the Minerals Act B.E. 2510, with the amended, and the essential Ministerial Regulations that prescribe basis for mineral exploration, mining operation, mineral processing, as well as purchase, sale, possession, transport, import and export of minerals. During translation, the greatest care has been taken, however, if there is other legal ramification, or if any conflict or inconsistency between the terms and conditions should arise, it must be referred to the original publications of the legislation in Thai.

The main function of the Department of Primary Industries and Mines is granting mineral exploration contracts, mining leases, and related licences for mineral transactions, and also regulating and promoting mining investments. The department hopes that this publication provides detailed and complete comprehension of the mining and minerals industries as well as makes it beneficial and convenient to the prospective mining and mineral investors.

Department of Primary Industries and Mines
Ministry of Industry
August 2004

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Part I

Minerals Act B.E. 2510

and the amended by

Minerals Act (No. 2), B.E. 2516
Minerals Act (No. 3), B.E. 2522
Minerals Act (No. 4), B.E. 2534
Minerals Act (No. 5), B.E. 2545

Minerals Act B.E. 2510

BHUMIBOL ADULYADEJ. REX.
Given on the 26th day of December, B.E. 2510
Being the 22nd year of the Present Reign

His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that: whereas it is deemed expedient to revise the law on minerals, be it, therefore, enacted by the King, by and with the advice and consent of the Constituent Assembly in its capacity as the parliament as follows:

Section 1. This Act shall be called the "Minerals Act B.E. 2510".

Section 2. This Act shall come into force as from the day following the date of its publication in the Government Gazette.[1]

Section 3. The following are hereby repealed:
(1) Mining Act B.E. 2461
(2) Royal Proclamation extending the enforcement of the Mining Act B.E. 2461 to include precious stones dated 13th September, B.E. 2464
(3) Mining (Amendment) Act, B.E. 2474
(4) Mining Act (No. 3), B.E. 2479
(5) Mining Act (No. 4), B.E. 2479
(6) Mining Act (No. 5), B.E. 2483
(7) Mining Act (No. 6), B.E. 2483
(8) Mining Act (No. 7), B.E. 2484
(9) Mining Act (No. 8), B.E. 2485
(10) Act on Procedure for Collecting Mineral Royalties, B.E. 2486
(11) Mining Act (No. 9), B.E. 2506
(12) Mining Act (No. 10), B.E. 2509

All other laws, rules and regulations in so far as they are stipulated herein or are contrary to or inconsistent with the provisions hereof shall be superseded by this Act.

[1] *Government Gazettes (special issue) Vol. 84, Part 129, Page 1, Dated 31st. December B.E. 2510.*

CHAPTER 1
General Provisions

Section 4. In this Act:

"Minerals" mean resources which are inorganic matters, having permanent or slightly varied chemical components and physical properties, whether or not they require smelting or refining before being put to use, and include coal, oil shale, marble, metals and slags obtained from metallurgical processes, underground brine, rock which is prescribed by a Ministerial Regulation as dimensional stone or industrial rock, and clay or sand which is prescribed by a Ministerial Regulation as industrial clay or industrial sand, but does not include water, salt efflorescence, lateritic soil, rock, clay or sand;

(As amended by Section 3. of the Minerals Act No.4. B.E. 2534)

"Underground Brine" means salt solution that occurs naturally underground and contains salt concentration with the content higher than the amount prescribed in a Ministerial Regulation;

(As amended by Section 4. of the Minerals Act No.4. B.E. 2534)

"Prospecting" means drilling or pitting or any distinct method or combined methods to appraise the quantity, if any, of minerals within an area;

"Mining" means the operation undertaken on land or underwater to obtain minerals from an area by any other method or combined methods, but does not include underground brine drilling in accordance with Chapter 5 bis, and artisanal mining or ore panning for minerals as prescribed by a Ministerial Regulation;

(As amended by Section 4. of the Minerals Act No.4. B.E. 2534)

"Underground Mining" means the mining operation undertaken by shaft sinking or tunnelling to the depth below ground surface to obtain minerals from underground;

(As amended by Section 3. of the Minerals Act No.5. B.E. 2545)

"Drilling for Underground Brine" means the operation undertaken on land or underwater to obtain underground brine from an area, but does not include mining of rock salt by means of solution method;

(As amended by Section 4. of the Minerals Act No.4. B.E. 2534)

"Artisanal Mining" means the operation undertaken on land or underwater to obtain minerals from an area by using individual labourer, in accordance with the kind of minerals within the area and by means of digging methods prescribed by a Ministerial Regulation;

(As amended by Section 4. of the Minerals Act No.4. B.E. 2534)

"Ore Panning" means the operation undertaken on land or underwater to obtain minerals from an area by using individual labourer, in accordance with the kind of mineral, within the area, and by means of panning methods prescribed by a Ministerial Regulation;

"Mineral Processing" means any operation to upgrade a mineral or to separate from each other two or more minerals in mixed ore, which includes crushing, comminuting, and sizing of minerals;

"Purchase Minerals" means to accept the transfer of minerals by any means from another person except by way of legal succession;

"Sell Minerals" means to transfer minerals by any means to another person;

"Possession of Minerals" means any purchase, ownership, hold, or receipt of minerals by any means, whether or not for himself or others;

(Added by Section 3. of the Emergency Decree amending the Minerals Act, B.E. 2528)

"Mining Boat" means a boat or raft equipped with equipment, tools, or appliances for mining or mineral processing, to be used in that boat or raft;

(Added by Section 3. of the Emergency Decree amending the Minerals Act, B.E. 2528)

"Mineral Restricted Area" means the area where the Minister announced that it is a Mineral Restricted Area;

(Added by Section 3. of the Emergency Decree amending the Minerals Act, B.E. 2528)

"Director" means the director of a Mineral Restricted Area;

(Added by Section 3. of the Emergency Decree amending the Minerals Act, B.E. 2528)

"Metallurgy" means smelting or extracting metals from minerals by any method and includes purification of metals, alloying of metals, and manufacturing of finished or semi-finished metallic products of various kinds by melting, casting, rolling or any other processes;

"Mining Area" means the area specified in a Provisional Prathanabat or Prathanabat;

"Mineral Processing Area" means the area specified in a Mineral Processing Licence;

"Metallurgy Area" means the area specified in a Metallurgical Processing Licence;

"Mineral Store" means the place specified in a Mineral Storage Licence;

"Mineral Depository" means the place prescribed by the Minister to be a Mineral Depository in accordance with Section 103 ter;

(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2526)

"Mineral Transit Store" means the place specified in a Mineral Transport Licence where minerals may be stored in transit;

"Prospecting Atchayabat" means a permit issued for prospecting within the locality specified therein;

"Exclusive Prospecting Atchayabat" means a permit issued for exclusive prospecting and exploration within the area specified therein;

"Special Atchayabat" means a permit issued in a special case for exclusive prospecting and exploration within the area specified therein;

"Provisional Prathanabat" means a licence issued for mining before receiving Prathanabat within the area specified therein;

"Prathanabat" means a licence issued for mining within the area specified therein;

"Vacant Land" means a land that is not thus far owned or possessed by any person under the Land Code, is not public domain for the common use of the people or land in the legally protected or reserved area;

"Tailings" includes overburden, sand, gravel or rocks derived from mining operations;

"Slag" means any compound or by-product derived from metallurgical processing;

"Local Mineral Industry Official" means an Amphoe Mineral Industry Official or Provincial Mineral Industry Official, as the case may be, and in the absence of Provincial Mineral Industry official in any province, means the Director-General or the person entrusted by him**;**

"Competent Official" means a Local Mineral Industry Official and an official appointed by the Minister for the execution of this Act;

"Director-General" means the Director-General of the Department of Primary Industries and Mines;

"Minister" means the Minister taking charge and control of the execution of this Act.

Section 5.[2] The establishment of Provincial Mineral Resources Offices or Amphoe Mineral Resources Offices to exercise jurisdiction over any area shall be prescribed in a Ministerial Regulation.

In defining the authority of a Provincial Mineral Resources Office over an area, any Tambon or Amphoe may be included in such an area regardless whether the said Tambon or Amphoe is in the same Province or not.

Each Provincial Mineral Resources Office in any area shall be under control of a Provincial Mineral Resources Official.

In the event that a Provincial Mineral Resources Office has the authority over an area including another Province, the Mineral Resources Official in charge of the said office shall also be regarded as an official attached to that Provincial Administrative Board.

In defining the authority of an Amphoe Mineral Resources Office over an area, the territories of one or more Amphoes or of any Tambon in another Amphoe may be included under authority of the Amphoe Mineral Resources Office aforementioned.

The Amphoe Mineral Resources Office in any area shall be under control of one Amphoe Mineral Resources Official. Such an official shall be under the authority of the relevant Provincial Mineral Resources Official or may be directly responsible to the Director-General.

***Section 6.** Applications under this Act shall be in the printed forms provided by the Department of Primary Industries and Mines.

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[2] *Now the Mineral Resources Office becomes a part of the Industry Office, and the Mineral Resources Official is changed to the Mineral Industry Official.*

The qualifications of applicants, rules, procedures and conditions in the applications for an Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, Prathanabat, and licences including the applications for renewal of a Special Atchayabat, Prathanabat, Mineral Processing Licence and Metallurgical Processing Licence under this Act, shall be as prescribed in a Ministerial Regulation.

An applicant must pay application fees and deposit fees in advance along with the application and must also pay for expenses or deposit in advance for processing and issuance or renewal of an Atchayabat, Provisional Prathanabat, Prathanabat or licences, as the case may be, to the Local Mineral Industry Official. If the application is rejected or the Atchayabat, Provisional Prathanabat, Prathanabat or licence is not received for any reason, the expenses not yet incurred for processing shall be reimbursed to the applicant; if the processing has been made in part, then only the expenses not incurred shall be reimbursed.

As for the fees deposited in advance by the applicant, if the application has been rejected or withdrawn, the applicant must pay the fees which are not yet due at the rate of one quarter of the deposit unless the application is rejected without the fault of the applicant or the applicant dies.

**(As amended by Section 4. of the Minerals Act No.2. B.E. 2516)*

***Section 6 bis.** For the purpose of prospecting, testing, studying or researching in connection with minerals, the Minister of Natural Resources and Environment shall, with the approval of the cabinet, have the power to issue a notification in the Government Gazette specifying any area to be the area for prospecting, testing, studying or researching in connection with minerals.

Within the area specified under paragraph one, a person may not apply for an Atchayabat or a Prathanabat unless there is no further requirement to use such an area and the Minister of Natural Resources and Environment repeals the aforesaid notification in the Government Gazette.

**(As amended by Section 3. of the Minerals Act No.3. B.E. 2522)*

Section 6 ter. This Act shall not apply to the Department of Mineral Fuels, Department of Mineral Resources, and Department of Primary Industries and Mines in its works for the purpose of prospecting, testing and studying or researching in connection with minerals.

Section 6 quarter. For the benefit of the national economy, the Minister of Natural Resources and Environment, with the approval of the cabinet, shall have the power to establish, by notification in the Government Gazette, any area which is neither a water-head nor a swampy forest by which is known to have a mineral deposit of high economic value, to be a mineral area for the purpose of issuing of Provisional Prathanabat or Prathanabat at the first priority to any reservation, restriction or utilization for other purposes, provided due consideration is given to its effect on the environmental quality.

(As amended by Section 4. of the Minerals Act No.3. B.E. 2522)

Section 7. If an Atchayabat, Provisional Prathanabat, Prathanabat or licence is lost or destroyed, the holder of the Atchayabat, Provisional Prathanabat, Prathanabat or licence shall submit an application for a substitute to the Local Mineral Industry Official within fifteen days from the date of realizing the loss or destruction.

(As amended by Section 6. of the Minerals Act No.2. B.E. 2516)

***Section 8.** If the holder of an Atchayabat, a Provisional Prathanabat, Prathanabat or licence wishes to appoint a person to communicate with the competent official on his behalf, he must execute a power of attorney and have it registered with the competent official.

The execution of attorney and the registration thereof shall be in accordance with the forms and procedures prescribed by the Director-General.

**(As amended by Section 6. of the Minerals Act No.2. B.E. 2516)*

***Section 9.** The competent official may send communications or instructions for the execution in accordance with this Act to a person directly or to:

(1) the appointed person under Section 8;

(2) a *sui juris* person who lives at the domicile, residence or office of the person;

(3) that person by registered mail to the address where he has domicile, residence or office, which has been officially recorded with the governmental office.

After the communications or instructions have been sent according to (1) or (2) or by means of (3), the person is deemed to have received the communications or instructions.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2526)*

***Section 9. bis** If it appears later that an Atchayabat, Provisional Prathanabat, Prathanabat, or licence is issued to any person as a result of a mistake or misunderstanding of material facts, the Local Mineral Industry Official, Director-General or Minister who issues the Atchayabat, Provisional Prathanabat, Prathanabat or licence, as the case may be, shall have the power to recall the said Atchayabat, Provisional Prathanabat, Prathanabat or licence for correction or revoke the Atchayabat, Provisional Prathanabat, Prathanabat or licence.

In case the Atchayabat, Provisional Prathanabat, Prathanabat or licence has been corrected or revoked under paragraph one, the holder of the Atchayabat, Provisional Prathanabat, Prathanabat or licence may not claim any damage arising from the correction or revocation of the Atchayabat, Provisional Prathanabat, Prathanabat or licence.

**(As amended by Section 7. of the Minerals Act No.2. B.E. 2516)*

***Section 9 ter.** In the event that the use of land in any area under an Atchayabat, Provisional Prathanabat or Prathanabat shall be used for the benefit of public utilities, national defence or any other purpose for the general benefit of the State, the Minister, with the approval of the Council of Ministers, shall be empowered to recall the aforesaid Atchayabat, Provisional Prathanabat or Prathanabat for the alteration in its area.

In case an alteration in the area under an Atchayabat, Provisional Prathanabat or Prathanabat has been made under paragraph one, the holder of the said Atchayabat, Provisional Prathanabat or Prathanabat may not claim any damage arising from such an alteration.

**(As amended by Section 5. of the Minerals Act No.3. B.E. 2522)*

***Section 9 quarter.** In the event that necessity should arise for the control of mining, mineral processing, purchase of minerals, sale of minerals, or possession of minerals for the purposes of the prevention and suppression of illegal mining or illegal export of minerals out of the Kingdom, or for the benefit of economic stability, the Minister, with the approval of the cabinet, shall have the power to publish in the Government Gazette a demarcation of a certain area as well as a part of Thai waters as a Mineral Restricted Area for the purpose of restriction on one or more types of minerals.

When the necessity to demarcate the Mineral Restricted Area in accordance with the first paragraph has ceased, the Minister shall publish its revocation in the Government Gazette.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 9 quinque.** In each Mineral Restricted Area, there shall be a committee called the Mineral Restricted Area Committee comprising of the Director as the chairman of the committee; the provincial governor having the authority over the Mineral Restricted Area, a representative from the National Police Bureau, a representative from the Customs Department, a representative from the Office of the Attorney General, a representative from the Army, and a representative from the Navy as committee members; a representative from the Department of Primary Industries and Mines as a committee member and secretary; and the Local Mineral Industry Official from the area where the office of the Mineral Restricted Area is located as a committee member and assistant secretary.

In case the Mineral Restricted Area spans into more than one province, each governmental office in the first paragraph shall appoint no more than two representatives and the committee shall appoint one of the representatives from the Department of Primary Industries and Mines, who is an appointed committee member, as a secretary.

For the appointment of the representatives in accordance with the first and second paragraph, the duties and responsibilities of the appointees in the area demarcated as the Mineral Restricted Area shall be primarily taken into account.

Quorum and the meeting regulations of the Mineral Restricted Area Committee shall be determined by the Mineral Restricted Area Committee with the approval of the Minister.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 9 sext.** The Mineral Restricted Area Committee shall have the power to approve the operation in compliance with the powers and duties of the Director under Section 9 octo., including rendering consultations and recommendations to the Director for the other duties in the Mineral Restricted Area.

The Mineral Restricted Area Committee may appoint a subcommittee to give opinions or perform an operation entrusted by the Mineral Restricted Area Committee.

Quorum and the meeting regulations of the subcommittee shall be determined by the subcommittee with the approval of the Mineral Restricted Area Committee.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 9 septem.** In each Mineral Restricted Area, the Minister shall establish an Office of Mineral Restricted Area and publish it in the Government Gazette. Additionally, the Minister, with the approval of the cabinet, shall appoint a Director vested with the powers and duties in accordance with Section 9 octo and Section 9 novem to control and take responsibility of the operation of the office of Mineral Restricted Area. In this case, one or more vice directors or assistant directors may be appointed by the Minister in consultation with the Mineral Restricted Area Committee to assist in giving order and performing the operation entrusted by the Director.

In the absence of the Director or his inability to perform his duties, the most senior vice director shall act in place of, and assume the same powers and duties as, the Director.

The Director, vice director, and assistant director under the first paragraph shall be appointed from the officials of the relevant governmental offices and the appointments shall be published in the Government Gazette.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 9 octo.** In a Mineral Restricted Area, the Director, with the approval of the Mineral Restricted Area Committee, shall have the power to prescribe the following measures:

(1) Mining/Suction Boats

(a) to demarcate an area where the making or building of mining boats, or assembling or fabricating any part of mining boats, are prohibited;

(b) to demarcate an area where mining boats are not to be brought into, unless a permission is given by the Director or the competent official entrusted by the Director;

(c) to demarcate an area where adjustment, modification, or repair of mining boats is prohibited, unless it is in compliance with (f) and the adjustment, modification, or repair is considered negligible according to the kinds and methods prescribed by the Director;

(d) to prescribe features, types, and sizes of the tools, appliances, machinery, or equipment for use in mining or mineral processing permitted to be used or installed in the mining boats;

(e) to prescribe characteristics and qualities including the maximum amount of minerals in storage or possession in a mining boat. They may be prescribed differently depending upon the size and quality of the boats and other conditions as deemed appropriate;

(f) to prescribe that the types, sizes, and capability of mining boats shall be registered with the competent official, as well as the prescription that the owner or possessor of the boats shall put marks indicating the types of boats,

which shall be visible from the outside, in accordance with the procedures and rules prescribed by the Director;

(g) to designate navigating routes, boating docks, and piers for the mining boats.

(2) Mining Area and Mineral Processing Area

(a) to prescribe types and conditions of the tools, appliances, machinery, or equipment for mining or mineral processing, which will be used in the mining area or the mineral processing area;

(b) to prescribe conditions and characteristics including a maximum amount of minerals allowed to be stored or possessed in the mining area or mineral processing area;

(c) to prescribe the locations or conditions of the buildings or places for mineral storage, mineral processing, or possession of minerals.

(3) Other measures

(a) to prescribe the conditions and methods in the transportation or removal of minerals, whether or not by land or by water; and designate the routes of the carriers for transportation or removal of minerals, parking places and stations, including the time and period of time allowed for the transportation or removal of minerals;

(b) to prescribe the conditions and quantities of minerals including the maximum amount of minerals, which the holder of an Atchayabat, Prathanabat, licence, or permit may store or possess including the conditions on which, or period of time for which, the aforesaid person may store or possess the minerals;

(c) to prescribe that the holder of an Atchayabat, Prathanabat, licence, or permit shall keep an account and provide a report relating to the amount of minerals stored or possessed in accordance with the rules, procedures, and period of time as specified by the Director;

(d) to designate the location or conditions of the buildings or places used for mineral storage, mineral transit, or possession of minerals, belonging to the holder of a Mineral Storage Licence, Mineral Purchase Licence, or Mineral Possession Licence;

(e) to prescribe that the owner or person, who is in possession of the carriers used for the transportation or removal of minerals, shall put the marks as specified by the Director on the carriers to show that the carriers are being used for transportation or removal of minerals in accordance with the rules and procedures stipulated by the Director.

The execution of the power under this section may be prescribed with any condition as deemed appropriate.

In case there is an execution of power under this section, the conditions of any licence permitted by the competent official in accordance with this Act or other laws shall still be in effect only if they are not contrary to the provisions under this section, or unless the Director, with the approval of the Mineral Restricted Area Committee, prescribes otherwise.

The announcements of the provisions under this section shall be made and posted at the Provincial Office, Amphoe Office, and Local Industry Office in every Mineral Restricted Area at least 3 days before the date they are in force, and if the Mineral Restricted Area Committee deems them appropriate, they shall be published in a local newspaper, which is sold in the area, for an appropriate period of time, unless it is an emergency, therefore the Director, with the approval of the Mineral Restricted Area Committee, may specify that they are in effect immediately at the time of announcement.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 9 novem.** In a Mineral Restricted Area, the Director and competent official entrusted by the Director shall have the powers as follows:

(1) to enter any place in a mining boat or vehicle within the Mineral Restricted Area, or one that will enter into a Mineral Restricted Area, in order to search at any time when it is suspected, under valid circumstances, that an offence under this Act is committed or will be committed;

(2) to order the owner or controller of a mining boat or vehicle, who is suspected of committing an offence under this Act, under valid circumstances, to stop or bring the mining boat or vehicle to a certain place for a search or bring it out of the Mineral Restricted Area;

(3) to issue a communication requesting any person to testify, or to order in writing that the businessman, who is suspected of being involved in an illegal mineral business, submits his accounts, documents, or other evidence for the benefit of an execution in accordance with this Act;

(4) to order in writing that the owner or controller of a mining boat or a violator of the provisions under Section 9 octo complies with the law or provisions, within the period of time prescribed by the Director or the competent official entrusted by the Director.

If the owner or controller of the mining boat or violator under Section 9 octo does not comply with the order under (2) (3) or (4) without a proper reason, or the aforesaid person commits the offence again within the period of time, which is prescribed by the Director with the approval of the Mineral Restricted Area Committee, the Director or competent official, shall immediately seize or impound the mining boat, any part of the mining boat, tools, appliances, machinery, equipment, or minerals that are illegally used, stored, or possessed; or seize or impound the buildings, places, or vehicles facilitating or causing such an offence, unless the Director, with the approval of the Mineral Restricted Area Committee, considers that there is a reason to order otherwise.

**(Added by Section 4. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

Section 10. In case an offence under this Act is committed by an agent or employee acting as agent or employee or acting for the benefit of the holder of an Atchayabat, Provisional Prathanabat, Prathanabat or licence, regardless of such agent or employee being constituted as an agent by a power of attorney registered with the competent official, it shall be considered that the holder of the Atchayabat, Provisional Prathanabat, Prathanabat, or licence is the principal in the commission of such offence.

(As amended by Section 8. of the Minerals Act No.2. B.E. 2516)

Section 11. While prospecting or mining, if there is a discovery of ancient objects, fossils, or minerals of special value to the study of geology, apart from complying with the laws pertaining to discovery of such materials, the holder of an Atchayabat, Provisional Prathanabat, or Prathanabat must immediately report such discovery to the Local Mineral Industry Official.

(As amended by Section 8. of the Minerals Act No.2. B.E. 2516)

Section 12. In an Exclusive Prospecting Atchayabat area, Special Atchayabat area, mining area, area licenced for retaining slime or tailings or area already demarcated by the competent official for the aforesaid purpose, no person other than the holder of the Atchayabat, Provisional Prathanabat, Prathanabat or licence shall enter to take over, occupy, destroy or deteriorate the land or resources therein unless such person has the rights to do so lawfully.

(As amended by Section 6. of the Minerals Act No.3. B.E. 2522)

Section 13. Violation of Section 12, apart from being an offence under this Act or under other laws, shall also be deemed a violation of the rights of the holder of an Atchayabat, Provisional Prathanabat, Prathanabat, or licence, as the case may be.

(As amended by Section 8. of the Minerals Act No.2. B.E. 2516)

Section 14. After the competent official has located boundary demarcation posts of a mining area or established map posts under this Act at any place, no one shall destroy, alter, move, take out or loosen such posts or benchmarks except with the permission of the Local Mineral Industry Official.

Section 15. The competent official under this Act shall be the person designated under the Criminal Code and, in functioning under this Act in connection with the criminal offences, be regarded as an administrative official or policeman under the Criminal Procedure Code.

***Section 15 bis** The competent official is empowered to seize or impound minerals used in an offence and any tool, appliance, beast of burden, carrier, vehicle, or machinery, which a person acquired or used in an offence, or suspected under valid circumstances of being used in an offence, or used as an accessory to derive results from the commission of an offence under this Act, as evidence for legal proceedings until the final non-prosecution decision is reached or until the case is extinguished, regardless of whether they belong to the offender or to a person suspected under valid circumstances of being an offender. In case a suit is filed, the provisions under Section 154, paragraph two and three, shall apply.

In the event that a final decision is reached, should the owner or possessor make no claim for the recovery of their properties within six months from the date he knows or is deemed to know of the final order against prosecution, the property seized or impounded under paragraph one shall come under the ownership of the state, unless the Director-General uses his power to announce a search for the owner or possessor in accordance with Section 15 quinque.

**(Added by Section 5. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 15 ter.** In the event that the property seized under Section 15 bis does not belong to the offender or a person suspected under valid circumstances of being an offender, the competent official is required, with the approval of the Minister, to return them or the financial proceeds, as the case may be, to their owner before the period defined under Section 15 bis, paragraph one, in the following cases:

(1) The said property is not required as evidence in the trial of the case bringing about its seizure, or

(2) The offender or the person suspected under valid circumstances of being an offender has acquired the said property from its original owner through the commission of a criminal offence.

**(As amended by Section 8. of the Minerals Act No.3. B.E. 2522)*

***Section 15 quarter.** In the event that the seized or impounded property in accordance with Section 15 bis or Section 15 quinque should present a risk of damage or incur a higher cost of custody than its intrinsic value, the Minister may proceed as follows:

(1) sell or dispose of the property or exhibit before the end of the period of time under Section 15 bis, paragraph two, or Section 15 quinque, paragraph two, as the case may be;

(2) in the event that the property or exhibit may be beneficial to the mitigation of the damage or expense of the cost of custody, the property or exhibit shall be used for the benefit of the State in accordance with the rules prescribed by the Director-General.

Before the order under the first paragraph is made, the Director-General, or the person entrusted by him, shall publish it in a local newspaper at least two consecutive days in order that the owner or possessor is acknowledged. The owner or possessor is entitled to petition for a recovery of the property or exhibit to take in his own custody within the period of time specified by the competent official, which shall be no less than 15 days from the first date of publication in the newspaper. After the owner or possessor makes a contract with the Department of Primary Industries and Mines that he will take the property or exhibit into his custody in compliance with the rules and procedures, and provides insurance or guarantee for the State in accordance with the conditions prescribed in a Ministerial Regulation, the Director-General shall transfer the property or exhibit to the owner or possessor to take into his custody. However, the owner or possessor is prohibited to use or seek to benefit from the property or exhibit by any means.

In the event that there appears no owner or possessor applying for the recovery of the property or exhibit to take into his custody, or there is the aforesaid person, but he does not comply with the contract in accordance with the conditions prescribed in a Ministerial Regulation, or in case there is such a contract, but the owner or possessor breaches the contract or does not comply with the conditions stipulated in the contract, the Director-General shall reclaim the property or exhibit from the owner or possessor and have the power to order an enforcement of the insurance contract and proceeds in accordance with paragraph one.

The rules and procedures under paragraph one (1) and (2) shall be prescribed in a Ministerial Regulation, and, in this case, the owner or possessor shall be prohibited from filing for any compensation or remuneration from the State resulting from the execution or seizure or impoundment of the property or exhibit.

**(Added by Section 6. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 15 quinque.** In the event of a seizure of an exhibit suspected in the commission of an offence without the appearance of the owner or possessor thereof, the competent official, who seizes the exhibit, shall deliver the exhibit to the Local Mineral Industry Official or official as specified by the Director-General for custody, and the Director-General or the person entrusted by him is empowered to issue a notification in search of the owner or the possessor thereof so as to enable the aforesaid person to produce evidence for the recovery of the exhibit.

The notification under the first paragraph shall be posted at the Office of Local Mineral Industry where the seizure of the exhibit occurred and published in a local daily newspaper for at least two consecutive days. The owner or possessor thereof is entitled to petition, in person with the Local Mineral Industry Official or official as the Director-General specified in the notification, for the recovery of the exhibit within thirty days from the first date of publication in the newspaper.

In the event that there is no person claiming, in person, to be the owner or possessor thereof so as to apply for the recovery of the exhibit within the period as specified in the second paragraph, the exhibit shall become the property of the State; nevertheless, if there is any person claiming to be the owner or possessor thereof and applying for the recovery of the exhibit within the specified period, the Director-General or person entrusted by him shall proceed according to the law.

In the event that the person claiming in person to be the owner or possessor thereof under the first paragraph is the person whom the prosecutor has reached the final non-prosecution decision on, or the person as evidence during an investigation that he is not an accomplice in the offence or the owner or possessor thereof, the Director-General shall notify in writing the aforesaid person to exercise his rights to file a lawsuit to the court for the recovery of the exhibit within thirty days from the date of receipt of such a written notification from the Director-General. If the rights to file a lawsuit are not exercised within the specified period, it shall be deemed that the aforesaid person is not the owner or possessor of such property.

**(Added by Section 6. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

Section 16. Each competent official shall have an identity card in the form prescribed in a Ministerial Regulation; and in the execution of this Act, the identity card must be produced when requested by those concerned.

***Section 17.** The Minister of Industry shall take charge and control of the execution of this Act and have the power to appoint competent officials and issue Ministerial Regulations:

(1) prescribing fees not exceeding the rates in the schedule annexed hereto;

(2) prescribing forms of Atchayabat, Provisional Prathanabat, Prathanabat and licences;

(3) prescribing rules and procedures concerning prospecting under Atchayabat, mineral conservation and mining;

(3 bis) prescribing rules and procedures concerning the issuance of a licence to sublease the mining rights and cancellation thereof; *(As amended by Section 9. of the Minerals Act No.3. B.E. 2522)*

(3 ter) prescribing rules, procedures, and conditions in obtaining underground brine by drilling, including production of salt from underground brine; *(As amended by Section 5. of the Minerals Act No.4. B.E. 2534)*

(4) prescribing rules and procedures concerning purchase, sale, storage, possession and transport of minerals;
(5) prescribing rules and procedures concerning mineral processing, metallurgy, import and export of minerals;
(6) prescribing protective measures for workers and safety measures for third persons;
(7) prescribing other matters for the execution of this act.

Such Ministerial Regulations shall come into force after their publication in the Government Gazette.

**(As amended by Section 9. of the Minerals Act No.2. B.E. 2516)*

CHAPTER 2
Committee

Section 18. There shall be a committee consisting of the Permanent Secretary to the Ministry of Industry as the chairman; Director-General of the Royal Irrigation Department, Director-General of the Department of Mineral Resources, Director-General of the Land Department, Director-General of the Royal Forest Department, Director-General of the Department of Primary Industries and Mines, or representatives appointed by the aforesaid Director-Generals, and other persons not exceeding three in number whom the Minister may appoint as members; and the Director of the Bureau of Mines and Concession of the Department of Primary Industries and Mines shall be a member as well as the secretary to the Committee.

(As amended by Section 10. of the Minerals Act No.2. B.E. 2516)

***Section 19.** The committee shall have a duty to render consultation, advice and opinion to the Minister in the matters concerning:

(1) Issuance of an Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat and Prathanabat in the national reserved forest or officially declared restricted areas.
(2) Renewal of a Special Atchayabat and Prathanabat
(3) Approval on a transfer of Prathanabat.
(4) Revocation of an Atchayabat and Prathanabat.
(4/1) Imposition of conditions on the Prathanabat for individual underground mining under Section 88/7. *(As amended by Section 4. of the Minerals Act No.5. B.E. 2545)*
(5) Other matters entrusted by the Minister.
(6) Other matters specified under this Act *(As amended by Section 5. of the Minerals Act No.5. B.E. 2545)*

**(As amended by Section 10. of the Minerals Act No.3. B.E. 2522)*

Section 20. Committee members duly appointed by the Minister shall hold office for a term of two years. A committee member who has served his term of office may be re-appointed.

***Section 21.** A committee member appointed by the Minister shall vacate his office before the end of his term upon:

(1) death,
(2) resignation,
(3) being dismissed by the Minister,
(4) being adjudged incompetent or quasi-incompetent,
(5) being sentenced by final judgement to imprisonment except for a petty offence or offence committed by negligence.

Whenever a committee member vacates his office before the expiry of his term of office, the Minister may appoint any other person to fill the vacancy.

The member appointed under paragraph two hereof shall hold office for the remaining term of the committee member he replaces.

**(As amended by Section 11. of the Minerals Act No.2. B.E. 2516)*

Section 22. At any meeting of the Committee, attendance of not less than one half of the total membership shall be required to constitute a quorum.

In the event that the Chairman of the Committee is absent from the meeting, the members shall select one among themselves to be the Chairman of the meeting.

Section 23. Any decision of the meeting shall be reached by a majority of votes.

Each member shall cast one vote. In the event of a tie in voting, the Chairman shall cast one extra vote to reach a decision.

Section 24. In the execution of its duties, the Committee is empowered to appoint a subcommittee for any purpose as designated, or invite any person for his presence to furnish information, explanations, recommendation or opinions

The provisions of Sections 22 and 23 shall apply to a meeting of the subcommittee *mutatis mutandis*

CHAPTER 3
Prospecting and Exclusive Prospecting

Section 25. No person shall undertake prospecting in any area, regardless of any person's rights over the area to be prospected, unless he has been vested a Prospecting Atchayabat, an Exclusive Prospecting Atchayabat, or a Special Atchayabat.

(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)

***Section 26.** Apart from paying fees for the issue of an Exclusive Prospecting Atchayabat or a Special Atchayabat, the holder of such an Atchayabat must also pay in advance the mining area rental fees for the area granted.

The payment in advance of the mining area rental fees may be allowed to be made by instalments with surety or securities in accordance with the rules and procedures prescribed by a Ministerial Regulation.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

Section 27. A Prospecting Atchayabat, an Exclusive Prospecting Atchayabat or a Special Atchayabat shall be exclusively valid to the holder of such an Atchayabat including his employees.

(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)

***Section 28.** A person wishing to apply for a Prospecting Atchayabat shall submit an application to the Local Mineral Industry Official.

A Prospecting Atchayabat is issued by the Local Mineral Industry Official.

A Prospecting Atchayabat shall be valid for one year from the date of issue.

The holder of the Prospecting Atchayabat must comply with the conditions specified in the Prospecting Atchayabat.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

***Section 29.** A person who wishes to apply for an Exclusive Prospecting Atchayabat shall submit an application to the Local Mineral Industry Official.

An application for an Exclusive Prospecting Atchayabat is limited to an area not exceeding two thousand five hundred rai[3], except an application for an Exclusive Prospecting Atchayabat to prospect in the offshore.

An Exclusive Prospecting Atchayabat is issued by the Minister or the person entrusted by him.

An Exclusive Prospecting Atchayabat shall be valid for one year from the date of issue.

The holder of an Exclusive Prospecting Atchayabat must comply with the conditions specified in the Exclusive Prospecting Atchayabat.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

Section 30. In issuing an Exclusive Prospecting Atchayabat to prospect offshore, the Minister or the person entrusted by him has the power to grant each applicant an area not exceeding five hundred thousand rai and specify the validity of the Atchayabat not exceeding two years from the date of issue.

(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)

***Section 31.** The holder of an Exclusive Prospecting Atchayabat must commence prospecting within sixty days from the date of receiving the Exclusive Prospecting Atchayabat and report the results of operations and prospecting works undertaken within one hundred and eighty days from the date of receiving the Exclusive Prospecting Atchayabat, in the forms prescribed by the Department of Primary Industries and Mines, to the Local Mineral Industry Official within thirty days from the end of the said period, and must report the results of operations and prospecting works undertaken thereafter within thirty days before the expiration of the Exclusive Prospecting Atchayabat.

The Minister, or the person entrusted by him, has the power to revoke an Exclusive Prospecting Atchayabat when the holder of an Exclusive Prospecting Atchayabat fails to comply with the conditions specified therein.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

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[3] *1 rai = 1600 sq. metres or 1914 sq. yards. Or 1 acre = 2.5 rai (approx.)*

***Section 32.** An Exclusive Prospecting Atchayabat shall expire before the date specified therein in the following circumstances:

(1) when the holder of the Exclusive Prospecting Atchayabat who is a natural person dies;

(2) when the holder of the Exclusive Prospecting Atchayabat who is a juristic person ceases to be juristic person;

(3) when the holder of the Exclusive Prospecting Atchayabat lacks any qualification specified in a Ministerial Regulation issued under Section 6 paragraph two;

(4) when the holder of the Exclusive Prospecting Atchayabat fails to report the results of operations and prospecting works undertaken within one hundred and eighty days from the date of receiving the Exclusive Prospecting Atchayabat, within thirty days from the expiration date of the period;

(5) when the Minister or the person entrusted by him revokes the Exclusive Prospecting Atchayabat, from the date of receiving the revocation order.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

***Section 33.** Any person who wishes to apply for a Special Atchayabat shall submit an application to the Local Mineral Industry Official.

The applicant for a Special Atchayabat shall specify his prospecting obligations by stating the amount of each year's prospecting expenditure throughout the duration of the Special Atchayabat and offer special benefits to the interest of the state in accordance with the rules prescribed by the Minister. The aforesaid offer of special benefit shall further bind the holder of the Special Atchayabat in the event that he receives any Provisional Prathanabat or Prathanabat for mining in the area for which the Special Atchayabat has been granted.

Each application for a Special Atchayabat shall be made for an area not exceeding the area in which the prospecting can be completed within five years, according to the rules laid down by the Committee, but not exceeding ten thousand rai.

A Special Atchayabat is issued by the Minister.

A Special Atchayabat shall be valid for five years from the date of issue.

The holder of a Special Atchayabat must comply with the conditions and prospecting obligations in each year as specified therein.

If the holder of the Special Atchayabat has already complied with the conditions and prospecting obligations under the sixth paragraph in each year, and the prospecting outcome in the previous year indicates that the minerals for which he wishes to mine in the area applied for the Special Atchayabat are commercially insufficient to mine entirely or partly, the holder of the Special Atchayabat may surrender the Special Atchayabat or parts of the area thereof by submitting a petition to the Local Mineral Industry Official. The Special Atchayabat shall expire, or the surrender of parts of the area shall be effective on the submission date of the petition, and the obligations for the remaining years or the surrendered parts of the area shall be terminated, as the case may be.

**(As amended by Section 6. of the Minerals Act No.5. B.E. 2545)*

***Section 34.** Upon receipt of an application for an Exclusive Prospecting Atchayabat or an application for a Special Atchayabat, the competent official shall demarcate the area for the Exclusive Prospecting Atchayabat or Special Atchayabat. The demarcation of said area may be made by surveying or other method in accordance with the rules and procedures prescribed by a Ministerial Regulation.

In case the demarcation of an area is made by surveying, the applicant or his appointee shall accompany government surveyors to make a survey on such a date and at such a time and place as to be specified in writing by the competent official.

The Director-General has the power to reject an application for an Exclusive Prospecting Atchayabat or a Special Atchayabat when the applicant:

(1) neglects to accompany the official surveyors to make a survey under paragraph two without justification;

(2) ignores the instructions of the competent official in the process of issuing the Exclusive Prospecting Atchayabat or Special Atchayabat; or

(3) violates or fails to comply with any provisions of Chapter 3 or Chapter 4 or is involved in the commission of such act.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

***Section 35.** A Special Atchayabat shall not be issued to include the area already covered by any other Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat or Prathanabat.

If parts of the area applied for cover the area of any existing Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat or Prathanabat, the issue of the Special Atchayabat shall be made only by excluding such an area.

(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)

***Section 36.** If, at the end of each obligation year, the holder of a Special Atchayabat has not yet fully complied with the prospecting obligation under Section 33, he must pay a sum of money equal to the amount of prospecting expenses not yet incurred in such an obligation year to the Department of Primary Industries and Mines within thirty days after the expiration date of the said obligation year.

If the holder of a Special Atchayabat has made prospecting expenses in any obligation year in excess of the amount proposed for such an obligation year, he shall be entitled to have the excess deducted from the prospecting obligations of the subsequent obligation year.

**(As amended by Section 12. of the Minerals Act No.2. B.E. 2516)*

Section 37. *of the Minerals Act B.E. 2510 has been repealed by Section 7 of the Minerals Act (No. 5) B.E. 2545.*

Section 38. *of the Minerals Act B.E. 2510 has been repealed by Section 13 of the Minerals Act (No. 2) B.E. 2516.*

Section 39. *of the Minerals Act B.E. 2510 has been repealed by Section 13 of the Minerals Act (No. 2) B.E. 2516.*

Section 40. The holder of a Special Atchayabat must commence prospecting within ninety days from the date of receiving the Special Atchayabat and must report the results of the operations and prospecting works to the Department of Primary Industries and Mines every one hundred and twenty days from the date of receiving the Special Atchayabat.

(As amended by Section 14. of the Minerals Act No.2. B.E. 2516)

Section 41. The Minister has the power to revoke a Special Atchayabat when the holder of the Special Atchayabat fails to comply with Section 33 paragraph six or Section 40.

(As amended by Section 14. of the Minerals Act No.2. B.E. 2516)

Section 42. *of the Minerals Act B.E. 2510 has been repealed by Section 15 of the Minerals Act (No. 2) B.E. 2516.*

CHAPTER 4
Mining

Section 43. No person shall mine in any area regardless of any person's rights over that area unless he has received a Provisional Prathanabat or Prathanabat.

(As amended by Section 16. of the Minerals Act No.2. B.E. 2516)

Section 44. A person who wishes to apply for a Prathanabat shall submit an application to the Local Mineral Industry Official together with reliable evidence to prove the discovery or existence of the mineral for which he wishes to mine in the area applied for, and may also offer special benefits to the interest of the state in the event of his receipt of the Prathanabat in accordance with the rules laid down by the Minister.

(As amended by Section 12. of the Minerals Act No.3. B.E. 2522)

An application for a Prathanabat shall be for an area not exceeding three hundred rai, unless it is an application of a Prathanabat for offshore mining and an application of a Prathanabat for underground mining.

(As amended by Section 8. of the Minerals Act No.5. B.E. 2545)

***Section 45.** For each applicant for a Prathanabat, the Minister is empowered to designate an area for underground mining to an extent not exceeding ten thousand rai, and for offshore mining to an extent not exceeding fifty thousand rai.

For the interest of the state, the Minister, with the approval of the cabinet, may designate the mining area for an applicant for the underground mining Prathanabat or for offshore mining in excess of the extent specified under the first paragraph.

The designation of the mining area under the first and second paragraph shall be subject to the conditions as follows:

(1) If an application for the Prathanabat is a result of prospecting according to the Special Atchayabat under which the applicant for the Prathanabat has

prospected according to the conditions on the aforesaid Special Atchayabat until he discovers a mineral deposit within the prospecting area, the Minister shall designate the mining area according to the mineral deposit and the amount of the area where the applicant specified in the application for the Prathanabat.

(2) If an application for a Prathanabat is not the case under (1), the Minister shall designate the mining area according to the recommendation of the Committee.

For the issuance of a Prathanabat under the first and second paragraph, the Minister may, as he deems expedient, impose any special condition for the holder of the Prathanabat to perform.

**(As amended by Section 9. of the Minerals Act No.5. B.E. 2545)*

Section 46. In the area covered by an Exclusive Prospecting Atchayabat or Special Atchayabat of any person, no other person shall apply for a Prathanabat unless such person has the ownership or possession in such area under the Land Code.

(As amended by Section 17. of the Minerals Act No.2. B.E. 2516)

Section 46/1. For the purpose of safety, the issuance of the Prathanabat for mining or Prathanabat for underground mining that causes the mining area to entirely or partly overlap in the different depths shall be prohibited.

(As amended by Section 10. of the Minerals Act No.5. B.E. 2545)

***Section 47.** Upon receipt of an application for a Prathanabat, the competent official shall demarcate the area of the Prathanabat. The demarcation of the said area may be made by surveying or other methods in accordance with the rules and procedures prescribed in a Ministerial Regulation.

In case the demarcation of the area is made by surveying, the applicant or his appointee shall accompany the Government surveyors to make a survey on such a date and at such a time and place to be specified in writing by the competent official.

The Director-General has the power to reject the application when the applicant:

(1) neglects to accompany the official surveyors to make a survey under paragraph two without justification;

(2) ignores the instructions of the competent official in the process of issuing the Prathanabat;

(3) violates or fails to comply with any provisions of Chapter 3 or Chapter 4 or is involved in the commission of such act; or

(4) when it appears that the minerals for which he wishes to mine in the area applied for is insufficient for mining.

**(As amended by Section 17. of the Minerals Act No.2. B.E. 2516)*

Section 48. For the purpose of undertaking a survey, the competent official and his workers are empowered to enter, during the daytime, on land which a person has rights or possession. But he must notify the landowner or the occupier before hand, and

the landowner or the occupier shall render reasonable assistance as the case may require.

When there is a need to erect map posts on the land of any person, the competent official and his workers have the power to erect the map posts as it is necessary.

In case of necessity, the competent official or his workers shall have the power to dig, cut down trees or branches, or dispose of anything that obstructs the work of surveying as it is necessary, however, these actions must cause the least damage to the landowner.

Section 48/1. In case of an application for the Prathanabat for underground mining, the competent official shall, with the expenses paid by the applicant for the Prathanabat, erect map posts or demarcation posts with mine numbers clearly visible on the surface of the land.

(As amended by Section 11. of the Minerals Act No.5. B.E. 2545)

Section 49. After having demarcated the area, the Local Mineral Industry Official shall make an announcement of the application for a Prathanabat by posting a copy thereof at a conspicuous place at the Local Industry Office, Amphoe or King-Amphoe Office and local Kamnan Office in the locality where the Prathanabat is applied for. If no objection is raised within twenty days from the date of posting the announcement, the Local Mineral Industry Official shall proceed with the application further.

(As amended by Section 18. of the Minerals Act No.2. B.E. 2516)

Section 50. If the area for which a Prathanabat is applied for is not entirely vacant land, the applicant must produce evidence to the competent official that the applicant is entitled to mine in such an area.

(As amended by Section 12. of the Minerals Act No.5. B.E. 2545)

***Section 51.** After the area has been demarcated, the applicant for a Prathanabat who wishes to commence mining before the Prathanabat is granted shall submit an application for a Provisional Prathanabat to the Local Mineral Industry Official.

A Provisional Prathanabat is issued by the Minister or the person entrusted by him.

A Provisional Prathanabat shall be valid for one year from the date of issue. In case the application for a Prathanabat is rejected under Section 47 paragraph three, the Provisional Prathanabat shall expire on the date of rejection thereof.

The holder of a Provisional Prathanabat has the same rights, duties and liabilities under this Act as the holder of a Prathanabat.

A Provisional Prathanabat may not be transferred. In case the holder of a Provisional Prathanabat dies or is adjudged incompetent, his heir or guardian, as the case may be, shall become the holder of the Provisional Prathanabat, and Section 81 shall apply *mutatis mutandis*. When the Prathanabat is to be issued, it shall be issued to the heir or guardian for and on behalf of the applicant.

**(As amended by Section 19. of the Minerals Act No.2. B.E. 2516)*

Section 52. If any demarcation post or map post established by the competent official in the demarcation survey of the mining area is lost, the holder of the Prathanabat is liable to pay all expenses for re-surveying to establish a new demarcation post or a map post.

***Section 53.** The Minister or the person entrusted by him has the power to revoke a Provisional Prathanabat upon the occurrence of any cause for revoking a Prathanabat under this Act.

When the Minister or the person entrusted by him revokes any Provisional Prathanabat, the application for the Prathanabat shall be automatically rejected.

**(As amended by Section 20. of the Minerals Act No.2. B.E. 2516)*

***Section 54.** A Prathanabat is issued by the Minister.

A Prathanabat shall be valid for not in excess of twenty five years from the date of issue and in the case where the applicant for a Prathanabat has received a Provisional Prathanabat, the validity of the Prathanabat shall begin from the date of issue of the first Provisional Prathanabat.

In the case where the combined validity of the Provisional Prathanabat is more than the validity of a Prathanabat to be issued, the Prathanabat shall not be issued.

When a Prathanabat provides for a validity period of less than twenty five years and the holder thereof applies for an extension to the Local Mineral Industry Official at the time not less than one hundred and eighty days before the expiry of the Prathanabat, the Minister may extend the validity period of the Prathanabat, provided that the total period of the validity does not exceed twenty five years.

When the holder of a Prathanabat has applied for extension under paragraph four, he may, notwithstanding that the Prathanabat term has expired, continue to mine as though he were the holder of the Prathanabat, but for no more than one hundred and eighty days after the expiry of the Prathanabat; provided, however, that the Local Mineral Industry Official has in the meantime and by written document informed him of the Minister's refusal of extension of the Prathanabat, his rights to mine shall cease on the date he was thus informed.

**(As amended by Section 21. of the Minerals Act No.2. B.E. 2516)*

***Section 55.** In addition to the fee for the issuance of a Provisional Prathanabat or Prathanabat, the holder thereof is required to pay in advance on a yearly basis a mining area rental fee for mining to the amount of the entire mining area, and to pay a special subscription at a rate not exceeding ten percent of the royalty paid for minerals produced from the area under the Provisional Prathanabat or Prathanabat. This special subscription shall be kept by the Department of Primary Industries and Mines as expenses for restoration of the mined area, prevention and suppression of offences prohibited under this Act, and for local development funds in the province where the mining area is located.

The rate of payment of the special subscription, rules, procedures and conditions for its collection, including the budget allocation thereof, shall be prescribed by a Ministerial Regulation.

**(As amended by Section 14. of the Minerals Act No.3. B.E. 2522)*

Section 56. The rights in the Prathanabat are not subject to the execution of judgment.

Section 57. The holder of a Prathanabat must conduct his mining operations in accordance with the mining methods, plans, operating schemes and conditions prescribed in the issue of the Prathanabat; for any addition to the kinds of minerals which are to be mined or any change in mining methods, project plans, and conditions aforesaid, the holder of a Prathanabat must first obtain a written permission from the Director-General.

Section 58. The mining development such as construction of buildings, water ways, dams or any operation carried out in the mining area for the purpose of mining including construction or installation of labour-saving machines shall be treated as mining operations.

(As amended by Section 23. of the Minerals Act No.2. B.E. 2516)

Section 59. The construction of buildings used for mining operation, the establishment of mineral processing plant, slime retainment or tailings dams cannot be made outside the mining area, unless a licence is obtained from the Local Mineral Industry Official and the conditions prescribed in the licence are complied with.

The licencee under the first paragraph must pay a mining area rental fee as though he were using the land for mining.

Section 60. The holder of a Prathanabat must conduct his mining operations by employing labourers and scheduling the working time as follows:

(1) There must be labourers working in every twelve month period with a monthly average of not less than one labourer for an area of two rai, fraction thereof being counted as two rai; but in the event that labour-saving machines are used, the power of such labour-saving machines will be calculated in place of labourers per area at the rate of one brake horsepower to eight labourers;

(2) There must be a total working time of not less than one hundred and twenty days in every twelve month period.

In the event that a holder holds several Prathanabats, contiguous Prathanabats shall be deemed as the same mine for the purpose of calculating labourers and working time provided above.

Holders of several Prathanabats covering contiguous mining areas may coordinate mining projects into a single mine by submitting an application to, and obtaining a licence from the Local Mineral Industry Official, and for this purpose the provisions regarding labourers and working time shall apply to a single mine as stated.

*The provisions of paragraph one shall not apply to the holder of a Prathanabat in the first year from the date of receiving the Prathanabat unless he is exempted under the rules, procedures and conditions prescribed in a Ministerial Regulation.

**(As amended by Section 24. of the Minerals Act No.2. B.E. 2516)*

Section 61. If the holder of a Prathanabat cannot conduct mining operations as prescribed in Section 60 as a result of a Ministerial Regulation, he shall apply for *a Licence for Suspension of Mining Operation* in the whole mining area or a part thereof with the Local Mineral Industry Official. The Local Mineral Industry Official may issue a licence to suspend mining operations to him for each period not exceeding one year.

(As amended by Section 25. of the Minerals Act No.2. B.E. 2516)

Section 62. The holder of a Prathanabat shall not mine within fifty metres of a highway or public waterway, unless the Prathanabat allows him to do so or he has obtained a licence from the Local Mineral Industry Official, however, he must comply with the conditions prescribed in such a licence.

Section 63. The holder of a Prathanabat shall not obstruct, destroy or undertake any work which may be detrimental to the use of highways or public waterways, unless he has obtained a licence from the Local Mineral Industry Official and he must comply with the conditions prescribed in such a licence.

Section 64. The holder of a Prathanabat shall not dam up or draw water from a public waterway, regardless of whether such a waterway is within or outside of the mining area, unless he has obtained a licence from the Local Mineral Industry Official and he complies with the conditions prescribed in such a licence.

An application for a licence to dam up or draw water from a public waterway must be submitted with a map and detailed explanations regarding the procedure for damming up or drawing water.

Section 65. The Local Mineral Industry Official is empowered to issue a licence allowing the holder of a Prathanabat in one mining area to construct roads, whether over land or water, or water-channel for the purpose of discharging slime or tailings through the mining area of another Prathanabat, provided that the aforesaid operations result in any damage, the holder of the Prathanabat who possesses such a licence shall be liable to pay for the compensation.

Section 66. In case of necessity, the Minister is empowered to issue a licence allowing a holder of a Prathanabat in one mining area to discharge slime or tailings for retainment in the mining area of another Prathanabat, which has already been mined out or does not contain sufficient amount of minerals for mining, provided that any damage does occur, the holder of the Prathanabat who possesses such a licence shall be liable to pay for the compensation.

The person who possesses a licence under the first paragraph shall pay the mining area rental fee for using the land to retain slime or tailings in place of the Prathanabat holder whose land is used.

Section 67. The holder of a Prathanabat shall not discharge outside his mining area any slime or tailings resulting from his mining operation unless such water does not contain solid matter in excess of the amount prescribed in a Ministerial Regulation.

When it is necessary, the Minister is empowered to issue a licence to omit the enforcement of the first paragraph and he may prescribe any condition as he deems appropriate.

Section 68. In discharging slime or tailings outside his mining area, the holder of a Prathanabat, even though complying with Section 67, must take measures to prevent the slime or tailings from causing public waterways to become shallow or from being detrimental to the use of such waterways.

In case of necessity the Minister is empowered to designate certain public waterways as allowable for one or more Prathanabat holders to discharge slime or tailings and demand the holders of Prathanabats to make payment in compensation for maintenance and damage and may prescribe conditions as he deems appropriate.

Section 69. In undertaking mining or mineral processing operations, the holder of a Prathanabat shall not perform, or fail to perform, any act that is likely to render toxic minerals or other poisonous materials harmful to persons, animals, vegetation, or properties.

Section 70. The competent officials are empowered to enter into a mining area for inspection of the mining operations at any time while the possessor of the mining area shall offer facilities as may be appropriate under such circumstances; and the competent officials are empowered to give orders in writing to the holder of the Prathanabat to undertake any action to prevent any harm resulting from the mining or mineral processing operations.

Section 71. When the mining or mineral processing operation is considered to be harmful to persons, animals, vegetation or properties, the Local Mineral Industry Official is empowered to give an order in writing to the holder of a Prathanabat to alter or modify the mining or mineral processing procedure as he may consider necessary for the prevention of such harm, and he is also empowered to give an order in writing to totally or partially suspend the mining or mineral processing operation as he may deem appropriate.

Section 72. Any sump, pit, or shaft which is no longer used in the mining operation shall be filled up or the land restored to its original condition by the holder of a Prathanabat regardless of whether the Prathanabat has expired or not; unless the Prathanabat provides otherwise or unless the Local Mineral Industry Official, with an approval of the Director-General, has ordered otherwise in a written communication.

In the event that the holder of a Prathanabat fails to comply with the first paragraph hereof, the Local Mineral Industry Official is empowered to give an order in writing to the holder of a Prathanabat to fill up or restore the land to its original condition, and the holder of the Prathanabat must fulfil the requirements in such an order within ninety days after receiving the said order.

***Section 73.** The holder of a Prathanabat has the rights within the mining area:

(1) To mine and sell minerals as specified in the Prathanabat. Other minerals which are by-products of the mining operation may be sold by the holder of the Prathanabat only upon receiving a licence from the Director-General.

(2) To construct buildings or undertake other works in connection with the mining operation including mineral processing or retaining slime or tailings.

(3) To use the land which has been mined out or which does not contain minerals at the amount sufficient for mining, for agricultural purposes during the term of the Prathanabat provided that upon the expiry of the Prathanabat this shall not be construed as the acquisition of rights to possession.

(4) To take legal action to the court in the event of a dispute or obstruction of the rights to mine.

The provisions in (2) and (3) shall not apply to the holder of a Prathanabat for underground mining with the exception that it has been conducted within the area of which he has the ownership or possession.

**(As amended by Section 13. of the Minerals Act No.5. B.E. 2545)*

Section 74. The holder of a Prathanabat shall not remove or allow any other person to remove tailings or mine waste out of the mining area unless a licence is obtained from the Local Mineral Industry Official, and the conditions prescribed in such a licence are complied with.

Section 75. A Prathanabat shall be valid only to the holder of the Prathanabat and shall cover his employees.

(As amended by Section 26. of the Minerals Act No.2. B.E. 2516)

Section 76. The holder of a Prathanabat shall not sublease to another person the mining operation within any part or the whole of the mining area unless a licence is obtained from the Minister or the person entrusted by him.

The rules, procedures and conditions for the issuance of a Mining Sublease Licence and the cancellation thereof shall be prescribed by a Ministerial Regulation.

(As amended by Section 15. of the Minerals Act No.3. B.E. 2522)

Section 77. When the holder of a Prathanabat wishes to sublease the mining operation to another person, he shall submit an application to the Local Mineral Industry Official, specifying the person to whom the mining operation shall be subleased, for any single period within the term of the Prathanabat, and the portion of the mining area to be subleased.

A Mining Sublease Licence is issued by the Minister or the person entrusted by him as may be deemed proper and for this purpose any condition may be prescribed in such a licence. The holder of a Prathanabat who subleases the mining operation under the first paragraph hereof shall still remain bound and liable by law, and the sub-lessee shall have the rights, duties and liabilities under the law as though he were also the holder of a Prathanabat.

Section 78. When any holder of a Prathanabat wishes to transfer his Prathanabat to another person, the holder of the Prathanabat and the prospective transferee shall submit an application to the Local Mineral Industry Official for successive submission to the Minister. After the Minister has ordered approval and the holder of the Prathanabat has discharged all debts obligated under this Act to the Local Mineral Industry Official, the Prathanabat may then be transferred.

Section 79. In transferring a Prathanabat, the holder of the Prathanabat and the prospective transferee or authorized agent shall, upon producing the Prathanabat and documents related to mining, register such a transfer with the Local Mineral Industry Official.

Section 80. In transferring a Prathanabat, apart from the application fee and the transferring fee, the transferor must also pay a mining rights transferring fee for the amount which he shall receive from transferring the mining rights.

The mining rights transferring fee shall be collected only on the part of the amount received for transferring the mining rights, excluding parts of the amount received from transferring other properties.

In the event that the holder of a Prathanabat declares no disbursement on the mining rights transfer, or in the event that the Local Mineral Industry Official considers the declared amount to be unreasonably low, the Local Mineral Industry Official shall, according to the principles prescribed by the Director-General, assess the amount of the mining rights to be transferred and the amount assessed shall be used for calculating the mining rights transferring fee.

No mining rights transferring fee is to be paid for a transfer of a Prathanabat as a personal gift to the transferor's own father, mother, husband, wife or descendants.

Section 81. In the event that the holder of a Prathanabat dies, his heir shall submit an application to the Local Mineral Industry Official for a transfer of the Prathanabat by way of succession within ninety days from the death of the holder of the Prathanabat, otherwise it shall be deemed that the Prathanabat shall expire upon termination of the ninety day period.

No mining rights transferring fee is to be paid for a transfer of a Prathanabat by way of succession.

When the heir of the holder of a Prathanabat applies for a transfer of the Prathanabat by way of succession within the period aforesaid in the first paragraph, the heir may continue mining as though he held the Prathanabat, but if the Minister considers that the heir should not receive the transfer of the Prathanabat, the Minister may order refusal of the transfer and in this event it shall be deemed that the Prathanabat expires on the day such order is received from the Local Mineral Industry Official.

In the event that the holder of a Prathanabat is adjudged incompetent, the provisions in the three preceding paragraphs shall apply to the guardian *mutatis mutandis*.

Section 82. In the event that the holder of a Prathanabat who is an ordinary person is adjudged bankrupt, the Prathanabat shall expire.

Section 83. In the event that the holder of a Prathanabat is a juristic person and this juristic status terminates, the Prathanabat shall expire.

Section 84. The holder of a Prathanabat may surrender the Prathanabat by submitting an application and delivering the Prathanabat to the Local Mineral Industry Official, in which case the Prathanabat shall expire upon completion of one hundred and eighty days from the date the Local Mineral Industry Official receives the application, unless the holder of the Prathanabat and the Local Mineral Industry Official agree to an expiration within a lesser period of time.

Section 85. In the event that the holder of a Prathanabat departs from the place of domicile or address and the Local Mineral Industry Official is unable to communicate with him, the Minister is empowered to revoke that Prathanabat.

Section 86. If any holder of a Prathanabat does not discharge all debts obligated under this Act within ninety days after receiving a written notice of payment from the Local Mineral Industry Official, the Minister is empowered to revoke that Prathanabat.

Section 87. In the event that the Minister has ordered a revocation of any Prathanabat, the Prathanabat shall expire on the date the order is received from the Local Mineral Industry Official.

Section 88. An expiry of any Prathanabat shall be published in the Government Gazette except when the holder of the Prathanabat has applied for an extension and the Minister has not refused it in accordance with Section 54.

CHAPTER 4/1
Underground Mining[4]

Part I
General Provisions

Section 88/1. The provisions in other Chapters under this Act shall be applicable to underground mining to the extent that they are not contradictory to the provisions under this Chapter.

Section 88/2. Underground mining shall be conducted at the safe depth level in consideration of the geological structure and mining procedures in accordance with the principles of mining engineering in each area for the safety of living things.

Section 88/3. In case the underground mining passes beneath the land, which is not vacant land, and the mining depth level is not over 100 metres below the surface of the land, the applicant for a Prathanabat must produce evidence to the competent official that he is entitled to mine in that area.

Section 88/4. The mining area under a Prathanabat for underground mining shall not encroach upon a national park or an animal reserve.

In the event that the underground mining in any area has been found to cause a significant impact on the quality of the environment, which cannot be remedied or rehabilitated, the Minister shall impose a condition on the Prathanabat prohibiting underground mining in that area.

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[4] *As added by Section 14 of the Minerals Act No.5 B.E. 2545.*

Section 88/5. The issuance of a Prathanabat for underground mining shall be subject to the following conditions:

(1) The applicant for the Prathanabat submits an application in compliance with the conditions under Section 88/6.

(2) The Minister has correctly carried out the hearing of the opinions under Section 88/7 paragraph one.

(3) The Minister has correctly imposed the conditions on the Prathanabat under Section 88/7.

Part II

Imposition of Conditions on the Prathanabat for Underground Mining

Section 88/6. An application for a Prathanabat for underground mining shall consist of the details of mining, plans, and a complete project in compliance with the rules prescribed by the Minister in a Ministerial Regulation, which shall at least comprise of the following information:

(1) the preliminary information indicating depths and technical measures under Section 88/2;

(2) the maps concisely indicating the mining area together with the environmental impact assessment data in different areas for consideration under Section 88/4;

(3) the concise technical information on mining method and mineral processing procedure, including alternatives commonly available in mining engineering, and the alternatives to be used by the applicant for the Prathanabat as he deems expedient, with the reasons for choosing such alternatives;

(4) the concise information, plans, process, mining method, mineral processing procedure, and rehabilitation of the areas after the underground mining indicating the measures to reduce the impact or preserve the quality of the relevant environments, which may affect the existence of the nature and community;

(5) the proposal for the participation of stakeholders in the inspection of underground mining in accordance with Section 88/9 (2), which stipulates the amount of supporting funds and rules of mining inspection that the applicant shall propose to the persons entitled to inspect mining under Section 88/11;

(6) the routes of transportation and sources of water to be used in the project whether they are already in existence or will be developed together with the details of their uses throughout the period of the project, which is adequate for the assessment that the underground mining in the project shall not affect the existence of the community and nature;

(7) the proposal to insure against liability under Section 88/13 specifying the covered insurance amount and insured period.

Section 88/7. When the environmental impact assessment report of the applicant for the Prathanabat for underground mining has been approved according to the law on promotion and preservation of the environmental quality, the Minister shall compile the following information and bring it into the process of hearing of opinions of the stakeholders in accordance with the rules prescribed in the laws or relevant governmental regulations, as the case may be, for the assistance of the impositions of necessary conditions in the Prathanabat.

(1) The project information submitted with the application for a Prathanabat under Section 88/6.

(2) The environmental impact assessment report accompanied with the opinions of the report evaluators.

Once the process of the hearing of opinions ends and upon his receipt of the report from the note-taking committee, the Minister shall study the report and pass judgment on the imposition of the conditions in the Prathanabat according to the following rules:

(1) the conditions on the Prathanabat shall cover the project at least in every item as prescribed in a Ministerial Regulation issued under Section 88/6;

(2) in case a discrepancy appears about the information or opinions in the hearing of opinions carried out under the first paragraph, the Minister shall make a final conclusion; nevertheless, in case the report or information on certain problems is not adequate for making a decision or the hearing of opinions is not correctly carried out or is significantly wrong, the Minister shall issue a remedial order as the case may be, so as to finalise the conclusion;

(3) in addition to the conclusion of the Minister under (2), the conditions in the Prathanabat shall cover the entire details of the project presented by the applicant in the environmental impact assessment report, the report accompanying the application under Section 88/6, and the additional conditions or measures in the environmental impact assessment report as well.

Section 88/8. In case of the amendment of the conditions in the Prathanabat for underground mining stipulated under Section 88/7, the provisions in this part shall be applied *mutatis mutandis*. It shall be deemed that the hearing of opinions of the persons entitled to inspect mining under Section 88/11 is the hearing of the stakeholders in general as specified in Section 88/7, paragraph one.

Part III
Rights to Participate of Stakeholders

Section 88/9. In the case where any person wishing to apply for the Prathanabat for underground mining deems expedient to have a preliminary consultation with the stakeholders so as to develop his underground mining, he shall submit an application to the Director-General for an appointment of a committee for organizing consultation meetings according to the procedures prescribed in a Ministerial Regulation at his own expense.

The notification in a Ministerial Regulation under the first paragraph shall prescribe the following rules and procedures:

(1) The completion of a preliminary report, which will be brought into a consultation, shall clearly consist of necessary information and problematic issues.

(2) The criteria to support groups or organizations resulting from the association of stakeholders and the participation of delegates in the consultation, including the groups of Kamnans and village headpersons, administrative groups and members of the parliament of local administrative organizations, and groups of people who have the rights to the land or reside in that mining area.

(3) The composition of the committee for organizing consultation meetings shall comprise of representatives from the relevant regional governmental offices and the State's institutes of higher education.

(4) The procedures of the consultation meetings shall include a public announcement of an invitation to stakeholders so that they may send their representatives to participate in the meetings, a registration of meeting participation, and an appropriate period of time for the stakeholders under Section 88/9 (2) to study the information thereof in advance.

Section 88/10. Whenever the necessity to organize the hearing of opinions under Section 88/7, paragraph one, should arise, the Director-General shall establish a supporting fund for the research project of the stakeholders of the underground mining project under Section 88/9 (2), which shall be funded by:

(1) The expenses collected from the applicants for Prathanabats in accordance with the rates prescribed in a Ministerial Regulation.

(2) The supporting funds from various public and private funds.

The rates of expenses under (1), rules, procedures, and conditions for the proposal and support of the project, and regulations of the acceptance and remittance of the supporting funds shall be in compliance with the notifications in Ministerial Regulations.

Section 88/11. Within sixty days from the date of issuance of a Prathanabat for underground mining, the Director-General shall call for a meeting of the representatives of the stakeholders under Section 88/9 (2) in order to make an agreement on specifying the persons entitled to inspect mining in accordance with the rules provided in the conditions of the Prathanabat.

Within thirty days from the date of acquiring the persons entitled to inspect mining, the holder of the Prathanabat shall allocate financial funds for hiring specialists to assist the persons entitled to inspect mining at the wage rates specified in the conditions of the Prathanabat.

After being informed about the contracts and details on employment of the specialists from the persons entitled to inspect mining, the Director-General shall pay the wages for the specialists when receiving job acceptance from the persons entitled to inspect mining.

The working term of the persons entitled to inspect mining; conditions and procedure for dismissal of the person entitled to inspect mining, who misconducts his authority, by the decision of the meeting of the stakeholders under Section 88/9 (2); safekeeping of supporting funds; standard qualifications of specialists; contract features

for employment of specialists; and rules for withdrawal or payment shall be prescribed in a Ministerial Regulation.

Part IV
Protection of Rights in Immovable Properties

Section 88/12. Underground mining in any area within the mining area with the following characteristics shall be deemed to cause damage to the rights in immovable properties in that area. Additionally the injured party shall be entitled to demand that the holder of the Prathanabat for underground mining suspend his activities and provide necessary remedies for the protection of the danger, which may occur.

(1) The underground mining at the depth level below the surface of the land lesser than the level specified in the conditions of the Prathanbat, and no deeper than 100 metres.

(2) The underground mining at any depth level, of which the mining method according to the principles of mining engineering to stabilize the ground layers is not in compliance with the conditions in the Prathanabat for underground mining.

Section 88/13. In the event that any ground layer in a mining area of the Prathanabat for underground mining has collapsed causing all kinds of damage to persons, properties, or environment, the following principles of legal liabilities shall be applied to the damage:

(1) It shall be initially presumed that the collapse of the ground was caused by the underground mining.

(2) If it is finally concluded that the underground mining is the cause of the collapse of the ground, the holder of the Prathanabat for underground mining and the relevant government offices, which are responsible for the mining inspection, shall be jointly liable to the injured party in all cases, and after the aforesaid governmental offices have already paid the compensation to the injured party, they are entitled to exercise the rights of subrogation against the holder of the Prathanabat for underground mining.

CHAPTER 5
Artisanal Mining and Ore Panning

Section 89. No one shall undertake any artisanal mining or ore panning unless he has obtained an Artisanal Mining Licence or an Ore Panning Licence.

Section 90. Any person who wishes to obtain an Artisanal Mining Licence or Ore Panning Licence shall submit an application to the local Nai Amphoe, and the local Nai Amphoe shall forward the matter to the Local Mineral Industry Official or the Person appointed by the Director-General to consider the issuance of such a licence.

An Artisanal Mining Licence or Ore Panning Licence is issued by the Local Mineral Industry Official or the person appointed by the Director-General and any conditions may be prescribed in the licence.

An Artisanal Mining Licence or Ore Panning Licence is valid only until 31st December of the year of issue.

Section 91. The rules and procedures concerning the issue of an Artisanal Mining Licence or Ore Panning Licence and the suspension and revocation of such a licence shall be prescribed by a Ministerial Regulation.

CHAPTER 5 bis
Drilling for Underground Brine[5]

Section 91 bis. No one shall undertake any underground brine drilling in excess of the depth level as notified by the Minister in the Government Gazette unless he has obtained an *Underground Brine Drilling Licence*.

For the interest of the people's personal use in a specific area, the Minister shall have the power to prescribe the depth level of the underground brine drilling in excess of the specified depth level under the first paragraph with a clear stipulation of the area and the depth level, which shall be published in the Government Gazette.

Subject to Section 91 ter, any person who wishes to obtain *an Underground Brine Drilling Licence* under the first paragraph shall submit an application to the Local Mineral Industry Official or the person appointed by the Director-General. The aforesaid officials are empowered to issue *an Underground Brine Drilling Licence*, which is valid for no more than three years from the date of issue, and specify any condition in the licence therein.

Section 91 ter. For the purpose of the protection of the ground collapse and environmental impacts caused by the underground brine drilling, the Minister shall have the power to demarcate a specific area as an Underground Brine Drilling Restricted Area, and also prescribe the minimum depth level, allowed for the underground brine drilling in the aforesaid restricted area, other than the depth level as prescribed in Section 91 bis.

The demarcation, cancellation, or alteration of any underground brine drilling restricted area and the prescription or alteration of the minimum dept level under the first paragraph shall be notified in the Government Gazette.

Any person who wishes to obtain an Underground Brine Drilling Licence as prescribed in the first paragraph shall submit an application to the Director-General or the person entrusted by him. The Director-General, or the person appointed by him, is empowered to issue *the Underground Brine Drilling Licence* for the aforesaid restricted area, which is valid for no more than five years from the date of issue, and he may specify any condition therein.

Section 91 quarter. The competent official is empowered to enter, at any time, into the area in which the underground brine drilling is granted for an inspection of the operations in order to ensure the conformity of the conditions as specified in the licence,

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[5] *As added by Section 6. of the Minerals Act No.4. B.E. 2534)*

and the licencee or the possessor of the area in which the underground brine drilling is granted shall offer facilities as appropriate under the circumstances. In this case, the competent official is empowered to give orders in writing to the licencee or the possessor of the area to undertake any action to prevent damage, which may occur.

Section 91 quinque. In case the Local Mineral Industry Official considers that the operation of the licencee may cause harm to persons, animals, vegetation, or properties, he is empowered to give orders in writing to the licencee to alter, modify, or suspend that operation as he deems necessary to prevent or extinguish such harm.

Section 91 sext. The provisions in Chapter 1, General Provisions, and Chapter 2, Committee, shall apply to the underground brine drilling in this chapter by regarding an Underground Brine Drilling Licence as a Prathanabat.

The provisions in Chapter 3 to Chapter 11 shall not apply to the underground brine drilling, brine, and salt derived from the underground brine according to this chapter.

Section 91 septem. The qualifications of applicants, amount of land per application, rules, procedures, and conditions concerning the application for an Underground Brine Drilling Licence, issuance, transfer, extension, suspension, and revocation of an Underground Brine Drilling Licence shall be in accordance with the provisions in Ministerial Regulations.

Section 91 octo. The holder of an Underground Brine Drilling Licence shall pay the royalties in accordance with the law on mineral royalty rates before the removal of underground brine, or salt derived from the underground brine, from the area in which underground brine drilling is granted as specified in the licence, unless it is transported to the places as specified in the licence or the places as later granted by the Local Mineral Industry Official. The aforesaid holder shall provide a cash deposit or a bank guarantee to the Local Mineral Industry Official as an insurance for the royalty payment, in accordance with the rules and conditions prescribed by the Director-General or the person appointed by the Director-General.

In the case where the purchase and sale of underground brine or salt derived from the underground brine forfeited by the State, for which royalties have remained unpaid, the purchaser shall pay the royalties for the aforesaid underground brine and salt derived from the underground brine by the time of purchasing.

CHAPTER 6
Purchase, Sale, and Storage of Minerals

***Section 92.** No person shall purchase minerals for business purposes unless he has received a Mineral Purchase Licence from the Local Mineral Industry Official.

The provision of paragraph one shall not apply to:

(1) the purchase of minerals from an Artisanal Mining Licencee;

(2) the purchase of metal derived from metallurgy;

(3) the purchase of minerals in accordance with the kind and conditions of minerals which have been altered so that they can be mixed with other materials or made into finished products, as to be prescribed by the Director-General and notified in the Government Gazette.

*(As amended by Section 27. of the Minerals Act No.2. B.E. 2516)

Section 93. Any person who wishes to obtain a Mineral Purchase Licence shall submit an application to the Local Mineral Industry Official in the locality where the applicant is to establish his place of business for purchasing minerals.

The Local Mineral Industry Official is empowered to issue a Mineral Purchase Licence, specify the place of purchase, and may prescribe any conditions in the Mineral Purchase Licence.

A Mineral Purchase Licence is valid only until 31st December of the year of issue.

Section 94. The holder of a Mineral Purchase Licence shall not purchase minerals at any place other than the place of purchase specified in the Mineral Purchase Licence unless he has obtained from the Local Mineral Industry Official a Licence for Mineral Purchasing outside the Designated Place to purchase minerals outside his place of purchase.

If the holder of a Licence for Mineral Purchasing outside the Designated Place wishes to have another person purchase minerals outside his place of purchase on his behalf, he must also specify the name of such person in applying for such a licence.

As for the application and issuance of a Licence for Mineral Purchasing outside the Designated Place, the provisions of Section 93 shall apply *mutatis mutandis*.

A Licence for Mineral Purchasing outside the Designated Place shall expire at the same time as the Mineral Purchase Licence.

Section 95. The holder of a Mineral Purchase Licence shall display the licence at the conspicuous place specified in the licence. In the event that he also holds a Licence for Mineral Purchasing outside the Designated Place he shall display the names of purchasing agents, if any, at the same place.

Purchasing agents so named must carry the Licence for Mineral Purchasing outside the Designated Place with them while purchasing minerals.

Section 96. A Mineral Purchase Licence is not transferable.

Section 97. Upon the death of the holder of a Mineral Purchase Licence, if his heir or the administrator of his estate wishes to continue purchasing minerals under the licence, he shall submit an application to purchase minerals under the deceased's licence within thirty days from the death of the licence holder and at the same time produce evidence of succession or appointment as administrator of the estate. The Local Mineral Industry Official is empowered to allow the applicant to continue purchasing minerals under such a licence.

In the event that the heir or administrator of the estate has applied for purchasing minerals under the deceased's licence within the period aforesaid in the first paragraph, the heir or administrator of the estate may continue to purchase minerals until the Local Mineral Industry Official orders interdiction. If the heir or administrator of the estate

does not apply to purchase minerals under the deceased's licence within the period aforesaid in the first paragraph, the Mineral Purchase Licence shall expire upon completion of thirty days from the death of the licencee.

In the event that the holder of a Mineral Purchase Licence is adjudged incompetent, the provisions in the two preceding paragraphs shall apply to the guardian *mutatis mutandis*.

In the event that the holder of a Mineral Purchase Licence, who is an ordinary person, is adjudged bankrupt, the Mineral Purchase Licence shall expire.

In the event that the holder of a Mineral Purchase Licence is a juristic person and this juristic status terminates, the Mineral Purchase Licence shall expire.

Section 98. No holder of a Mineral Purchase Licence or a Licence for Mineral Purchasing outside the Designated Place shall purchase minerals unless the seller has:

(1) delivered documents in the form issued by the Department of Primary Industries and Mines to show that the minerals were acquired under a Provisional Prathanabat or a Prathanabat, by stating its number and bearing the signature of the holder of the Provisional Prathanabat or Prathanabat or his agent who is duly registered with the Local Mineral Industry Official;

(2) delivered documents in the form issued by the Department of Primary Industries and Mines to show that the minerals belong to the seller who holds a Mineral Purchase Licence, stating its number and bearing the signature of the purchase licencee or his agent who is duly registered with the Local Mineral Industry Official;

(3) delivered documents showing that the person has obtained from the Director-General a special permission for this particular sale; or

(4) produced an Ore Panning Licence and proved that the minerals were acquired in the quantity not exceeding the limit specified in the licence.

The documents delivered by the seller of minerals under (1), (2) or (3) must be retained by the purchase licencee for inspection by the competent official at any time during a period of five years from the purchase of the minerals.

When the seller produces documents under (4) the Mineral Purchase Licencee must record the purchase on the selling list in the Ore Panning Licence and then return the licence to the holder thereof immediately.

Section 99. No one shall sell minerals unless he is:

(1) the holder of a Provisional Prathanabat or Prathanabat, or his agent duly registered with the Local Mineral Industry Official, who sells minerals acquired from the mining operations under the Provisional Prathanabat or Prathanabat; *(As amended by Section 29. of the Minerals Act No.2. B.E. 2516)*;

(2) the holder of a Mineral Purchase Licence or his agent who is duly registered with the Local Mineral Industry Official;

(3) the holder of an Artisanal Mining Licence or the owner of minerals obtained from a holder of an Artisanal Mining Licence;

(4) the holder of an Ore Panning Licence;

(5) the person who has obtained a special permission from the Director-General for the particular sale; or

(6) the person who sells metals obtained from metallurgical processes.

Section 100. The person who is entitled to sell minerals under Section 99 shall not sell minerals to any person except the holder of a Mineral Purchase Licence or the holder of a Licence for Mineral Purchasing Outside the Designated Place; unless the minerals are acquired from Artisanal mining, or the metals are obtained from metallurgical processes, or the minerals are for direct export out of the Kingdom.

Section 101. No person shall store minerals for business purposes at any place, except at the place where the person has obtained a Mineral Storage Licence from the Local Mineral Industry Official or unless the minerals are retained in possession under Section 105.

Section 102. Any person who wishes to obtain a Mineral Storage Licence shall submit an application to the Local Mineral Industry Official.

A Mineral Storage Licence is issued by the Local Mineral Industry Official who may prescribe any condition in the licence.

A Mineral Storage Licence is valid only until 31st December of the year of issue.

Section 103. The Director-General is empowered to revoke any licence issued under the provisions in this chapter when it appears that there have been violations of the provisions hereof or violations of the conditions prescribed in the licence or there have been the occurrence of causes which affect public safety or welfare.

The order revoking a licence shall be delivered to the licencee, and such a licence shall be deemed to expire on the date that order is received.

The holder of a licence which is revoked is entitled to appeal the order to the Minister by submitting such appeal to the Local Mineral Industry Official within fifteen days after receiving the order. The Minister's decision shall be final.

The holder of a licence which has been revoked shall not apply for a new licence until two years have lapsed since the revocation of the previous licence.

Section 103 bis. When it is deemed expedient, the Minister may, by issuing the notification in the Government Gazette, determine any kind of mineral and its quantity from which the person who purchases, sells or stores that mineral be exempted from the necessity to comply with the provisions of this chapter, provided royalty for such mineral has been duly paid in full as required by Section 104.

(As amended by Section 16. of the Minerals Act No.3. B.E. 2522)

Section 103 ter. For the economic interest in the promotion of mining and the storage control of the mineral surplus, which is produced in excess of the quantity permitted by the State for exportation outside of the Kingdom at a certain time, upon the case where the Mineral Storage Licencee, the Mineral Processing Licencee, or the Metallurgical Processing Licencee submits a request in writing that his mineral store, mineral processing area, or metallurgy area, as the case may be, shall be established as a mineral depository, the Minister is empowered to designate the place or area belonging to such a licencee to be a mineral depository by consideration of the necessity and quantity of minerals in each locality, the condition and appropriateness of the place, and may also appoint an official to work regularly at the mineral depository, or stipulate any condition for the Mineral Storage Licencee, Mineral Processing Licencee, or Metallurgical Processing Licencee, whose mineral store, mineral processing area, or

metallurgical proceeding area is also a mineral depository, as the case may be, to perform.

The term of the mineral depository that is established according to the first paragraph shall not exceed one year.

The holder of a Provisional Prathanabat, Prathanabat, or Mineral Purchase Licence who purchases minerals from the Ore Panning Licencee may deposit the mineral surplus, acquired from the mining in his possession with the quantity exceeding that permitted by the State for exportation outside of the Kingdom at a certain time, to the mineral depository according to the rules, procedures, and conditions as specified by the Director-General.

**(Added by Section 5. of the Emergency Decree amending the Minerals Act, B.E. 2526)*

CHAPTER 7
Payment of Royalty, Possession, and Transport of Minerals

***Section 104.** The holders of a Provisional Prathanabat, Prathanabat, Mineral Purchase Licence, the possessor of other minerals derived from mineral processing and the holder of a Metallurgical Processing Licence shall pay the royalties under the law on mineral royalty rates as follows:

(1) Royalties for the minerals designated in the Prathanabat, including other minerals which are mined as by-products, shall be paid in full and in accordance with their quantities before their removal from the mining area.

(2) The holder of a Mineral Purchase Licence who purchases minerals from an Ore Panning Licencee shall pay royalties for the minerals purchased in the previous month by the fifth day of the following month.

(3) In case the holder of a Provisional Prathanabat, Prathanabat, or the holder of a Mineral Purchase Licence, who purchased minerals from an Ore Panning Licencee, transports the minerals to his own mineral processing or metallurgical area, or that of others, with prior approval from the Director-General, the said person may ask for a deferment of the royalty payment until the completion of mineral processing or metallurgical processing, provided he furnishes to the Local Mineral Industry Official, as may be designated by the Local Mineral Industry Official, a cash deposit or a bank guarantee, issued by a bank approved by the Director-General, as an insurance against the royalty payment.

(4) In case the mineral processing recovers other kinds of minerals, mineral royalties must be paid for the recovered minerals together with the application for the possession thereof as required by Section 105.

(5) In case the slag contains other minerals at a quantity exceeding that is designated by the Director-General and for which royalties have not yet been paid, the metallurgical processor shall pay in full royalties for the admixed minerals according to the assessed quantity before removing the slag from the metallurgical processing area.

In case the purchase and sale of minerals forfeited by the State, and for which royalties have remained unpaid, the purchaser shall pay the royalties under the law on

mineral royalty rates together with the application for possession of the said minerals as required by Section 105.

**(As amended by Section 17. of the Minerals Act No.3. B.E. 2522)*

Section 104 bis. The person who deposits the minerals at the mineral depository under Section 103 ter may ask for a deferment of the royalty payment in accordance with the term, rules, procedures, and conditions specified a Ministerial Regulation.

(Added by Section 6. of the Emergency Decree amending the Minerals Act, B.E. 2526)

Section 105. No person shall be allowed to have in his possession an excess of two kilograms of each kind of minerals, unless it is:

(1) the mineral for which a Mineral Possession Licence has been issued or for which exemption has been given under Section 103 bis;
(2) the mineral acquired from prospecting for use in analysis or research at a quantity not exceeding that specified in the Atchayabat;
(3) the mineral acquired from mining in the mining area where it is kept;
(4) the mineral for which a Mineral Transport Licence has been issued for its removal to the place designated under the Mineral Storage Licence;
(5) the mineral which is in the course of transportation under a Mineral Transport Licence or which is kept in a transit store specified in the said Mineral Transport Licence;
(6) the mineral in the mineral purchasing place, which is acquired under a document provided under Section 98;
(7) the mineral transported under a Mineral Transport Licence to the mineral processing or metallurgical processing area for processing;
(8) the mineral acquired under an Artisanal Mining Licence or Ore Panning Licence or under paragraph two (3) of Section 92;
(9) the mineral kept under possession for the purpose of study or research by a private research institute that has received a written permission from the Director-General, government agencies, government organizations or education institutes;
(10) the mineral which has been allowed by written permission from the Director-General to be kept under possession for a special and individual case;
(11) the mineral in the form of finished products which are utensils, decorative articles, sculptures, or products from metallurgical or industrial processes. *(As amended by Section 18. of the Minerals Act No.3. B.E. 2522)*
(12) the mineral for which a Mineral Transport Licence has been issued for its removal to a mineral depository under Section 103 ter. *(Added by Section 7. of the Emergency Decree amending the Minerals Act, B.E. 2526)*

Section 106. Any person who wishes to obtain a Mineral Possession Licence shall submit an application to the Local Mineral Industry Official.

A Mineral Possession Licence is issued by the Local Mineral Industry Official who shall specify the place where the minerals are to be retained and may prescribe any conditions in such licence.

The holder of a Mineral Possession Licence may retain minerals in possession only in the place specified in the licence. In this case, the licencee does not need to hold

a Mineral Storage Licence, but shall obtain a Mineral Transport Licence before transporting the minerals out of such a place.

A Mineral Possession Licence is valid only until 31st December of the year of issue.

Section 107. Upon the death of the holder of a Mineral Possession Licence, it shall be deemed that the possessor of the minerals is the holder of the Mineral Possession Licence until the expiry of the licence.

***Section 108.** No person shall transport minerals from any place except:

(1) that such minerals are allowed to be transported under the Mineral Transport Licence or are exempted under Section 103 bis;
(2) that such minerals are acquired from prospecting for analysis or research not exceeding the quantity specified in the Atchayabat;
(3) the transportation of minerals within a mining area, mineral processing area, metallurgy area, mineral purchasing place specified in the Mineral Purchase Licence, mineral store, or mineral transit store;
(4) the transportation of minerals by an Artisanal Mining Licencee, Ore Panning Licencee, or holder of a Licence for Mineral Purchasing Outside the Designated Place;
(5) that such minerals belong to the owner who acquires them under Section 92, paragraph two (1) or (3);
(6) that such minerals are not more than two kilograms each kind thereof;
(7) that such minerals are for education or research by a private research institute authorized in writing by the Director-General, government agencies, government organizations, or educational institutes;
(8) that such minerals are in the form of finished products which are appliances, decorative materials, statues, or products obtained from industrial processes;
(9) that such minerals are allowed to be transported as a special case by written permission of the Director-General; or
(10) that are metal obtained from metallurgy, unless they are transported out of a metallurgy area.

**(As amended by Section 32. of the Minerals Act No.2. B.E. 2516)*

Section 109. Any person who wishes to obtain a Mineral Transport Licence shall submit an application to the Local Mineral Industry Official and shall produce evidence that the payment of royalties on the minerals, for which a Mineral Transport Licence is applied, has been paid in full or a Licence for Deferment of the Royalty Payment has been issued in advance.

(Added by Section 8. of the Emergency Decree amending the Minerals Act, B.E. 2526)

A Mineral Transport Licence is issued by the Local Mineral Industry Official who may prescribe any condition in such a licence.

***Section 110.** The holder of a Mineral Transport Licence can, at each time, transport minerals between places for a quantity specified in the licence.

The extent and quantity of each kind of mineral that can be transported in excess of the limit provided in the Mineral Transport Licence shall be prescribed by a Ministerial Regulation.

The mineral transported in excess of the quantity specified in the licence under paragraph two shall be regarded as that legally allowed by the licence, provided royalty for the excess quantity is duly paid.

The transportation of minerals in excess of the quantity permitted and prescribed by the Ministerial Regulation shall cause the entire lot of minerals to be regarded as being transported without a licence.

**(As amended by Section 19. of the Minerals Act No.3. B.E. 2522)*

Section 111. Subject to Section 112, the holder of a Mineral Transport Licence may transport minerals only of the same kind and condition as specified in the licence. If other minerals are mixed therein and such minerals are not being found and mixed in natural occurrence, it shall be deemed that the entire lot of minerals is illegally transported.

Section 112. The holder of a Mineral Transport Licence cannot transport minerals in which other minerals are admixed in natural occurrence and the minerals thus mixed are in the categories and quantities as prescribed by a Ministerial Regulation, except when the licence specifies the categories of the admixed minerals and the holder of a Mineral Transport Licence complies with the conditions prescribed in the Ministerial Regulations.

In the event that minerals are transported with other minerals admixed therewith and the provisions in the first paragraph are violated, it shall be deemed that the entire lot of minerals is transported without a licence.

Section 113. In the event that a person holds several Prathanabats with contiguous mining areas, or several persons hold several Prathanabats with contiguous mining areas and have received permission from the Local Mineral Industry Official to coordinate their mining projects into a single mine, it shall be regarded under the purposes of this chapter that such mining areas are combined into one mining area.

Section 113 bis. The Minister shall be empowered to designate, by notification in the Government Gazette, any location or place as a mineral checkpoint area.

(As amended by Section 20. of the Minerals Act No.3. B.E. 2522)

CHAPTER 8
Mineral Processing

***Section 114.** No one shall undertake mineral processing operations unless he has received a licence from the Local Mineral Industry Official or has been a holder of a Provisional Prathanabat or Prathanabat who undertakes mineral processing operations within the mining area.

Section 113 shall apply thereto *mutatis mutandis*.

**(As amended by Section 33. of the Minerals Act No.2. B.E. 2516)*

***Section 115.** A person who wishes to apply for a Mineral Processing Licence shall submit an application to the Local Mineral Industry Official.

A Mineral Processing Licence is issued by the Local Mineral Industry Official who may specify any condition therein.

A Mineral Processing Licence shall be valid for a period specified in the licence but not exceeding three years from the date of issue and may be renewed for not exceeding three years from the date of each renewal.

A Mineral Processing Licencee must comply with the conditions specified in the Mineral Processing Licence.

**(As amended by Section 33. of the Minerals Act No.2. B.E. 2516)*

Section 116. In undertaking a mineral processing operation, the holder of a Mineral Processing Licence shall not perform any act likely to render, or fail to perform any act the failure of which is likely to render toxic minerals or other poisonous materials harmful to persons, animals, vegetation, or properties.

Section 117. The competent officials are empowered to enter into a mineral processing area for inspection of the mineral processing operation at any time and the possessor of the mineral processing area shall offer such facilities as may be appropriate under the circumstances. The competent officials are also empowered to give orders in writing to the holder of the Mineral Processing Licence to undertake any action to prevent any harm which may result from the mineral processing operation.

Section 118. When the Local Mineral Industry Official considers that the mineral processing operation will cause harm to persons, animals, vegetation or properties, he is empowered to give an order in writing to alter or modify the mineral processing operation to prevent such harm, and to suspend the mineral processing operation totally or partially as he may deem appropriate.

Section 119. The Director-General is empowered to revoke a Mineral Processing Licence when it appears that there has been violation of the provisions hereof or of the conditions prescribed in the licence, or upon the occurrence of causes affecting public safety or welfare.

The order revoking a licence shall be delivered to the licencee, and the licence shall expire on the date that order is received.

The licencee whose licence is revoked is entitled to appeal the order to the Minister by submitting such appeal to the Local Mineral Industry Official within fifteen days after receiving the order. The decision of the Minister shall be final.

The holder of a licence which has been revoked shall not apply for a new licence until two years have lapsed since the revocation of the previous licence.

CHAPTER 9
Metallurgical Processing

Section 120. Metallurgical processing of any kind of minerals, together with production capacity and processes which are to be restricted by this Act shall be prescribed in a Ministerial Regulation.

Section 121. No one shall undertake any metallurgical processing restricted by this Act unless he has obtained a Metallurgical Processing Licence.

The provisions in the first paragraph shall not apply to the metallurgical processes exempted by a Ministerial Regulation.

Section 122. A person who wishes to obtain a Metallurgical Processing Licence shall submit an application to the Local Mineral Industry Official.

A Metallurgical Processing Licence is issued by the Director-General who may prescribe any condition in the licence.

A Metallurgical Processing Licence is valid for the period specified in the licence but not exceeding twenty five years from the date of issue and the licence may be extended for a specified period of not exceeding twenty five years from the date of extension.

Section 123. In undertaking metallurgical processing, the holder of a Metallurgical Processing Licence shall not perform any act likely to render or fail to perform any act the failure of which is likely to render toxic minerals or other poisonous materials harmful to persons, animals, vegetation or properties.

Section 124. The competent officials are empowered to enter at any time into a metallurgy area for inspection of the metallurgical processing and the possessor of the metallurgy area shall offer facilities as may be appropriate under the circumstances. The competent officials are also empowered to give orders in writing to the holder of the Metallurgical Processing Licence to undertake any action to prevent any harm which may result from the metallurgical processing.

Section 125. When the Local Mineral Industry Official considers that the metallurgical processing will cause harm to persons, animals, vegetation or properties, he is empowered to give an order in writing to the holder of the Metallurgical Processing Licence to alter or modify the metallurgical processing as he may consider necessary to prevent such harm, and he is empowered to give an order in writing to suspend the metallurgical processing totally or partially as he may deem appropriate.

Section 126. The Director-General is empowered to revoke a Metallurgical Processing Licence when it appears that there has been violation of the provisions thereof or of the conditions prescribed in the licence, or upon the occurrence of causes affecting public safety or welfare.

The order revoking a Metallurgical Processing Licence shall be delivered to the licencee and the licence shall expire on the date that order is received.

The licencee whose licence is revoked is entitled to appeal the order to the Minister by submitting such an appeal to the Local Mineral Industry Official within fifteen days after receiving the order. The decision of the Minister shall be final.

In the event that there has been an appeal to the Minister on a revoking order, the appellant may request the Minister's permission to carry on metallurgical processing under the licence while awaiting the Minister's decision. In permitting the metallurgical processing to be temporarily carried on, the Minister may prescribe any condition.

CHAPTER 10
Reimbursement of Royalties

***Section 127.** In case any mineral for which the royalties have been duly paid, the Minister shall be empowered to reimburse the royalties to the mineral user if he has proven with sufficient satisfaction to the Minister that the mineral has been used within the country for the industries, which are not those for which the royalties cannot be reimbursed as prescribed by the Minister in the Government Gazette, or that the mineral is consumed as energy matter within the country.

The royalty reimbursement for each type of mineral according to the first paragraph shall be in compliance with the rules, procedures, conditions, and rates prescribed in a Ministerial Regulation.

Any person who wishes to reimburse the royalties shall submit a petition to the Local Mineral Industry Official in the locality where the mineral is consumed.

**(Added by Section 7. of the Emergency Decree amending the Minerals Act, B.E. 2528)*

CHAPTER 11
Import and Export of Minerals

Section 128. The import or export of minerals of any kind, condition, and quantity, which is to be restricted by this Act, shall be prescribed in a Ministerial Regulation.

Section 129. No one shall import or export minerals restricted by this Act unless he has obtained a Mineral Import Licence or a Mineral Export Licence.

Section 130. Any person who wishes to import or export minerals restricted by this Act shall submit an application to the Local Mineral Industry Official.

A Mineral Import or a Mineral Export Licence is issued by the Director-General or his appointee who may prescribe any condition in the licence.

The conditions under the second paragraph may be prescribed by including selling and purchasing procedures as well as utilization of minerals to be imported or exported.

Section 131. Upon the occurrence of causes affecting the security or economy of the country, the Minister is empowered to revoke any Mineral Import or Mineral Export Licence at any time by publishing such a revocation in the Government Gazette.

CHAPTER 11/1
Liabilities[6]

Section 131/1. The holder of an Atchayabat, a Prathanabat, or any licence under this Act shall be responsible for his actions that cause any damage or nuisance to a person, property, or environment.

In case the damage has occurred within the licenced area, it shall be presumed that the aforesaid damage is caused by the actions of the holder of the Atchayabat, Prathanabat, or licence.

CHAPTER 12
Punishment

Section 132. Whoever violates section 7 shall be liable to a fine not exceeding five hundred baht.

***Section 132 bis.** Whoever fails to comply with the order of the Director under Section 9 octo shall be punished as follows:

(1) Violation of Section 9 octo (1) (a) shall be subject to a punishment of imprisonment for the term of one to three years or a fine of fifty thousand to three hundred thousand baht, or both.

(2) Violation of Section 9 octo (1) (b) (c) (d) or (g) or Section 9 octo (2) (a) or Section 9 octo (3) (e) shall be subject to a punishment of imprisonment for the term not exceeding two years or a fine of ten thousand to a hundred thousand baht, or both, and, in the case where the aforesaid violation continues, by a daily fine of two thousand baht throughout the period of violation.

In case of violation under Section 9 octo (1) (g), if the offender has proved that the violation was necessary and unavoidable for a reason, which was not his fault or was caused by his participation, for the safety of life or property, he shall be exempt from the punishment.

(3) Violation of Section 9 octo (1) (e) or Section 9 octo (2) (b) or Section 9 octo (3) (b) shall be subject to a punishment of imprisonment for the term not exceeding one year or a fine of two thousand to thirty thousand baht, or both.

(4) Violation of Section 9 octo (1) (e) or Section 9 octo (2) (b) or Section 9 octo (3) (a) (c) or (d) shall be subject to a punishment of imprisonment for the term not exceeding one year or a fine of two thousand to thirty

[6] *(As amended by Section 15 of the Minerals Act No.5 B.E. 2545)*

thousand baht, or both and, in the case where the aforesaid violation continues, of a daily fine of five hundred baht throughout the period of violation.

If the holder of an Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, Prathanabat, licencee, or the holder of a permit under this Act committed the offence according to this Section, the Minister shall have the power to revoke the Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, Prathanabat, licence, or permission, as the case may be.

**(Added by Section 8 of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 132 ter.** The owner or possessor of any vehicle, which is being used in the transportation or removal of minerals without the sign as specified by the Director under Section 9 octo (3) (e), shall be liable to a fine of five hundred to five thousand baht.

The transportation or removal of mineral on the public way by the vehicle without the sign under the first paragraph shall be initially presumed to be an illegal transportation or removal of mineral, and the Director or the competent official shall be empowered to issue any order under this Act, unless the owner or possessor of the vehicle can clearly and undoubtedly prove to the competent official who is inspecting it that the official licence or permission is truly original. Any person who has no legal rights to transport or remove mineral and uses the sign prescribed by the Director under Section 9 octo (3) (e) shall be liable to a fine of two hundred to two thousand baht.

**(Added by Section 8 of the Emergency Decree amending the Minerals Act, B.E. 2528)*

Section 132 quarter. Whoever obstructs or does not offer facilities to the Director or the competent official in the execution of his functions as prescribed in Section 9 novem (1) or (2) or fails to comply with the order of the Director, or the competent official, under Section 9 novem (2) (3) or (4) shall be liable to imprisonment for a term not exceeding one year or a fine not exceeding thirty thousand baht, or both.

(Added by Section 8 of the Emergency Decree amending the Minerals Act, B.E. 2528)

Section 133. Whoever violates Section 11, Section 12, or Section 14 shall be liable to imprisonment for a term not exceeding one month or to a fine not exceeding one thousand baht, or to both.

Section 133 bis. Whoever fails to comply with a Ministerial Regulation issued under Section 17 (3 bis) (4) (5) or (6) shall be liable to a fine not exceeding ten thousand baht.

(As amended by Section 7 of the Minerals Act No.4 B.E. 2534)

Section 133 ter. Whoever violates Section 25 shall be liable to imprisonment for a term not exceeding one year or to a fine not exceeding ten thousand baht or to both.

(As amended by Section 34 of the Minerals Act No.2 B.E. 2516)

Section 134. Whoever fails to comply with Section 31 paragraph one or Section 40; or fails to comply with the conditions specified in Section 28 paragraph four or Section 33 paragraph six shall be liable to a fine not exceeding two thousand baht.

(As amended by Section 35 of the Minerals Act No.. B.E. 2516)

***Section 135**. Whoever violates Section 43 or Section 91 bis shall be liable to imprisonment for a term not exceeding three years or a fine not exceeding thirty thousand baht, or both.

In the case where the violation of Section 43 occurred in a mineral restricted area or the violation of Section 91 bis occurred in the underground brine drilling restricted area, the violator shall be liable to imprisonment for a term of two to seven years or a fine of three hundred thousand to five hundred thousand baht, or both.

**(As amended by Section 8 of the Minerals Act No.4 B.E. 2534)*

Section 136. Whoever obstructs, or does not offer facilities, or fails to comply with the order of the competent official in the due exercise of his functions under Section 48, Section 70, Section 91 quarter, Section 117, or Section 124, if such action does not amount to an offence as stipulated in the Criminal Code, shall be liable to a fine not exceeding a thousand baht.

(As amended by Section 9 of the Minerals Act No.4 B.E. 2534)

Section 137. Whoever fails to comply with the order of the Local Mineral Industry Official under Section 71, or Section 91 quinque shall be liable to imprisonment for a term not exceeding three months or to a fine not exceeding five thousand baht and the Minister is empowered to revoke the Prathanabat or the Underground Brine Drilling Licence.

(As amended by Section 9 of the Minerals Act No.4 B.E. 2534)

Section 138. Whoever violates or fails to comply with Section 57, Section 59, Section 62, Section 63, Section 64, Section 67, Section 68, Section 69, or Section 74 or fails to comply with the conditions specified in Section 59, Section 62, Section 63, Section 64, Section 67, Section 68, or Section 74 shall be liable to a fine not exceeding two thousand baht and the Minister is empowered to revoke the Prathanabat.

(As amended by Section 36 of the Minerals Act No.2 B.E. 2516)

Section 138 bis. Whoever fails to comply with Section 60 shall be liable to a fine not exceeding ten thousand baht and the Minister is empowered to revoke the Prathanabat.

(As amended by Section 37 of the Minerals Act No.2 B.E. 2516)

Section 139. Whoever fails to comply with the order of the competent official under Section 72, paragraph two, shall be liable to a fine not exceeding two thousand baht and shall be liable to compensate for the expense of restoring the land to its original condition.

Section 140. The holder of a Prathanabat who violates section 76 shall be liable to a fine not exceeding ten thousand baht and the Minister is empowered to revoke the Prathanabat.

Section 141. The holder of a Prathanabat or sub-lessee of mining operations who fails to comply with the conditions prescribed under Section 77 shall be liable to a fine not exceeding two thousand baht.

Section 142. Whoever violates Section 89 or fails to comply with the conditions prescribed under Section 90 shall be liable to a fine not exceeding one thousand baht.

Section 143. Whoever violates Section 92, Section 99 or Section 101 shall be liable to imprisonment for a term not exceeding six months or to a fine of not exceeding five thousand baht, or both.

Section 144. Whoever fails to comply with the conditions prescribed under Section 93 or Section 102 shall be liable to a fine not exceeding two thousand baht.

Section 145. Whoever violates Section 94 shall be liable to a fine not exceeding two thousand baht.

Section 146. Whoever violates Section 95 shall be liable to a fine not exceeding five hundred baht.

Section 147. Whoever violates Section 98 or Section 100 shall be liable to a fine not exceeding two thousand baht.

Section 147 bis. Any Mineral Storage Licencee, a Mineral Processing Licencee, or a Metallurgical Processing Licencee whose mineral store, mineral processing area, or the metallurgical processing area, as the case may be, is established as a mineral depository, who violates or fails to comply with the conditions as prescribed in the first paragraph of Section 103 ter shall be liable to imprisonment for a term not exceeding one year or to a fine not exceeding ten thousand baht, or both.

(Added by Section 9 of the Emergency Decree amending the Minerals Act, B.E. 2526)

***Section 148.** Whoever violates Section 105 or Section 108 shall be liable to a fine from one to five times the value of minerals based on the price fixed under the law on mineral royalty rates in force on the date of the offence. The Minister has the power to revoke the Provisional Prathanabat, Prathanabat or licence in the case of the following:

(1) illegal possession of minerals from other sources in the mining area, mineral processing area, metallurgical area, storage place or mineral purchasing area, or

(2) illegal transportation of minerals from the mining area, mineral processing area, metallurgical area, storage place or mineral purchasing area.

**(As amended by Section 21 of the Minerals Act No. 3 B.E. 2522)*

If the violation of the first paragraph occurred in the mineral restricted area, the violator shall be liable to imprisonment for a term of one to five years or a fine from two to six times the value of minerals based on the price fixed under the law on mineral royalty rates in force on the date of the offence, or both, and, in such case, the Minister is empowered to revoke the Provisional Prathanabat, Prathanabat, or licence involved, in the case that (1) or (2) is applied.

(Added by Section 10 of the Emergency Decree amending the Minerals Act, B.E. 2528)

Section 148 bis. Whoever violates Section 106 or fails to comply with the conditions prescribed under Section 106 or 109 shall be liable to a fine not exceeding five thousand baht.

(As amended by Section 22 of the Minerals Act No. 3 B.E. 2522)

Section 149. Whoever violates Section 114 or Section 121 or fails to comply with conditions prescribed under Section 115 or Section 122 shall be liable to a fine not exceeding two thousand baht.

Section 150. Whoever violates Section 116 or Section 123 shall be liable to a fine not exceeding two thousand baht.

Section 151. Whoever fails to comply with the orders of the competent official given under Section 118 or Section 125 shall be liable to a fine not exceeding two thousand baht.

***Section 152.** Whoever violates Section 129 shall be liable to imprisonment for a term not exceeding ten years or to a fine from five to ten times the value of minerals based on the price fixed under the law on mineral royalty rates in force on the date of the offence, or both.

When it appears that the illegally exported minerals are from any Provisional Prathanabat, Prathanabat, mineral purchasing area, storage place, mineral processing area or metallurgical area, in which the holder of the Provisional Prathanabat, Prathanabat or licence, as the case may be, is an offender, abettor, or accomplice in the offence, the Minister shall have the power to revoke the said Provisional Prathanabat, Prathanabat, or licence.

Provisions of the customs law and the customs officers' powers invested thereof, especially those concerning inspection, seizure, forfeit, arrest of offenders, false declaration and prosecution, shall also apply to the import and export of minerals subject to the import and export control under Section 129.

**(As amended by Section 23 of the Minerals Act No. 3 B.E. 2522)*

Section 152 bis. Whoever fails to comply with the conditions prescribed under Section 130 shall be liable to a fine not exceeding ten thousand baht.

(As amended by Section 24 of the Minerals Act No. 3 B.E. 2522)

Section 152 ter. In the event of a shortage of minerals from the production stock–book kept by the holder of a Provisional Prathanabat, Prathanabat, or from the balance –in–stock book kept by the holder of a Mineral Purchase Licence, Mineral Storage Licence, Mineral Possession Licence, Mineral Processing Licence, Metallurgical Processing Licencee; or a person whose mineral store, mineral processing area, or metallurgical processing area is also a mineral depository, who cannot prove that the shortage of such minerals is not his fault, the holder of a Provisional Prathanabat, Prathanabat, Mineral Purchase Licence, Mineral Storage Licence, Mineral Possession Licence, Mineral Processing Licence, Metallurgical Processing Licence; or a person whose mineral store, mineral processing area, or metallurgical processing area is a mineral depository, as the case may be, shall be liable to a fine from one to three times the value of the missing minerals based on the price fixed by the law on mineral royalty rates in force on the date of the offence, and, in such case, the Minister is empowered to revoke the Provisional Prathanabat, Prathanabat, licence, or mineral depository involved.

(Added by Section 10 of the Emergency Decree amending the Minerals Act, B.E. 2526)

Section 153. As for the commission of an offence which is liable to imprisonment for a term not exceeding one month or a fine not exceeding ten thousand baht, the competent official shall have the power to settle it.

Section 153 bis. As for the commission of an offence according to Section 148 paragraph one or Section 152 ter, the Director-General shall have the power to settle it with a fine at the amount of no less than the minimum set by the law. Payment of the fine by the offender shall bring the case to extinction.

(Added by Section 11 of the Emergency Decree amending the Minerals Act, B.E. 2528)

***Section 154**. All minerals, equipment, tools, appliances, beasts of burden, vehicles or machinery which a person acquires or uses in the commission of an offence, or possesses for use in the commission of an offence or uses as accessory to derive results from the commission of an offence under Section 132 bis, Section 132 ter, Section 132 quarter, Section 133, Section 133 ter, Section 135, Section 138, Section 142, Section 143, Section 145, Section 147, Section 148, Section 148 bis, Section 152 or Section 152 bis, shall be forfeited wholly, regardless of any person being sentenced by a judgment.

A prosecutor shall submit a request to the court to give orders for the forfeiture of the properties according to the first paragraph, and upon such request submitted by the prosecutor, the competent official shall publish the request at least two consecutive days in a local daily newspaper to allow the person who may claim to be the owner to submit a request to enter into the case before the court of first instance pronounces a judgment, whether there appears a person who is deemed to be the owner or not.

In the case where no person claims to be the owner before the court of first instance pronounces a judgment, or the owner cannot prove to the court that he does not know or there is no reason for him to suspect that the commission of such an offence has occurred, granted that he has exercised such care as may be expected to prevent such offence, or cannot prove to the court that he does not know or there is no reason for him to suspect that the properties are used in the commission of such offence according to this Act, the court shall order a forfeiture of such property after thirty days

from the date of publication in the local daily newspaper as prescribed in the second paragraph, and, in this case, Section 36 of the Penal Code shall not be applied.

**(Added by Section 12 of the Emergency Decree amending the Minerals Act, B.E. 2528)*

***Section 155**. In the case of the offence under Section 132 bis, Section 132 ter, Section 133 ter, Section 135, Section 142, Section 143, Section 145, Section 147, Section 148, Section 148 bis, Section 152, Section 152 bis, or Section 152 ter, the Director-General is empowered to order the payment of rewards to the informer who supplies information leading to the arrest and to the person who makes the arrest in accordance with the Ministerial Regulations as published in the Government Gazette at the total rate of no more than fifty five percent of the net sale of the exhibits or fine, as the case may be. In the prescription of the rates of the reward for the informer or the reward for the arresting party, the Minister may prescribe the payment of such rewards in the case where there appears an accused person and/or offender criminally convicted by a final judgment more than the payment of the rewards in the case where there appears no accused person and/or no offender convicted by a final judgment.

The reward for an informer and reward for the arresting party according to the first paragraph shall be paid, by the Director-General, from the sale of the exhibits forfeited by the court, or from the fine paid to the court in the case where the exhibits are not forfeited by the court or are unsaleable, or from the settlement fine in the event that the case is extinguished through the settlement of fine or the sale of exhibits, which become the properties of the State under Section 15 quinque. In the event where the case is concluded by the settlement of fine, the competent official who has the power to settle the case, as appointed by the Director-General, shall order the payment and may stipulate any condition thereof.

**(Added by Section 12 of the Emergency Decree amending the Minerals Act, B.E. 2528)*

CHAPTER 13
Transitory Provisions

Section 156. The provisions of Section 89 where they relate to artisanal mining, Section 101, Section 105 and Section 114 shall not apply until sixty days after this Act has come into force.

Section 157. During the period before Ministerial Regulations or Proclamations under this Act are issued, all the Ministerial Regulations and Proclamations under the laws relating to mining which are in force on the day this Act is published in the Government Gazette shall continue to apply in so far as that they are not contrary or contradictory to the provisions of this Act.

Section 158. During the period before the laws relating to petroleum are promulgated, the provisions of this Act shall temporarily apply to petroleum *mutatis mutandis*.

Section 159. Whoever wishes to obtain an Exclusive Prospecting Atchayabat to prospect for petroleum shall submit to the Director-General an application together with a map showing the area for which an Exclusive Prospecting Atchayabat to prospect for petroleum is applied.

Section 160. Whoever wishes to obtain a Prathanabat to mine for petroleum shall submit to the Director-General an application together with a map showing the area for which the Prathanabat is applied.

Section 161. The Minister is empowered to prescribe, by publication in the Government Gazette, the zonal areas, validity periods, principles, procedures, conditions, and benefits to accrue to the State in issuing an Exclusive Prospecting Atchayabat to prospect for petroleum and in issuing a Prathanabat to mine for petroleum, which may differ form the provisions of this Act.

Section 162. The holder of an Exclusive Prospecting Atchayabat to prospect for petroleum shall be exempted from the mining area rental fee under Section 26.

The holder of a Provisional Prathanabat to mine for petroleum or the holder of a Prathanabat to mine for petroleum shall be exempted from the mining area rental fee under Section 55.

Section 163. All Prathanabats, Atchayabats, or licences issued under the laws repealed under Section 3 prior to the date this Act comes into force, shall be deemed to be Prathanabats, Atchayabats, or licences issued under this Act until their expiry.

Countersigned by
Field Marshal Thanom Kittikachorn
Prime Minister

Remark: The reason to promulgate this Act is due to the fact that at the present time there are many laws concerning minerals which shall be combined into a single code and amended in such a way that the State has the power to manage mineral productions, conservation, purchases, and metallurgical processes, and at the same time shall facilitate the mining entrepreneurs while providing protection to labourers as well as public safety in accordance with the most recent conditions.

Schedule of Fees[7]

Serial No.	Particulars	Rates of fees
1	Fee for an application, each	20 baht
2	Fee for a Prospecting Atchayabat, each	100 baht
3	Fee for an Exclusive Prospecting Atchayabat, each	500 baht
4	Fee for a Special Atchayabat or its renewal, each	1000 baht
5	Fee for a Provisional Prathanabat	1000 baht
6	Fee for a Prathanabat or its renewal, each	1000 baht
7	Fee for a licence or its renewal, each	1000 baht
8	Mining area rental fee	
	(a) under an Exclusive Prospecting Atchayabat or a Special Atchayabat, every 1 rai or a fraction thereof, each year	6 baht
	(b) under a Prathanabat or Provisional Prathanabat, every 1 rai or a fraction thereof, each year	20 baht
9	Fee for surveying, every 40 metres of the length of traverse or a fraction thereof	20 baht
10	Fee for map drawing or duplicating, the first 50 square centimeters of area in the map or less, each sheet;	20 baht
	for every subsequent 50 square centimeters or a fraction thereof;	5 baht
	but not exceeding per copy	200 baht
11	Examining fee, each case	100 baht
12	Mining boundary demarcation post, each	100 baht
13	Fee for a transfer of Prathanabat, each	500 baht
14	Fee for a transfer of mining rights	4 per cent
15	Fee for technical examining, testing or analyzing each mineral sample.	1000 baht
16	Copying or photocopying fee, each page	10 baht
17	Documents certifying fee, each document	50 baht
18	Fee for inspecting documentary evidence, each matter	100 baht
19	Fee for filling in an application at the request of the applicant, each application	5 baht
20	Replacement certificate of an Atchayabat, a Provisional Prathanabat, Prathanabat or licence, each	200 baht
21	Fee for registration of power of attorney, each	100 baht
22	Fee for suspension of mining operations, every 1 rai or a fraction thereof, each year.	20 baht
23	Fee for damming up or pumping water, calculated from every cubic metre, or a fraction thereof, of water used per 1 minute.	100 baht

[7] *As amended by the Minerals Act (No. 4) B.E. 2534*

Part II

Selected Ministerial Regulations
Issued in Accordance with the Minerals Act B.E. 2510

Ministerial Regulation
No. 9 (B.E. 2513)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17 of the Minerals Act B.E. 2510, the Minister of National Development has issued the Ministerial Regulation as follows:

The procedures to provide protection and safety for workers and the third persons are the followings:

1. A holder of Prathanabat, Provisional Prathanabat, Mineral Processing Licence, or Metallurgical Processing Licence shall provide first-aid necessities without any charge to help workers in a timely manner in the case that they are injured or sick.

2. When an accident occurs resulting in human fatality or inability to work within 48 hours, or more than 48-hour shutdown of the operation and the accident causing the shutdown may harm workers or the third persons; the holder of Prathanabat, Provisional Prathanabat, Mineral Processing Licence, or Metallurgical Processing Licence shall report the incidence to the Local Mineral Industry Official within 72 hours after the accident. However, in case the inability to work or the required shutdown takes less than 48 hours, the holder shall make a report in the official monthly report form, which is designated by the Department of Primary Industries and Mines, no later than the fifth day of the following month.[1]

3. The holder of a Prathanabat, Provisional Prathanabat, Mineral Processing Licence, or Metallurgical Processing Licence must provide drinking water, water supply, lighting, and lavatory in hygienic condition for the workers in a mining area, mineral processing area, or metallurgy area.

4. The holder of a Prathanabat, Provisional Prathanabat, Mineral Processing Licence, or Metallurgical Processing Licence must perform as follows.

[1] *As amended by the Ministerial Regulation No. 50 (B.E. 2525)*

CHAPTER 1
General Provisions

1) Appoint a representative upon the absence of the statutory tenant of mining area, mineral processing area, or metallurgy area.
2) In case more than 20 workers are employed, arrange to have a supervisor to look after routine operation for safety and accident prevention during mining, mineral processing, or metallurgical processing. In addition, the results of the safety inspections must be documented in order to present to the competent official.
3) Cooperate by sending personnel to be trained at the training center on the supervision of the operation with regard to the accidental protection and first aid.
4) Keep the mining face in the condition that is safe from sliding, collapsing, and falling of any objects that may cause harm to persons, and arrange a chief worker or a deputy for close supervision throughout the period of operation.
5) Provide sufficient lighting for operation at the mining face, mineral processing plant, or metallurgical processing plant.
6) Equip all the buildings in mining, mineral processing, or metallurgy area with fire extinguishers.

CHAPTER 2
Provisions on the Use of Water Jet Monitor

7) Prevent any person from standing in front of a water jet monitor while loosening the ground. In case of necessity in doing so, stop the water jet first.
8) Keep the distance between the monitor and the mining face at no less than the height of the face to be mined.
9) Arrange to have an operator in active duty at all times during ground loosening by water jet.

CHAPTER 3
Provisions for Machine and Equipment Operation

10) Allow only authorized person to operate the equipment.
11) Well-fitting dress must be worn by the operator when working around moving parts of the equipment.
12) Machines, belt conveyors, gears, crankcases, or flywheels, which may cause accident or fatality to workers, must be covered with protection for safety.
13) The pulleys that are located no higher than 2.5 metres above the ground must have protected cover for safety.
14) Prevent anyone from operating any equipment unless it is certain that nobody else is in the vicinity that may be harmed by the equipment.

15) The walkways along equipment need to have suitable spacing. In case they are in the limited space between equipment, there must be side protection against the equipments for safety on both sides of the walkways.
16) Designate that the operator of a stone grinding machine must wear safety glasses.
17) Maintain every vehicle with good working condition of brakes and signals.

CHAPTER 4
Provisions on the Use of Boiler

18) Arrange for a routine check inside the boilers at least once a year.
19) Arrange for regular checks on the safety valves.
20) Keep a water-level gauge, vapor-pressure gauge and their accessories in a clear and good working condition.
21) Prevent anybody from repairing the boilers and their connected accessories while the vapor pressure is active.
22) Arrange for at least two exits in a boiler room. In case there are door panes, they must be pushed open only in an outward direction.

CHAPTER 5
Provisions on the Use of Electricity

23) Arrange the high-voltage power lines to be installed at no less than 5 metres above the ground. If the installation across any buildings or structures is necessary, the power lines need to be installed at least 3 metres in height above these structures.
24) Provide lightning protection facilities for electrical devices and high-voltage circuits.
25) Post a sign “Danger-High Voltage” to be clearly seen by using red-coloured letters on white background board to the place where a transformer or a high-voltage panel is installed.
26) Provide ground lines for any parts that may have electrical leak, e.g., metal structure, outer-covering, motor cover, generator cover, electrical panel or other electrical devices.
27) Regularly check the ground lines to ensure they are in good working condition.
28) Provide the electrical control panel with the following:
    (a) enough room around the panel for convenient operation,
    (b) sufficient lighting, and
    (c) emergency circuit breaker.
29) Designate clear displaying devices for all switches to signal their functioning.
30) Prevent any person from working on the electrical circuit that still has active electric current unless it is necessary.
31) When the high-voltage circuit is switched off, there must be a fastening or a key lock combined with the clearly-shown sign “Danger-Do Not Switch On.”
32) Prevent anybody from switching on any circuit unless it is certain that nobody else is operating on the circuit.

33) Prevent any person from wrapping active cable line that still has electric current.
34) The power lines connected into a building, or installed inside a building or structures must be insulated.

CHAPTER 6
Provisions on the Use of Explosives

35) Arrange to have the explosive magazine in the following manner:
    (a) The magazine building must be fire-proof, water-proof, as well as bullet-proof. The floor material must have no potential to spark.
    (b) The magazine must be located at no less than 75 metres from any other building, and no less than 100 metres from a main shaft or an access to underground working area.
    (c) Always keep the magazine securely locked.
    (d) Post the sign "Danger-Explosives" to be clearly seen using red-coloured letters on a white board.
    (e) Provide good ventilation.
36) Keep high explosives at least 30 metres away from the detonators or the detonating cord magazine, and put them separately in two different magazines.
37) Arrange for an exclusive magazine to keep only explosives.
38) There must be no dry weed or any flammable material within 8 metres around the magazine.
39) Make a balance record to show to the officials the remaining amount of high explosives, detonators and detonating cords.
40) Prevent the use of deteriorated explosives.
41) Prevent any person from carrying detonators together with high explosives.
42) Prevent any person from transporting the following together with explosives: any metal, tools made of metal, fuel, matches, acid, or any flammable material.
43) Allow only the operator with direct responsibility to make the loading of explosives, with the requirement to move away any flame to a safe distance from the blasting site.
44) Prevent any person from smoking during any operation on explosives.
45) Allow only wooden materials to be used during loading operation.
46) Return the remaining explosives to the magazine immediately after daily use.
47) Before each blasting, the blaster must give the signals known to everybody, and at least 15 minutes after the blast to provide the signals of the safe area that has no dust and smoke, prior to the workers can re-access for working.
48) Safety fuse in use must be at least 1 metre in length.
49) Use only the pliers designed for crimping a plain detonator with safety fuse.
50) Prevent any person from using any other material except copper or wooden tool to pierce into high explosives for the insertion of plain detonator with safety fuse.
51) Electric blasting must be operated as follows:
    (a) Short-circuit the two lines of the detonator until the blasting is ready.
    (b) Short-circuit the two electric leading lines for the blast until the blasting is ready.
    (c) When the blast is ignited from an electric circuit, use the two-way switch that must is placed at a safe distance from the blasting area, and maintain short-circuit the two electrical lines until the blasting is ready.

52) In case of misfire after the blast, blast them out first before any operation is conducted in that area. Drill a new hole parallel to the misfired holes by applying at least 50 centimeters spacing between holes.
53) Post the signs “Danger-Blasting Area” to be clearly seen through red-coloured letters on white background board, and put them within 100 metre radius around the area.

CHAPTER 7
Provisions for Dredging

54) Before starting any moveable parts of any equipment in a dredge, keep everybody away from the parts at a safe distance.
55) Give known signals audible to all persons, before starting to move bucket chain or trommel.
56) Provide sufficient illumination at all ladders and walkways. Handrails must be installed at all ladders.
57) Take precaution not to put any equipment or tools/devices in a possibly rolling-out or falling-down manner.
58) During dredging operation, the head and swing lines must be able to move without any obstruction along their length. Take precaution not to allow any person to cross, to go under, or to approach near the head and the swing lines.
59) If the head and the swing lines need to be cast across the walkway or the roadway, relocate them at a safe distance. In this case, a prior approved document by Local Mineral Industry Officials must be referred before taking such an action.
60) Arrange a supervisor to facilitate as well as to provide safety for the passing-by barges or boats, in case of necessity to cast the head or the swing lines across the public waterway.
61) Provide sufficient easy-access life-savers for the workers in the dredge.
62) Put the signs “Danger from Dredge Lines” in a clearly seen manner, using red-coloured letters on white boards; and post them at regular intervals along the lines with the distance between 10 to 30 metres away from the lines.
63) Prevent any person from working in the water near the dredge during dredging.

CHAPTER 8
Provisions on Excavators

64) Prevent any person from approaching near the excavating, mucking, grading or bulldozing equipment during its operation.
65) Designate the employees working around excavators to wear safety hats and safety shoes.

CHAPTER 9
Provisions on Underground Mining

66) Provide good ventilation according to the appropriate technical practice, and supply the minimum amount of 1.5 cubic metres per minute per manpower working underground.
67) Prevent any person from working in the underground area that has oxygen less than 20 percent by volume, or carbon dioxide or other toxic gases more than 0.5 percent by volume, or methane more than 1 percent by volume.
68) Provide at least two accesses to the underground, with the exception at the development stage prior to ore production that one access is temporarily allowed.
69) Prevent any person from using any fuel consuming equipment underground, except with the written approval from the Local Mineral Industry Officials.
70) Use only electric, dry cell, carbide lantern, or candle to illuminate underground; however, the underground coal mine must be illuminated by electric or dry cell only.
71) Provide strong and stable supports for shafts, adits, and tunnels.
72) Prevent any person from making a support stretching out further than 2.5 metres span.
73) Take precaution not to allow any person to work in an unsafe adit or tunnel, unless a safe condition can be managed.
74) In order to take precaution against danger or accident to persons or properties, assign a shift supervisor to inspect the following: shaft and tunnel supports, ventilation system, machinery, hoisting wire ropes, and other activities. In case of any defect or malfunction, immediately correct it to obtain safe condition. Always make each shift fill out an inspection record as evidence to present to competent officials.
75) Arrange to have the mining faces checked before any blast hole drilling. If unsafe, support them to be in a safe condition before making any operation.
76) After blasting, arrange to have the adit or tunnel checked for safe condition before making any successive operation.
77) Provide each underground operator with personal dry cell or carbide-lantern.
78) The shaft that is used as a passage way, if equipped with ladders, must be in rigid and safe condition, with no less than 50 centimeters in width, no more than 30 centimeter between steps, and the minimum area of 60x120 centimeters for the platforms which should not be more than 8 meter interval.
79) Prevent any person from being transported up and down along a shaft using manual or rope winch.
80) In case of using equipment to hoist workers up/down along the shaft, the hoisting speed must not be more than 300 metres per minute, and needs to be equipped with safety protection.
81) The hoisting rope must be strong enough to withstand both the load to be hoisted up/down and the weight of the rope itself. It is compulsory to have the factor of safety at least 6 times the specified load to be used.
82) Spray water into the drilled holes at all times when drilling blast holes with a drilling machine, unless having sufficient dust protection.
83) To use mine cars for transportation, there must be in good condition, equipped with sound-signal devices, and headlights at the locomotive, and light signals at the last mine car. The locomotive with its trailing mine cars need to have the minimum

clearance of 60 centimeters from each side of the adit or tunnel wall. Also, take precaution not to allow any loading stretched out from the mine car carrier. The rails as well as the switching keys must be in good working condition.

84) Take precaution not to allow any unauthorized person to accompany in the explosive transporting vehicles. The explosive truck must have a minimum traveling distance of 100 metres from other vehicles. During transportation, the explosives must be contained in the cases or packages that are made of materials non-conductive to electricity or heat.
85) Explosive containers that are used underground must be made of materials not conductive to electricity or heat, and must be at least 8 metres away from the engine-driven machine or the power line.
86) Assign the underground operators to wear safety hats and safety shoes.
87) Arrange to store fuel, lubricant, and grease to be used underground only in containers with tight covers.
88) Prevent the following persons from working underground: any person under 18 years of age, female, unhealthy person, any person with contagious diseases.
89) Except for the worker or the person involved in the underground operation, other persons are not permitted to go underground, unless accompanied by a mine personnel.

Given on the 24th day of March B.E. 2513
Signed by Poj Sarasin
Minister of National Development

Remark: The reason for the Ministerial Regulations to be promulgated is for the purposes of providing the workers with safety environment during working, hygienic living, justice to be received from employers in case of accidents, and no grievance to the third person because of the operations.

Ministerial Regulation
No. 10 (B.E. 2513)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17 and Section 67 of the Minerals Act B.E. 2510, the Minister of National Development has issued the Ministerial Regulation as follows:

The allowable content of discharged slime or tailings from mining operations, out of the mining area shall not contain solid matter or tailings in excess of 6 grams per one litre of slime.

The slime or tailings concentration to be discharged out of the mining area shall be defined as the sample that officials collect from the last dewatering gate with the volume of at least one litre.

Given on the 24th day of March B.E. 2513

Signed by Poj Sarasin
Minister of National Development

Remark: The reason for promulgating this Ministerial Regulation is to protect public waterways from becoming shallow and prevent damage to agriculture.

Ministerial Regulation
No. 13 (B.E. 2513)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17 and Section 112 of the Minerals Act B.E. 2510, the Minister of National Development has issued the Ministerial Regulation as follows.

The kinds and the amounts of admixed minerals in natural condition that prevent a holder of a Mineral Transport Licence from transporting them are:

1) Tin, exceeding four percent
2) Tungstic oxide, exceeding four percent
3) Columbium/Tantalum pentoxide, altogether exceeding two percent
4) Zinc, exceeding eight percent
5) Lead, exceeding ten percent
6) Gold, exceeding five grams per ton
7) Silver, exceeding one hundred grams per ton

Given on the 24th day of March B.E. 2513

Signed by Poj Sarasin
Minister of National Development

Remark: The reason for the Ministerial Regulation to be promulgated is for the purpose of regulating a holder of a Mineral Transport Licence not to transport other minerals which is required to pay for royalties along with the minerals specified in the licence.

Ministerial Regulation
No. 19 (B.E. 2516)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 6 and Section 17 of the Minerals Act B.E. 2510 amended by the Minerals Act (No. 2) B.E. 2516, the Minister of industry has issued the Ministerial Regulations as follows:

CHAPTER 1
Qualifications of the Applicant for Atchayabat, Prathanabat, and Licence

Article 1. For the minerals other than gold, the applicant for Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, and Prathanabat shall have the following qualifications and characters[1]:

(1) Not being under 20 years of age.
(2) Having a domicile or residence in the Kingdom.
(3) Being a member of the Mining Council.
(4) Not being a person of unsound mind, mental infirmity, incompetence, or quasi-incompetence.
(5) Not being a bankrupt person.
(6) Having never received a revocation of the application or a cancellation of the Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat or Prathanabat with the exception that more than 12 months has elapsed since the last issuance of the revocation or cancellation, or with the exception that the reason for the revocation or cancellation is not a result of the applicant's or the revoked person's fault.
(7) Having never been punished for the violation of Section 25 or Section 43 of the Minerals Act B.E. 2510, with the exception that more than 12 months has elapsed since the punishment is over.

In case the applicant is a juristic person, they shall have the qualifications and characters as specified in (2), (3), (6), and (7).

The provision under paragraph (3) shall not be applicable to the governmental body or state enterprise applying for Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, or Prathanabat.

Article 1 bis.[2] The applicant for Special Atchayabat, Provisional Prathanabat and Prathanabat for prospecting and mining for the gold ore within the area specified by

[1] *As amended by the Ministerial Regulation No. 64 (B.E. 2530)*

[2] *As amended by the Ministerial Regulation No. 64 (B.E. 2530)*

Ministry of Industry shall have the following qualifications and characters in addition to the provisions according to Article 1 (3), (6), and (7).

(1) Being a company
(2) Having the registered capital no less than 50 million baht, or registered capital plus the assets altogether no less than 50 million baht.
(3) Having sufficient tools, machinery, equipment, and specialists to be able to prospect for the reserves as well as to operate a gold mine.

In case the applicant does not have the qualifications specified in (3) above, there must be another company accredited by Department of Primary Industries and Mines, which is qualified according to (3) and has relationship both in capital investment and management with the applicant. The accredited company shall guarantee sufficient supply of tools, machinery, equipment, and specialists for prospecting and operation of a gold mine.

For the submission of an application, the applicant shall provide the evidence indicating the above qualifications and characters together with the application form.

Article 1 ter.[3] The applicant for Special Atchayabat, Provisional Prathanabat, and Prathanabat for the gold mine outside the area specified by the Ministry of Industry shall have not only the qualifications according to Article 1 (1) to (7), but also the ones under Article 1 bis. (3), or Article 1 bis paragraph 2.

In case the applicant is a company, it shall have the qualifications and characters in accordance with Article 1 (3), (6), (7) and Article 1 bis (3) or Article 1 bis paragraph 2.

For the submission of an application, the applicant shall provide the evidence indicating the above qualifications and characters together with the application form.

Article 2.[4] The following qualifications are required for the applicant for a Mineral Purchase Licence, Mineral Storage Licence, Mineral Processing Licence, Metallurgical Processing Licence, Mineral Import Licence and Mineral Export Licence:

(1) Not being under 20 years of age.
(2) Having a domicile or residence in the Kingdom.
(3) Being a member of the Mining Council.
(4) Not being the person of unsound mind, mental infirmity, incompetence, or quasi-incompetence.
(5) Not being a bankrupt person.
(6) Having never received a revocation of the application or cancellation of the licence, with the exception that more than 12 months has elapsed since the last issuance of the revocation or cancellation, or with the exception that the reason for the revocation or cancellation is not a result of the applicant's or the revoked person's fault.

The applicant who is a juristic person shall have the qualifications and characters as specified in (2), (3), (5), and (6).

The provision under (3) is not applicable to the applicant, which is a governmental body or state enterprise.

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[3] *As amended by the Ministerial Regulation No. 64 (B.E. 2530)*

[4] *As amended by the Ministerial Regulation No. 52 (B.E. 2526)*

Article 2 bis.[5] Except for the licences specified in Article 2, the applicant for other licences shall have the following qualifications:

(1) Not being under 20 years of age
(2) Having a domicile or residence in the Kingdom
(3) Not being the person of unsound mind, mental infirmity, incompetence, or quasi-incompetence.
(4) Not being a bankrupt person.
(5) Having never received a revocation of the application or cancellation of the licence, with the exception that more than 12 months has elapsed since the last issuance of the revocation or cancellation, or with the exception that the reason for the revocation or cancellation is not a result of the applicant's or the revoked person's fault.

The applicant who is a juristic person shall have the qualifications as specified in (2), (4), and (5).

Article 3.[6] The provisions under the Ministerial Regulation No. 19 (B.E. 2516) issued under Minerals Act B.E. 2510, which is later on amended by the Ministerial Regulation No. 30 (B.E.2517) issued under Minerals Act B.E. 2510, that are repealed or amended by this Ministerial Regulation, will remain in force for the consideration of the application for an Exclusive Prospecting Atchayabat, Special Atchayabat, Provisional Prathanabat, Prathanabat, and all other licences submitted before or on the date this Ministerial Regulation becomes effective.

CHAPTER 2
Rules, Procedures and Conditions Concerning Application for Atchayabat, Prathanabat and Licences

Article 3. For the submission of an application for an Exclusive Prospecting Atchayabat, the applicant shall enclose document as specified in the application form as well as the following items.

(1) The map designating the prospecting area in the application form, the boundary of which shall have all sides superimposed on the grid lines of the military map with the scale of 1:50,000 or 1:25,000, and also providing the U.T.M. coordinates at a corner of the map.
(2) Enclosed evidence indicating sufficient capital investment for the prospecting as prescribed by the Department of Primary Industries and Mines, together with the prospecting plan and methods that provide a list of items as prescribed in the Ministerial Regulation issued under Section 17 (3) of the Minerals Act B.E.2510.[7]

[5] *As amended by the Ministerial Regulation No. 52 (B.E. 2526)*

[6] *As amended by the Ministerial Regulation No. 52 (B.E. 2526)*

[7] *As amended by the Ministerial Regulation No. 69 (B.E. 2534)*

Article 4. For the submission of an application for a Special Atchayabat, the applicant shall enclose the evidence as specified in the application form and present additional items as follows:

(1) The map designating the prospecting area in the application form, the boundary of which shall have all sides superimposed on the grid lines of the military map with the scale of 1:50,000 or 1:25,000, and also providing the U.T.M. coordinates at a corner of the map.
(2) Enclosed evidence indicating sufficient capital investment for the prospecting, together with the prospecting plan and methods that provide a list of items as prescribed in the Ministerial Regulation issued under Section 17 (3) of the Minerals Act B.E.2510.
(3) Presentation of the prospecting obligations by specifying the expenses for yearly prospecting during the valid life of an Atchayabat.
(4) Presentation of the detailed special benefits intended to offer to the state in return, such as financial consideration, scholarship, or grant to the government, upon obtaining Special Atchayabat.

Article 5. To apply for Prathanabat, the applicant needs to enclose documental evidence as specified in the application form, as well as to provide the following:

(1) The map designating the mining area in the application form, the details of which shall include a map scale, map direction, and the indicated distance of all sides, together with the U.T.M. coordinates of any one corner of the map.
(2) Evidence on capital investment.
(3) When the competent official has demarcated the Prathanabat area, the applicant shall hand in the proposal and plan for the mining project that provides a list of items as specified in the Ministerial Regulation issued under Section 17 (3) of the Minerals Act B.E.2510.

Article 6. An application for a Provisional Prathanabat shall be submitted only after the completion of all the processes in Article 5.

Article 7. For the submission of an application for a Mineral Processing Licence and a Metallurgical Processing Licence, the applicant shall enclose evidence specified in the application form and additional items as follows:

(1) The map designating a mineral processing area or a metallurgy processing area, as the case may be.
(2) The flowchart and mineral processing method, or the flowchart and metallurgical processing method, as the case may be, indicating a list of items as prescribed in the Ministerial Regulation issued under Section 17 (5) of the Minerals Act B.E. 2510.

Article 8. For the submission of an application for any other licence, the applicant shall enclose the evidence specified in the application form.

CHAPTER 3
Rules, Procedures, and Conditions for Renewal of a Mineral Processing Licence and Metallurgical Processing Licence

Article 9. For a renewal of a Mineral Processing Licence or Metallurgical Processing Licence, the application shall be submitted at least 60 days before the expiration date of the licence.

Given on the 25th day of July B.E.2516

Signed by General K. Seevarar
Minister of Industry

Remark: The reason to promulgate this Ministerial Regulation originates from Section 6 of the Minerals Act B.E. 2510, as amended by the Minerals Act (No 2.) B.E. 2516, which sets the applicant's qualifications, rules, procedures, and conditions required for applying for an Exclusive Prospecting Atchayabat, Special Atchayabat, Prathanabat, Provisional Prathanabat, licences, and also in renewal of a Mineral Processing Licence and Metallurgical Processing Licence.

Ministerial Regulation
No. 20 (B.E. 2516)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17, Section 34, and Section 47 of the Minerals Act B.E. 2510, as amended by the Minerals Act (No. 2) B.E. 2516, the Minister of Industry has issued the Ministerial Regulations as follows:

Rules

Article 1. For the following cases, use the surveying method specified in Article 3 to demarcate the boundary of the area for Exclusive Prospecting Atchayabat, Special Atchayabat, or Prathanabat:

(1) When there is a dispute or an error about the boundary of the area.
(2) When the competent official deems expedient.

Article 2. With the exception of Article 1 above, the methods specified in Article 4 shall be applied to demarcate the boundary of the area for Exclusive Prospecting Atchayabat, Special Atchayabat, or Prathanabat.

Procedures

Article 3. In order to demarcate the boundary of the area for Exclusive Prospecting Atchayabat, Special Atchayabat, or Prathanabat by using the surveying methods, one or several of the following procedures shall be applied:

(1) Make a close traverse by theodolite and chain.
(2) Make a close traverse by theodolite and electronic device to measure distance.
(3) Measure a distance by using theodolite or electronic measuring device.
(4) Make a survey by using triangulation method.

Article 4. Employ one of the following methods in case of using other means to demarcate the boundary of the area for Exclusive Prospecting Atchayabat, Special Atchayabat, or Prathanabat.

(1) Demarcate the boundary of the area in the military map of the scale 1:50,000 or 1:25,000.
(2) Demarcate the boundary of the area by making a benchmark to find international Cartesian coordinates (Universal Traverse Mercator Coordinates or U.T.M. coordinates) and its grid azimuth.

Given on the 25th day of July B.E. 2516

Signed by General K. Seevarar
Minister of Industry

Remark: The reason to promulgate originates from Section 34 and Section 47 of the Minerals Act B.E. 2510, as amended by the 2nd issue B.E. 2516, which sets rules and procedures to designate the area of Exclusive Prospecting Atchayabat, Special Atchayabat, and Prathanabat by means of surveying method or other methods specified in the Ministerial Regulation, thus making it necessary to issue this Ministerial Regulation.

Ministerial Regulation
No. 21 (B.E. 2516)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 4 and Section 17 of the Minerals Act B.E. 2510, as amended by the Minerals Act (No. 2) B.E. 2516, the Minister of Industry has issued the Ministerial Regulation as follows:

Article 1. The Ministerial Regulation No. 18 (B.E. 2516) issued under the Minerals Act B.E. 2510 shall be repealed.

Article 2. This article was repealed and amended by the Ministerial Regulation No. 77 (B.E. 2539).

Article 3. This article was repealed and amended by the Ministerial Regulation No. 77 (B.E. 2539).

Article 4. Designate the followings as industrial soils:
(1) Fire Clay
(2) Diatomite or Diatomaceous Earth
(3) Marl
(4) Kaolinite
(5) Ball Clay

Article 5. Designate glass sand and silica sand to be industrial sand.

Given on the 25th day of July B.E. 2516
Signed by General K. Seevara
Minister of Industry

Ministerial Regulation
No. 24 (B.E.2516)
Issued in Accordance with the Minerals Act B.E.2510

By virtue of Section 17 of the Minerals Act B.E. 2510, as amended by the Minerals Act (No.2) B.E. 2516 and Section 128 of the Minerals Act B.E. 2510, the Minister of Industry has issued the Ministerial Regulation as follows:

1. The Ministerial Regulation No. 7 (B.E. 2512) issued under the Minerals Act B.E.2510 shall be repealed.

2. An import of minerals of the following kinds, conditions, and quantities into the kingdom shall be restricted by this Act:
   (1) Tin ore, in excess of two kilograms.
   (2) Tin metal or tin alloy, in excess of two kilograms.

3. An export of minerals of the following kinds, conditions, and quantities shall be restricted by this Act:[1]
   (1) Tin ore, in excess of fifty grams.
   (2) Gold ore of any quantity.
   (3) Copper ore, in excess of two kilograms
   (4) Zinc ore, in excess of two kilograms
   (5) Iron ore, in excess of two kilograms
   (6) Minerals containing colombium, tantalum, or thorium, and others with radio-active contents irrespective of the quantity.
   (7) Dolomite, in excess of one metric ton.
   (8) Barite, in excess of one metric ton.
   (9) Pyrophyllite, in excess of one metric ton.
   (10) Feldspar, in excess of one metric ton.
   (11) Gypsum, in excess of one metric ton.
   (12) Kaolin, in excess of one metric ton.

Given on the 25th day of July B.E. 2516

Signed by Gen. K. Seevarar
Minister of Industry

[1] *The statements in Article 3.(7), (8), (9), (11) and (12) were added by the Ministerial Regulation No. 73 rd. (B.E. 2537), which are printed herein.*

Ministerial Regulation
No. 25 (B.E.2517)
Issued in Accordance with the Minerals Act B.E.2510

By virtue of the Section 17 of the Minerals Ac. B.E. 2510 amended by the Minerals Act (No. 2) B.E. 2516, the Minister of Industry has issued the Ministerial Regulation as follows:

CHAPTER 1
Rules and Methods for Mineral Processing

1. For mineral processing, a single or several methods from the following shall be employed:
   (1) Crushing, grinding or classifying of the ore, including washing by water.
   (2) Hand sorting.
   (3) Separation by applying different specific gravity, for example, the methods using a lanchute, jig, shaking table, Humphrey's spiral or cyclone.
   (4) Magnetic separation.
   (5) Electrostatic or high tension separation.
   (6) Flotation.
   (7) Chemical method.
   (8) Other methods approved by the Director-General.

2. Flowsheet and method for mineral processing shall provide the followings:
   (1) The types of ore to be processed.
   (2) The processing method and the flowsheet to illustrate the mineral processing.
   (3) The list of machinery and equipment for mineral processing, including their sizes and horsepower used.
   (4) The location of machinery and equipment to be used for mineral processing.
   (5) The methods for storing tailing waste, slime water, dust protection and suppression, and disposal of toxic matters. If there is none of the aforesaid, notify that there is no toxic substance to be discharged out of the mineral processing area.
   (6) The method for dewatering from mineral processing area.
   (7) The map with appropriate scale showing location of mineral processing plant and mineral processing areas, roads and distance from the main roads, location of an office, a mineral storage area, a water storage area being used for mineral processing, and a storage area for tailing waste and slime.

Each field of professional engineers must sign in concerned documents, together with ranking class, branch of engineering and licence number,

3. The holder of a Mineral Processing Licence shall operate according to the approved flowsheet and method. Additionally the engineers, who certify the concerned documents, shall supervise and be responsible for each engineering work according to the laws regarding engineering profession. If the replacement of the supervised engineer is desired, the Local Mineral Industry Official shall be given a notification of the replacement together with a written consent from the substitute. The ranking class of the engineer, engineering branch and licence number must be specified together with the consent letter.

In case the holder of a Mineral Processing Licence would like to make a change or modify any item outside mineral processing line, a written notification shall be given to the Local Mineral Industry Official. However, if the change or modification relating to the mineral processing or tailings pond or wastewater pond, the holder shall submit the new mineral processing method with a flowsheet for approval before action can be taken.

4. The holder of a Mineral Processing Licence shall fill in the printed form, as designated by the Department of Primary Industries and Mines, specifying the actual account of workers, the amount of received ores and processed ores. These documents shall be kept in the mineral processing area so that the competent officials may examine them at all times.

5. The holder of a Mineral Processing Licence shall submit a monthly report, using the printed form provided by the Department of Primary Industries and Mines, on actual mineral processing to the Local Mineral Industry Official no later than the fifth day of the following month.

CHAPTER 2
Rules and Metallurgical Processing Methods

6. For metallurgical work, any single or several of the following methods shall be utilized:

(1) Pyrometallurgical process.
(2) Chemical solution process with metallurgical separation or precipitation (Hydrometallurgical process).
(3) Other processes as approved by the Director-General.

7. The flowsheet and the metallurgical processing methods shall indicate the following items:

(1) The types of ore, fuel and other raw materials to be used in metallurgical processing.
(2) The metallurgical processing methods and the illustrated flowsheet to be used.
(3) The list of smelting furnaces, blast furnaces, machinery and equipment for metallurgical processing, including their sizes and horsepower used.
(4) The locations of smelting furnaces, blast furnaces, machinery and equipment to be used in metallurgical processing.
(5) The methods in details for prevention or suppression of the dust as well as the hazardous matters resulted from metallurgical processing.

(6) The discharge of water, gas, fumes, or waste from metallurgical processes out of the metallurgy area.
(7) The map with attached scale to illustrate the location of a metallurgical processing plant, metallurgy area, main road, the distance to the main road adjacent to the metallurgy area including storage area for crude-ore feed, after-smelting metal products, slag, dust, and the dewatering route out of the metallurgy area.
(8) Production capacity per day.

Each field of professional engineers must sign in concerned documents, together with ranking class, branch of engineering and licence number,

8. The holder of a Metallurgical Processing Licence shall operate according to the approved flowsheet and metallurgical processing methods. Additionally the engineers, who certify the documents, shall supervise and be responsible for each engineering work according to the laws regarding engineering profession. If the replacement of the supervised engineer is desired, the Local Mineral Industry Official shall be given a notification of the replacement together with a written consent from the substitute. The ranking class of the engineer, engineering branch and licence number must be specified together with the consent letter.

In case the holder of a Metallurgical Processing Licence would like to make a change or modify any item outside metallurgical processing line, a written notification shall be given to the Director-General. However, if the change or modification relating to the metallurgical processing method, the holder shall submit the new flowsheet and the new metallurgical processing method for approval before any action can be taken.

9. The holder of the Metallurgical Processing Licence shall fill in the printed form, as designated by the Department of Primary Industries and Mines, specifying the actual records of the workers, the amount of received ores and metallurgical-processed ores, and the sale amount of ore. These documents shall be kept in the metallurgy area in order for the competent officials to be able to examine at all times.

10. The holder of a Metallurgical Processing Licence shall submit a monthly report, using the printed form provided by the Department of Primary Industries and Mines, on the actual metallurgical processing to the Local Mineral Industry Official no later than the fifth day of the following month.

Given on the 9th day of January B.E. 2517

Signed by Osoth Kosin
Ministry of Industry

Ministerial Regulation
No. 26 (B.E.2517)
Issued in Accordance with the Minerals Act B.E.2510

By virtue of Section 17 of the Minerals Act B.E. 2510, as amended by Section 120 of the Minerals Act (No. 2) B.E. 2516, and Section 121 of the Minerals Act B.E. 2510, the Minister of Industry has issued the Ministerial Regulation as follows:

1. The Ministerial Regulation No. 5 (B.E. 2512), issued under the Minerals Act. B.E. 2510 shall be repealed.

2. The metallurgical processing methods that are under restriction shall include all metallurgical processes by smelting method, other metal extraction methods from ores, purification of metal, and productions of steel at any capacity.

3. The offices in the Ministry of Defence as well as in the Ministry of Industry that undertake metallurgical processing will be exempted from the restriction.

Given on the 9th day of January B.E. 2517

Signed by Osoth Kosin
Ministry of Industry

Ministerial Regulation
No. 28 (B.E. 2517)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17 of the Minerals Act B.E. 2510 amended by the Minerals Act (No. 2) B.E. 2516, the Minister of Industry has issued the Ministerial Regulation as follows:

1. Chapter 1 and Chapter 2 of the Ministerial Regulation No. 6 (B.E. 2512) issued under the Minerals Act B.E. 2510 shall be repealed.

2. The rules and procedures concerning the prospecting for minerals according to Atchayabat, conservation of minerals, as well as mining method shall conform to this Ministerial Regulation.

CHAPTER 1
Prospecting and Exploration for Minerals

3. Mineral prospecting shall be made by investigation of the geologic conditions together with any single or several of the following methods:[1]

(1) Geochemistry or geophysics investigation.

(2) Drilling or boring method.

(3) Pitting according to a prospecting technique shall be done under the following rules:

(a) The pit shall not exceed 1.50 metres in width or in length or in diameter, driven downward with its section not exceeding this specified dimension.

(b) The spacing shall be at least 20 metres between pits.

(c) All abandoned pits shall be fully backfilled or restored.

(d) To make a new pit in between the existing backfilled or restored pits, the permission shall be obtained from the Local Mineral Industry Official and must follow the above (a), (b), and (c).

(4) Trenching along the mineral zone according to a prospecting technique shall be done under the following rules:

(a) The trench shall be no wider than 1.00 metre, no deeper than 3.00 metres, and shall have the smoothest and the most upright wall as possible.

(b) The spacing between trenches shall be no less than 10 metres.

(c) All abandoned trenches shall be fully backfilled or restored.

4. The prospecting by a principle or method rather than one of those specified in Article 3 shall require a working plan and prospecting methods together with supporting reasons to be submitted to the Local Mineral Industry Official in order to apply for a prior approval in writing by the Director-General before commencing the operation.

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[1] *The former statement in Article 3 was repealed and amended by the Ministerial Regulation No. 70 (B.E.2534), and is being used instead of the statement in Article 3 printed herein.*

5. The working plan and prospecting methods shall include the following details:
   (1) Topographic map with a scale of 1:25,000 or greater.
   (2) Area for each plot of land.
   (3) Type of ores and prospecting methods for each stage.
   (4) Type, size, and number of machinery and equipment for prospecting.
   (5) Capital investment and financial obligation for each prospecting year.
   (6) Number of workers.

A geologist or a mining engineer approved by the Director-General shall certify by affixing a signature on the working plan and prospecting methods specified in paragraph 1.[2]

6. The holder of a Prospecting Atchayabat shall make prospecting for minerals only by investigation of geologic conditions together with any method or several prospecting methods provided in Article 3 (1).

7. The holder of an Exclusive Prospecting Atchayabat or the holder of a Special Atchayabat shall make prospecting according to the principles and methods specified in Article 3, or act in accordance with Article 4 in case another principle or method will be applied.

8. The holder of an Exclusive Prospecting Atchayabat or the holder of a Special Atchayabat shall make prospecting for minerals according to the approved working plan and prospecting methods under the supervision and the responsibility of the geologist or mining engineer, approved by the Director-General, who has certified the working plan and prospecting methods.

The replacement of the geologist or mining engineer under the first paragraph shall require a prior written approval from the Director-General.

8 bis. The geologist or mining engineer who supervises the prospecting, as approved by the Director-General, shall certify the report on the results of the prospecting operations under Section 31 or Section 40 of the Minerals Act B.E. 2510.[3]

9. The holder of an Atchayabat is prohibited from taking the ores obtained from prospecting for analysis or research more than the allowed amount specified in each type of Atchayabat.

10. The competent official shall be empowered to enter the prospecting area at all times to inspect the prospecting operations, and the holder of Atchayabat shall offer facilities as appropriate under the circumstances. In addition, the official shall be empowered to issue a written order requiring the holder to arrange for a prevention of any harm resulted from the prospecting and shall strictly comply with the order.

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[2] *The statements in Article 5 paragraph two, Article 6, and Article 8 were repealed and amended by the Ministerial Regulation No. 70 (B.E. 2534), and are being used instead of the statements in Article 5 paragraph two, Article 6, and Article 8 as printed herein.*

[3] *The statement in Article 8 bis was amended by the Ministerial Regulation No 70 (B.E. 2534).*

CHAPTER 2
Conservation of Minerals

11. The mining operation, mineral processing, and metallurgical processing shall not generate unreasonable waste of minerals or metals.

CHAPTER 3
Mining

12. The mining operation shall technically utilize any mining method or methods from the following:

(1) Dredging method: The mining operation by installing machinery and equipment on a boat or a barge to extract ore bearing ground through mucking, excavating, or suctioning, and then deliver to lanchutes or other mineral processing equipment.

(2) Gravel Pumping method: The mining operation that uses each or several procedures such as labor use, hydro-power, excavator, or blasting to loosen ore bearing ground at the mining face, and then delivered by gravel pump or sand pump to lanchutes or other mineral processing equipment.

(3) Hydraulicking/Jetting method: The mining that uses each or several procedures to loosen the ore bearing ground at the mining face in the same manner as the Gravel pumping method, and then employs the hydraulic elevator to lift and further deliver the slurry to lanchutes or other processing equipment.

(4) Ground Sluicing method: The mining operation on the hill or its slope that uses each or several procedures such as labor use, hydro-power, excavator, or blasting to loosen ore bearing ground at the mine working face, and further deliver to lanchutes or other processing equipment.

(5) Open-Pit Mining method: The mining operation that uses each or several procedures such as labor use, excavator, or blasting either to excavate or to open the mining face to be a pit or a bench, and then further transports the crude ore to lanchutes, other processing equipment or handsorting for the direct use of the ore.

(6) Alluvial Gophering method: The mining operation in the alluvial ore deposit with thick overburden, by sinking shaft into an ore bearing layer, and then driving adits/tunnels to bring out ore bearing ground for lanchutes or other mineral processing equipment.

(7) Underground Mining method: The underground mining operation in the ore veins or other deposits rather than alluvial ores, by means of shaft, adit/tunnel, or both that uses each or several procedures such as labor use, machinery and equipment, or blasting in order to extract crude ores to feed to the mineral processing equipment or to directly make use of them.

(8) Gophering method: The mining operation in the ore vein by means of labor use, machinery and equipment, or blasting to excavate or to open

either the trench or the adit/tunnel into the mountain to vertically follow the vein at no more than 10 metres deep, and then to bring up the ore for washing, or breaking to sort out only the lump of high grade, or feeding to the mineral processing equipment.

(9) The other mining methods that the Director-General approves.

13. The proposal for the mining project plan shall include the following:

(1) Topography within the Prathanabat area.

(2) The characteristics of deposits: for alluvial deposit, specify the mining area, the depth of overburden and the average grade of the deposit; for the ore zone, ore vein, or other types of deposits, indicate the direction and the dimension of width, length, and depth, as detected.

(3) Mining methods and mineral processing methods.

(4) Map with correct scale to illustrate the location of all buildings in the mine, the direction and orientation of the ore vein, the starting location of the mining, the mining sequence of the working face, the storage area for tailings and slime from mining and mineral processing, the dams and the dewatering gates.

(5) The drawings to scale of the dams and the dewatering gates, and if there is any shaft sinking or tunneling operation, illustrate how to support the shafts and adits.

(6) The type, size and number of machinery and equipment, together with the number of workers that are utilized in mining and mineral processing.

(7) Method of drawing in water for mining.

(8) Method of storage of slime or waste tailings and the mine dewatering method.

(9) The routes of the relocated water courses, highways or other public roads within the area of the Prathanabat, which shall be illustrated in the map specified in (4).

Each field of professional engineers must sign in concerned documents, together with ranking class, branch of engineering and licence number,

14. A holder of Provisional Prathanabat or Prathanabat shall strictly conduct mining operation and mineral processing according to the approved mining methods and mining project plan. The engineers, who certify documents in the plan, shall supervise and be responsible for each engineering work according to the laws regarding engineering profession. In case he wishes to replace the supervised engineer, the Local Mineral Industry Official shall be informed with written consent as evidence from the substitute. The ranking level, the engineering branch and the licence number must be specified in the consent.

15. In case the holder of a Provisional Prathanabat or Prathanabat has modified the mining or mineral processing method, the dewatering route in a mining operation, or the storage area for slime as well as waste tailings, it shall be deemed that the holder has altered the mining method or the mining project plan under Section 57 of the Minerals Act. B.E.2510.

The modification and addition of machinery and equipment for mining operation or mineral processing without altering mining and mineral processing method needs no

submission of a new mining project plan; however, the notification to the Local Mineral Industry Officials is required as evidence.

16. Before commencing mining operation, the holder of a Provisional Prathanabat or Prathanabat shall accompany the competent official to inspect the pre-mining work. Only after receiving the written permission from the Local Mineral Industry Official, the mining operation is able to commence.

17. The holder of a Provisional Prathanabat or Prathanabat shall truthfully fill in workers records, amount of ore obtained in the printed form provided by the Department of Primary Industries and Mines, and the documents shall be kept in the mining area so that the competent official may examine them at all times.

18. The holder of a Provisional Prathanabat or Prathanabat shall truthfully make a monthly mining report, using the printed form provided by the Department of Primary Industries and Mines, and submit to the Local Mineral Industry Official no later than the fifth day of the following month.

19. The holder of a Provisional Prathanabat or Prathanabat, who utilizes these mining methods: dredging, gravel pump, water-jet, open-pit or underground mining, shall submit the map illustrating actual mining operation to the Local Mineral Industry Official, together with the monthly report specified in 18.

Given on the 17th day of January B.E. 2517

Signed by Osoth Kosin
Minister of Industry

Ministerial Regulation
No. 29 (B.E.2517)
Issued in Accordance with the Minerals Act B.E.2510

By virtue of Section 17 of the Minerals Act B.E. 2510 amended by the Minerals Act (No. 2) B.E. 2516, the Minister of Industry has issued the Ministerial Regulation as follows:

1. Chapter 3 of the Ministerial Regulation No. 6 (B.E.2512) issued under the Minerals Act B.E.2510 shall be repealed.

2. The rules and procedures for purchase, sale, storage, possession, and transportation of minerals shall be followed in accordance with this Ministerial Regulation.

Purchase of Minerals

3. The holder of a Mineral Purchase Licence shall operate according to the following rules and procedures:

(1) Purchase only the kind, quantity, and weight of minerals specified in the original document issued under Section 98 of the Minerals Act B.E. 2510 amended by the Minerals Act (No. 2) B.E. 2516.

(2) Store minerals only in the area specified in the Mineral Purchase Licence or in the permitted mineral storage area, and also allow the competent official to conveniently inspect it.

(3) Always fill in the lists of the minerals received, countersign the receipt or purchase of the minerals in the Mineral Transport Licence or the Ore Panning Licence, as the case may be, and immediately return the licence to the holder.

(4) Always post a record in the printed form designated by the Department of Primary Industries and Mines, upon each mineral purchase.

(5) Submit a monthly report to the Local Mineral Industry Official to verify the mineral purchases and the remaining quantity of minerals in accordance with the printed form designated by the Department of Primary Industries and Mines no later than the fifth day of the following month.

(6) Keep the documents concerning the purchase of minerals either at the purchasing place or at the mineral storage as specified in the licence.

(7) Provide the competent officials with facts and details concerning the purchase of minerals, and facilitate them in performing their inspection duties.

Sale of Minerals

4. The person who has the rights to sell minerals under Section 99 (1), (2), (4), and (5) of the Minerals Act B.E. 2510, as amended by the Minerals Act (No. 2) B.E. 2516, shall operate according to the following rules and procedures:

(1) At the time of each sale of minerals, submit to the holder of the Mineral Purchase Licence the documents specified in the Section 98 (1), (2), or (3) of the Minerals Act B.E. 2510, amended by the Minerals Act (No. 2) B.E. 2516, as the case may be.

(2) Present the Ore Panning Licence to the holder of a Mineral Purchase Licence or the holder of a Licence for Mineral Purchasing Outside the Designated Place in order to indicate that the amount of the mineral sale does not exceed the designated quantity in the licence, and also require the holder of the aforesaid licence to countersign in the Ore Panning Licence upon each mineral sale.

(3) Always post a record of each mineral sale in the printed form designated by the Department of Primary Industries and Mines and keep it for inspection by the competent official at all times with the exception of the person who has the rights to sell minerals in accordance with the Section 99 (4).

(4) Submit a monthly report indicating the mineral sale and the remaining quantity of minerals, by using the printed form designated by the Department of Primary Industries and Mines, to the Local Mineral Industry Official no later than the fifth day of the following month, with the exception of the person who has the rights to sell minerals under the Section 99 (4).

(5) Provide the competent officials with the facts and details concerning the sale of the minerals, and facilitate them in performing their inspection duties.

Storage of Minerals

5. The holder of a Mineral Storage Licence shall operate according to the following rules and procedures:

(1) Identify each mineral stockpile in the mineral storage area, and also provide posted-signs to clearly verify the kinds of minerals and the owner.

(2) Do not allow any other person to store minerals in the permitted mineral storage area, except for the individual who is granted permission to store minerals in the same mineral storage area.

(3) Always post a record in the printed form designated by the Department of Primary Industries and Mines every time the minerals are brought into or taken out of the storage.

(4) Submit a monthly report indicating the list of records of the minerals in the storage which has been either brought in or taken out, and the remaining amount by using the printed form provided by the Department of Primary Industries and Mines, to the Local Mineral Industry Official no later than the fifth day of the following month.

(5) Keep the documents concerning the storage of minerals at the permitted mineral storage area for inspection, at all times, by the competent official.

(6) Provide the competent officials with facts and details concerning the storage of minerals, and facilitate them in performing their inspection duties.

Possession of Minerals

6. The holder of a Mineral Possession Licence shall operate according to the following rules and procedures:

(1) Identify the storage area of the possessed minerals and provide posted-signs to clearly verify the kinds of minerals in each stockpile.

(2) Always post a record of each sale or transfer of the possessed minerals in the printed form designated by the Department of Primary Industries and Mines.

(3) Submit to the Local Mineral Industry Official a monthly report indicating the list of records of the mineral possessed, sale, and the remaining quantity of minerals by using the printed form designated by the Department of Primary Industries and Mines no later than the fifth day of the following month.

(4) Keep the documents concerning the possession of minerals at the location specified in the licence in order that the competent official may inspect them at all time.

(5) Provide the competent officials with facts and details concerning the possession of minerals, and facilitate them in performing their inspection duties.

Transport of Minerals

7. The holder of a Mineral Transport Licence shall operate according to the following rules and procedures:

(1) Only transport the minerals along the route specified in the Mineral Transport Licence.

(2) Always carry the original Mineral Transport Licence along with the mineral transportation.

(3) Transit places are permitted only in specific locations, within a period of time, which are specified in the Mineral Transport Licence.

(4) Provide the competent officials with facts and details, and facilitate them in performing their inspection duties.

(5) In case the holder of a Mineral Transport Licence is not able to deliver the minerals to the specified place so that the receiver cannot record and countersign in the licence, the Local Mineral Industry Official who issued the licence shall be notified of this before that licence is expired, with the exception that the holder is unable to give the notification by the designated time due to *force majeure*. In that case, the holder shall immediately inform the Local Mineral Industry Official of this as well as the reason of failure to notify on time.[1]

Given on the 17th day of January B.E. 2517

Signed by Osoth Kosin
Minister of Industry

[1] *The statement in Article 7 (5) was added by the Ministerial Regulation No. 44 (B.E. 2523).*

Ministerial Regulation
No. 42 (B.E. 2522)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 17 and Section 76 paragraph two of the Minerals Act B.E. 2510, as amended by the Minerals Act (No. 3) B.E. 2522, the Minister of Industry has issued the Ministerial Regulation as follows:

Sublease of Mining

1. The holder of a Prathanabat or a Provisional Prathanabat who desires to sublease a mining operation to another person must submit the application, using the printed form provided by the Department of Primary Industries and Mines, to the concerned Local Mineral Industry Official. The applicant shall provide at least the specified mining sub-lessee, time duration for the sublease, and the given area to be subleased for mining in the application form.

2. The application in article 1 above shall be submitted within the valid date of a Prathanabat or a Provisional Prathanabat.

3. The Minister, or the person entrusted by the Minister, is authorized to issue the Mining Sublease Licence to the person whom the holder of a Prathanabat or Provisional Prathanabat has specified in the application form as mentioned in article 1.

Cancellation of the Sublease of Mining Operations

4. The sub-lessor, and/or the sub-lessee, who wishes to terminate the mining sublease during the valid date of the Mining Sublease Licence shall submit the petition, using the printed from provided by the Department of Primary Industries and Mines, to the concerned Local Mineral Industry Official.

5. Upon submitting the application for cancellation of the sublease of mining operation, if the applicant has not yet discharged any debts obligated under the Minerals Act, the concerned Local Mineral Industry Official shall inform the applicant to pay all remaining debts, and then process the application to the Minister or the person entrusted by the Minister to consider the cancellation.

6. In case that either the sub-lessor or the sub-lessee has petitioned to cancel the mining sublease, the Mineral Industry Official shall inform the matter to the other party in writing in order to obtain the written consent or objection within 30 days from the date of notification.

After the receiver of the above notification gives the consent, the Local Mineral Industry Official shall further process the application according to article 5.

If the receiver of the notification gives neither the consent nor the objection within the time duration specified in the first paragraph, the concerned Local Mineral Industry Official shall further process the application according to article 5.

If the receiver of the notification gives an objection to the cancellation of the mining sublease, the concerned Local Mineral Industry Official shall inform the other party to file a lawsuit within sixty days from the date of notification. If the lawsuit is filed, the plaintiff shall send without any delay a copy of the complaint to the concerned Local Mineral Industry Official. If no lawsuit is filed within the specified time, it shall be deemed that the applicant does not wish to continue with the cancellation of the sublease.

In case a lawsuit is filed within the specified time in paragraph 4, the application for cancellation of the sublease will be under suspension until the case is finalized. Then, after the final decision is reached, the applicant must notify the Local Mineral Industry Official to continue with the process of the cancellation.

7. The cancellation of a sublease of mining operation is issued by the Minister or the person entrusted by the Minister.

Given on the 8th day of October B.E. 2522

Signed by Prasit Narongdech
Minister of Industry

Ministerial Regulation
No. 77 (B.E. 2539)
Issued in Accordance with the Minerals Act B.E. 2510

By virtue of Section 4 and Section 17 of the Minerals Act B.E. 2510, as amended by the Minerals Act (No. 4) B.E. 2534, the Minister of Industry has issued the Ministerial Regulation as follows:

Article 1. Article 2 and 3 in the Ministerial Regulation No. 21 (B.E. 2516) issued under the Minerals Act B.E. 2510 that was amended by the Ministerial Regulation No. 75 (B.E. 2537) issued under the Minerals Act B.E. 2510 shall be repealed.

Article 2. The following rocks which are able to be cut into slabs or various shapes and can be used for decoration shall be designated as dimensional stones:

(1) Conglomerate
(2) Breccia
(3) Granite
(4) Travertine
(5) Serpentine
(6) Gneiss
(7) Basalt
(8) Limestone
(9) Slate
(10) Sandstone

Article 3. Other types of rocks which are not specified in Article 2 above or types of rocks listed in Article 2 above and proclaimed by the Director-General of having sufficient reserves or having inappropriate quality to be used as dimension stones shall be classified as industrial rocks.

Article 4. Any rock blasting and aggregate crushing licence under the Land Code, the term of which is not expired before the effective date of this Ministerial Regulation, will be considered *mutatis mutandis* as a Prathanabat under the Minerals Act, and the operation can proceed until expiration.

The holder of the licence according to the first paragraph shall pay royalties according to the Minerals Royalty Rates Act.

Article 5. The application for a rock blasting and aggregate crushing licence under the Land Code, which is submitted before 13th June B.E. 2538 and is under consideration process, will be deemed *mutatis mutandis* to be the application for a Prathanabat under the Minerals Act. However, in consideration for issuing such a Prathanabat, the authorities according to the Minerals Act have the rights to revise as necessary in order to make it conform to the Minerals Act.

Given on the 8th day of March B.E. 2539

Signed by Chaiwat Sinsuwongse
Minister of Industry