

应对全球化：
全球矿产资源信息系统数据库建设
（之二十一）

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前 言

“应对全球化：全球矿产资源信息系统数据库建设”系列丛书是中国地质调查局发展研究中心境外矿产资源研究室的核心信息成果之一，是自 2003 年开始建设的“全球矿产资源信息系统数据库”阶段性成果的体现，本丛书自 2006 年开始发布，截止到 2009 年，共发布了有关 20 个国家的地质矿产国别报告、非洲大陆地质矿产概况、40 多个国家的矿业法律法规文本、全球矿产资源勘查开发形势、部分矿产资源全球供需形势分析以及境外不同国家的投资环境分析、战略研究等内容。本书为该系列报告丛书的第二十一部，为亚洲卷的越南篇。

众所周知，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，中国不日将成为许多矿产资源的世界第一消费大国。

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“中国大陆周边地区主要成矿带成矿规律对比及潜力评价”计划项目，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。2006 年和 2009 年，在“中国大陆周边地区主要成矿带成矿规律对比及潜力评价”计划项目下，设立了“中越合作哀牢山-红河-马江成矿带成矿背景与成矿规律研究”（2006-2008）和“中越合作滇桂南部-越东北矿集区成矿背景与成矿规律研究”（2009-2010）两个有关中越合作对比研究的工作项目，

由中国地质大学（北京）的刘俊来教授及其研究团队负责实施，通过近 5 年的辛勤工作，取得了一系列的成果，本报告就是这些研究成果的部分体现。

在中国地质调查局科技外事部和中国地质调查局发展中心的大力支持下，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。

本报告由刘俊来负责组织编写并统编了全报告，郭强、吴文彬、李勇超、吴虎峻、王东升等参与了编写工作，杨海波、许芳磊、甘浩男、张若愚、赵利、夏增明、董彦龙参加了图件的绘制。

本系列报告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。

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第一章 概 况

第一节 自然地理

越南，全称越南社会主义共和国，首都河内（Ha Noi）。位于中南半岛东部，东面与南面临海；北部与中国云南、广西接壤；西部和西南部与老挝、柬埔寨为邻。海岸线总长3260公里。越南地形狭长，地理坐标界以北纬8°20′~23°21′，东经102°8′~109°28′间，呈“S”形似镰刀状，南北距离长达1650公里，但是东西最狭窄处只有50公里宽。全国总面积331,212平方公里，其中25 %已经开垦为耕地（1987年）。

越南政府通常将全国众多省份归类为八大地理区划，其分别为：西北、东北、红河三角洲、中北部沿海地区（北中部）、中南部沿海地区（南中部）、中部高原（西原高原）、湄公河三角洲、东南部（如图1-1）。这些地理区划并非经常采用，而且亦可作其他方式的划分（如图1-2）。



图1-1 越南行政分区图（地区级单位）

表1-1 各区域所含省市一览

名称	首府	人口	面积 (km ²)
越南北部			
红河三角洲			
北宁省 (Bắc Ninh)	北宁市	1,024,151	805
河南省 (Hà Nam)	府里市	785,057	823.1
海阳省 (Hải Dương)	海阳市	1,723,319	1,650.27
兴安省 (Hưng Yên)	兴安市	1,128,702	923
南定省 (Nam Định)	南定市	1,825,771	1,676
宁平省 (Ninh Bình)	宁平市	898,459	1,400
太平省 (Thái Bình)	太平市	1,814,700	1,542
永福省 (Vĩnh Phúc)	永安市	1,115,700	1,371
河内 (直辖市) (Hà Nội)		6,448,837	3,324.92
海防 (直辖市) (Hải Phòng)		1,837,302	1,507.57
中北部			
河静省 (Hà Tĩnh)	河静市	1,227,554	6,055.6
乂安省 (Nghệ An)	荣市	3,113,055	16,487
广平省 (Quảng Bình)	同海市	846,924	8,051.8
广治省 (Quảng Trị)	东河市	597,985	4,745.7
清化省 (Thanh Hoá)	清化市	3,509,600	11,106
承天顺化省 (Thừa Thiên Huế)	顺化市	1,087,579	5,053.99
东北部			
北江省 (Bắc Giang)	北江市	1,555,720	3,822
北干省 (Bắc Kạn)	北干市	294,660	4,857.2
高平省 (Cao Bằng)	高平市	510,884	6,691
河江省 (Hà Giang)	河江市	724,353	7,884
谅山省 (Lạng Sơn)	谅山市	731,887	8,305
老街省 (Lào Cai)	老街市	613,075	6,357
福寿省 (Phú Thọ)	越池市	1,313,926	3,519
广宁省 (Quảng Ninh)	下龙市	1,114,381	6,110.813
太原省 (Thái Nguyên)	太原市	1,149,100	3,534.4
宣光省 (Tuyên Quang)	宣光市	752,467	5,868
安沛省 (Yên Bái)	安沛市	740,905	6,883
西北部			
奠边省 (Điện Biên)	奠边府市	491,046	8,560
和平省 (Hoà Bình)	和平市	786,964	4,663
莱州省 (Lai Châu)	莱州市	370,135	9,059.4
山罗省 (Sơn La)	山罗市	1,080,641	14,055
越南南部			
西原			
达乐省 (Đắk Lắk)	邦美蜀市	1,728,380	13,139
达农省 (Đắk Nông)	嘉义市	489,442	6,514
嘉莱省 (Gia Lai)	波来古市	1,272,792	15,495
昆嵩省 (Kon Tum)	昆嵩市	430,037	9,615
林同省 (Lâm Đồng)	大叻市	1,186,786	9,765
中南部			
平定省 (Bình Định)	归仁市	1,485,943	6,024.4
庆和省 (Khánh Hoà)	芽庄市	1,156,903	5,217.6
富安省 (Phước Yên)	绥和市	861,993	5,045

名称	首府	人口	面积 (km ²)
广南省 (Quảng Nam)	三歧市	1,419,503	10,406
广义省 (Quảng Ngãi)	广义市	1,217,159	5,138
岘港市 (直辖市) (Đà Nẵng)		887,069	1,256
东南部			
巴地头顿省 (Bà Rịa Vũng Tàu)	头顿市	994,837	1,982
平阳省 (Bình Dương)	土龙木市 (Thủ Dầu Một)	1,482,636	2,696
平福省 (Bình Phước)	同帅市	874,961	6,857
平顺省 (Bình Thuận)	潘切市	1,169,450	7,837
同奈省 (Đồng Nai)	边和市	2,483,211	5,904
宁顺省 (Ninh Thuận)	藩朗 - 塔占市 (Phan Rang-Tháp Chàm)	564,129	3,363
西宁省 (Tây Ninh)	西宁市	1,066,402	4,030
胡志明市 (直辖市) (Thành phố Hồ Chí Minh)		7,162,864	2,095
九龙江三角洲			
安江省 (An Giang)	龙川市	2,114,772	3,406
薄辽省 (Bạc Liêu)	薄辽市	856,250	2,526
槟榔省 (Bến Tre)	槟榔市	1,335,589	2,322
金瓯省 (Sóc Trăng)	金瓯市	1,205,108	5,211
同塔省 (Đồng Tháp)	高朗市	1,665,420	3,283
后江省 (Hậu Giang)	渭清市	756,625	1,608
坚江省 (Kiên Giang)	迪石市	1,683,149	6,299
隆安省 (Long An)	新安市	1,436,914	4,492
朔庄省 (Cà Mau)	朔庄市	1,289,441	3,223
前江省 (Tiền Giang)	美萩市	1,670,2160	2,367
茶荣省 (Trà Vinh)	茶荣市	1,000,933	2,215
永隆省 (Vĩnh Long)	永隆市	1,028,365	1,487
芹苴 (直辖市) (Cần Thơ)		1,189,089	1,390

西北部 (越: Tây Bắc Bộ/西北部): 包括北越西部的4个内陆省 (表1-1), 其中的两个省与老挝接壤, 一个与中国接壤。面积37336km²。

东北部 (越: Đông Bắc Bộ/东北部): 包括红河三角洲以北的11个省份 (表1-1), 当中不少省份位处山区。面积59538.21km²。

红河三角洲 (越: Đồng bằng sông Hồng/河内-海防): 包括红河四周面积细小但人口密集的9个省份 (表1-1)。另外还包括不属于任何省份的首都河内和海防直辖市。面积15539.57km²。

北中部 (越: Bắc Trung Bộ/北中部): 包括越南中部狭长地区的北半部6个沿海省份 (表1-1), 全部省份东面面向南海, 西面与老挝接壤。面积51508km²。

南中部 (越: Nam Trung Bộ/南中部): 包括越南中部狭长地区的南半部5个沿海省份 (表1-1), 东面面向南海, 西面是西原。中南部也包括岘港直辖市。面积32067km²。

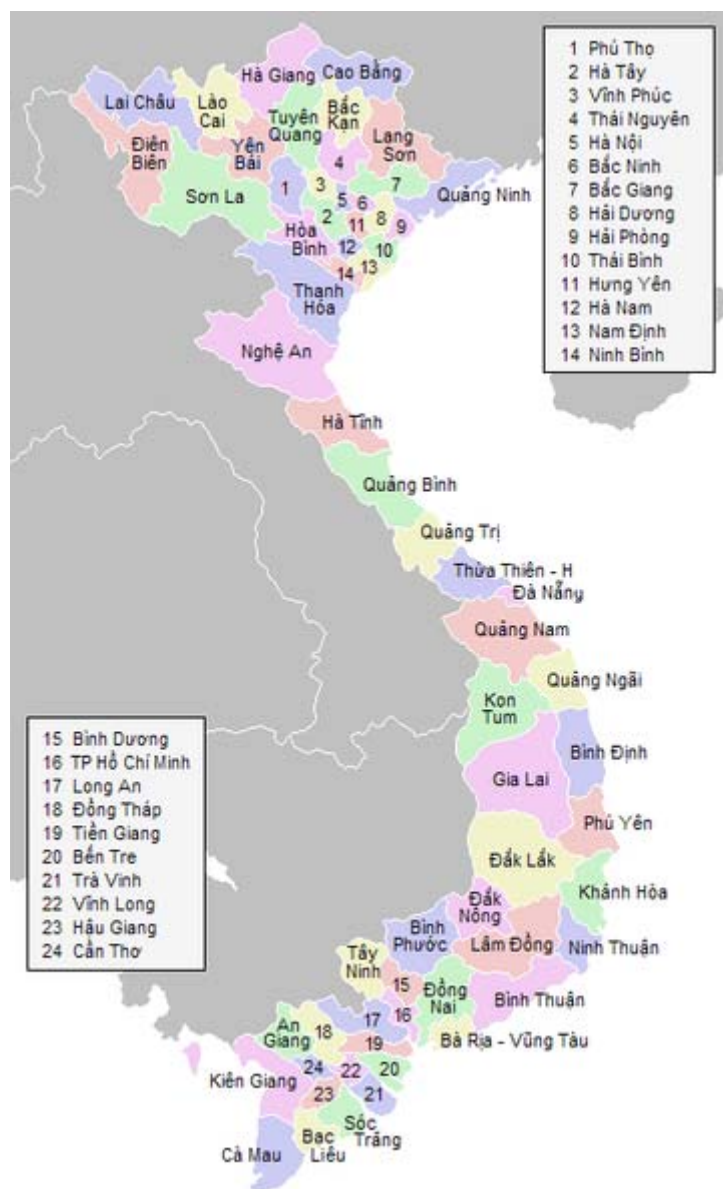


图1-2 越南行政分区图（省级单位）

西原（越：Tây Nguyên/西原）：包括越南中南部的5个内陆省份（表1-1）。这个地区大多数地处山区，为少数民族聚居地。面积54448km²。

东南部（越：Đông Nam Bộ/东南部）：包括越南南部低地、湄公河三角洲以北的地方，包括7个省份（表1-1）和胡志明直辖市。面积38733km²。

九龙江三角洲（越：Đồng bằng sông Hồng/红江九龍）：越南最南部的地区，是围绕湄公河、面积较小但人口密集的省份，包括12个省（表1-1）和芹苴直辖市。面积39814km²。

一、地形

越南全境地势北高南低，多山地高原，河流密集，侵蚀地貌发育。北部除红

河三角洲和沿海地带以外，大部分属于中高山区，平均海拔标高在2000米左右，黄连山主峰高达3142米，山高谷深，高差可达1000米以上。中部长山山脉属中山区，山峰与高原相间排列，平均海拔800-1000米，呈北西-南东向纵贯越老边境。南部西原地区（昆嵩-林同一带高原）地势减低，平均海拔700-800米，再南郎平顺一带东南沿海为低山区，转西魏湄公河三角洲和金瓯半岛。全境河流纵横，主要为湄公河、红河水系，水利资源丰富。

1. 红河三角洲

红河三角洲是一个平坦的三角形地带，面积3000 平方公里，比湄公河三角洲面积小，但是开发较早，人口密度很高。过去曾经是北部湾的一个港湾，逐渐被上千年来数量庞大的河流冲积物所填满，每年向北部湾推进100米。红河三角洲是越南民族的祖居地，1975年以前，越南北部70 % 的农业和80 % 的工业都集中在红河三角洲。

红河发源于中国的云南省，长约1200公里。它的两条主要支流，平均每秒5亿立方米，但是在雨季高峰期，可能增加到平时的60倍。整个三角洲地区，海拔高度不超过3米，许多地方甚至只有1米或不到1米，周围是陡峭的森林覆盖的高地，。该地区经常洪水泛滥，在一些地方洪水高水位的标志超过周围乡村14米高。许多世纪以来，控制洪水一直是红河三角洲经济文化的主要部分。建造了广大的堤防和运河系统以牵制红河，并灌溉富饶的稻作三角洲。古老的系统模仿中国，都拥有高度密集的人口，大约有一半地区进行复种水稻栽培。

2. 高地

越南北部和西北部的高地和高原主要的居民是少数民族部落。Dãy Núi Trường Sơn （Trường Sơn Range）起自西藏和中国西南部云南省，构成越南与老挝和柬埔寨的边界。它终结于湄公河三角洲，胡志明市（前西贡）以北。

中央山地中，有几处高原，高低起伏，形状也不规则。山地北部狭窄，非常崎岖；越南的最高峰Fan Si Pan位于西北端，高达3142米。山地南部伸出许多马刺，将狭窄的海岸平原分隔成许多一连串的小块。数百年来，这些地形特征不仅使得南北交通不易，而且构成南部湄公河三角洲地区有效的天然障碍。

3. 中央高地

在战略上极为重要，是控制南越乃至整个印度支那的南部的要害。1975年以后，已经有许多人口从人口密集的低地移入高地。

4. 沿海低地

在北方的红河三角洲于南方的湄公河三角洲之间，延伸着南北狭长的狭窄、平坦的沿海低地。在陆地一侧，Dãy Núi Trường Sơn 陡峭的，沿海岸延伸，在几个地方伸出马刺到海中。沿海的狭长地带通常都很肥沃，集中种植稻米。

5. 湄公河三角洲

湄公河三角洲的面积达到4万平方公里，地势极为低平，所有地方的海拔高度都不超过3米，无数的河流和运河纵横交错。湄公河的各条支流携带大量沉积物，使得湄公河三角洲每年向南海推进60-80米。一个越南官方资料估计每年沉积物的数量大约有10亿立方米，将近13倍于红河堆积物的数量。三角洲上大约有1万平方公里被开辟为水稻田，是世界上最重要的水稻耕作区之一。湄公河三角洲的最南端，称为金瓯半岛，覆盖着密集的灌木丛和红树林沼泽。

湄公河全长4220公里，是世界12条大河之一。它发源于青藏高原，流经中国的云南省后，构成老挝与缅甸边界，以及老挝和泰国边界，分为两条支流。

二、气候

越南全国都在北回归线以南，属于热带季风气候，年平均湿度达到84 %。不过，由于纬度的差异，以及地形地貌的显著差异，各地的气候也存在着相当差异。在冬季或旱季，大体上是从11月到4月，季风通常从东北方沿着中国海岸，穿越北部湾吹来，赶走许多的湿气；因此越南大部分地区的冬季较为干燥（当然只是与雨季或夏季相比）。夏季季风发生在从5月到10月，将潮湿的空气从西南方印度洋上吹向内陆，带来丰沛的降雨。

越南各地的年降雨量从1200毫米到3000毫米不等。接近90 %的降水发生在夏天。至于气温，主要是受地形的影响，平原地区的年平均气温通常高于山地和高原。在平原地区，在最冷的12月和1月，最低气温只有5°C；而在最热的4月，最高气温超过37°C。但是在一些高地，季节的变化很不明显，常年气温都在21°C到28°C 之间。不同纬度地区的气候也稍有不同，越南北半部的季节差异就比南半部分明。

第二节 社会经济状况

越南自1986年实行经济改革以来，经济迅速发展，宏观经济稳定，发展投资增加，经济结构向积极方向转变，取得了令世人瞩目的成果。

越南经济以农业为主，全国耕地面积930多万公顷，大部分种植水稻，主要

分布在湄公河三角洲、红河三角洲以及其他沿海平原。其它粮食作物有玉米、甘薯、木薯等。经济作物有天然橡胶、黄麻、甘蔗、咖啡、茶、烟叶、胡椒等。江河和沿海渔业较盛，年均捕鱼约100万吨。主要工业部门有电力、煤炭、冶金、机械制造、化工、采矿、建筑材料、纺织、造纸等。工业区有河内、海防、太原、鸿基、越池、南定、胡志明市、边和、岘港等。越南的矿产资源丰富，现已发现的矿种超过120种，其中探明储量的矿种有77种。主要有煤、铁、铝、钛、锰、铬、锡、磷、铜、铅、锌、稀土、宝石等。其中煤、铁、磷、铝（三水铝）储量较大。

越南陆上运输以铁路和公路为主。河内和胡志明市为两大交通枢纽。全国有铁路3100多千米，纵贯南北的“统一铁路”北起河内，南至胡志明市，全长1700多千米，于1976年全线修复通车。北部有两条铁路同中国广西、云南的铁路相接。全国公路长10万多千米。主要海港是鸿基、海防、岘港、归仁、金兰、头顿、胡志明市等。

1994年国内生产总值达170万亿盾（1美元合1.1万盾，约合154亿美元），比1993年增长8.5%，是国内生产总值高速增长的第四个年头（1991年6%，1992年8.6%，1993年8.1%）。工业产值增长13.5%。农业产值增长4.5%。出口增长20%。粮食产量逐年增长。自1990年以来粮食产量一直保持在2000万吨以上。1994年尽管遇到洪涝灾害，但粮食产量创历史最高纪录，达2600万吨，比1993年增长了2%。1989年以前为大米进口国，1990年一跃为大米出口国，每年出口大米150万至200万吨，居美国、泰国之后，为世界第三大米出口国。

随着经济改革的实施，通货膨胀得到抑制。物价上涨幅度1988年为400%，1991年为60%，1992年为20%，1993年为7.5%。1994年又上升到两位数，达14%。但仍低于1992年的上涨幅度，居民的生活仍然稳定并有所改善，黄金和美元价格保持稳定。

2000年越南经济步出低谷，实现了6.7%的增长率，比1999年高出将近1个百分点。在此基础上，进入2001年以来，越南逐步克服金融危机带来的影响，采取措施，加大投资力度，扩大内需，拓展出口市场，2005年上半年经济增幅又比上年有所提高，达到7.1%。据越南统计局的统计数据表明，2005年头7个月，越南的工业产值为133.6万亿越盾（约合89亿美元），比2004同期增长14.2%。越南上半年113.3万亿越盾的工业产值中，国营企业产值为46.4万亿越盾，增长11.5%；非国营企业产值为25.9万亿越盾，增长17.6%；外资企业产值增长15.1%。增幅较

大的产品主要是自行车、电扇、原油等。上半年越南共开采了880万吨原油，比2004年同期增加130万吨，其中绝大部分用于出口，达860万吨，价值17.76亿美元。目前越南产油主要依靠越苏油气公司，上半年开采量为683.4万吨，占全行业产量的80%，同比增长20.6%。该公司还向巴迪-富美发电厂供应了8.89亿立方米天然气，68920吨凝析油（CONDENSATE）。

2008~2009 年越南经济在温和通胀中保增长，虽然世界报道多数是负面新闻，不是金融危机，就是通货膨胀。确实，越南经济这两年的发展很不稳定，通胀率达两位数，股市也大起大落，越盾贬值。但是，这些是快速发展过程带来的问题，看得实在一点是经济有点过热，不能将其与 1997 年的泰国相提并论。而且越南与大多数东南亚国家的体制大相径庭，是正在从计划经济转向市场经济的国家，金融体系尚未完全与外部对接，世界金融危机对其有影响，但不会是颠覆性的。据越南官方测算，2009 年越南经济增长率为 5.32%（按现价 GDP 为 1645.48 万亿越盾约合 940 亿美元，1 美元兑换 17500 越盾计算），排在大多数东南亚国家的前面。贡献率最大的是服务领域，增长 6.63%；其次是第二产业，增长 5.52%；第一产业增长 1.83%。胡志明市作为越南经济发展的引擎，年经济增长率达到 7.5%~8%，比全国平均水平高近 2 个百分点。越南经济达到一定的增长速度的同时，通货膨胀率稳定在较低水平，仅为 7%，比 2008 年 23%减少了 16 个百分点。2009 年越南仅为轻微的通货膨胀，这既是越南自身采取措施取得的效果，同时也可以说是金融危机送给越南的礼物。

2009年越南经济增速比上年下降约1个百分点，主要是由于工业发展放缓，产值仅增长7.6%，比上年的14.6%下降7个百分点。增长最快的是民营工业，达10%，外资工业企业增长8%，国有企业仅3.7%。一些地方工业逆势增长，广宁省、清化省、巴地-头顿省分别增长13%、13%和10%。整体来说，越南仍然是一个农业比重较大的国家，农业的丰收为其经济稳定和取得相当速度的增长奠定了基础。虽然2009年遇上气候灾难，但越南粮食总产量和大米出口双双创下历史新纪录，分别达到4400万吨和600万吨，分别比上年增长700万吨和140万吨。一些重要的农产品产量增加，水产品产量达490万吨，增长4.5%，其中养殖260万吨，捕捞230万吨，咖啡仁超过100万吨，橡胶干片70万吨。2009年，尽管对越南来说是一个农业丰收年，农产品产量普遍大幅度增加，但由于受世界金融危机的影响，农产品价格大多下降，所以，越南的农业产值并没有随产量的大幅度增加而相应快速增加。

2009年,越南经济结构略有改变,第一、第二、第三产业比重分别从2008年的21.99、39.91、28.10演变为20.66、40.24、39.10。第一产业比重下降,减少1.33个百分点,主要由于农产品价格的大幅度下降;第二、第三产业分别上升0.33和1个百分点。越南的石化工业和造船工业发展突出。位于广义省的榕橘炼油厂已使用越南国内生产的原油炼制出首批汽油,标志着越南石化工业从简单开采原油阶段进入能自主加工的阶段。该炼油厂日加工原油能力为14万桶,年加工能力为650万吨;越南Hyundai Vinashin造船厂完成载重56000吨的E.R. Bilbao号散货轮的建造,正式起锚交付德国的E.R.Schifahrt造船公司。该艘货轮长187.8米,宽32.2米,高18.3米,容积达7万立方米,时速达14.5海里,耗资近5000万美元。这是该造船厂在两年前与德国造船公司签署的10艘新船制造合同中的第三艘。造船工业的发展标志着越南机械工业达到了一定的水平。

由于经济保持了一定的增长,越南其他方面也获得较快的发展。2009年越南财政收入达390万亿越盾。截至2009年12月底,越南的电话用户达1.23亿,同比增长51.3%。其中,固定用户达1810万,同比增长28.4%;手机用户达1.05亿,同比增长56.1%。网络用户达300万,同比增长45.5%。使用网络的人数达2290万,同比增长10.3%。

此外,2010年越南正式担任东盟轮值主席国,如何引领东盟的合作发展,包括如何发展与中国及东盟的关系,特别是如何利用中越建交60周年和中国-东盟自贸区建成来促进中越关系尤其是中越经贸的交流与合作的发展,都是值得关注的。

第三节 地质工作回顾及现状

一、地质工作回顾

越南的地质工作,最早始自1852年。A.Petiton编著了印度支那半岛第一本专著,20年后出版发行。1898年法国在越南建立印度支那地质调查所,开展地质普查工作,重点开展北越煤田盆地进行过填图和古生物研究。1925-1945年,J.Fromaget等编制了1:50万印度支那地质图(1963年版)。1950年后,黄汲清(1952)在印支运动一文中提出越南以红河为界,可以划分为两个大地构造单元,北部属于中国地台,西南属于印支构造带。1955年以来,北越在中国和前苏联及东欧各国帮助下开展地质工作,南越进行了地质填图。1965年,多夫什科夫

(A·E·Dovzikov) 和阮万前等人 (1965) 完成了1:50万越南地质图, 并开始1:20万地质测量; 1970—1975年, 伊赛恩 (Isaen) 和哈恩 (Khaen) 借助地球物理方法, 对越南深部构造、地壳类型和周围还去进行研究, 编出莫霍面地貌示意图, 完成了海区等应力线图测量。50年代至80年代期间, 苏联的刊物中发表了许多有关越南地质矿产的著作。目前, 越南全境完成了1: 20万地质与矿产填图, 80%的地区已完成了1: 5万地质与矿产填图。

二、地质调查工作程度

越南矿产资源丰富, 种类繁多。自上个世纪50年代中期开始, 在中国、苏联和东欧各国的援助下, 到目前为止, 该国已发现矿种超过120种, 探明储量的有77种, 其中资源较丰富的有煤、磷、铁、铬铁矿、铝土矿、铜和稀土金属等七种, 堪称优势矿产; 钛铁矿、铅锌、锡、镍、金、银、高岭土、石灰岩、黄铁矿和其他部分非金属矿产次之, 非金属的砷、钾盐等。而石油、煤、铁、红土型铝土矿、铬铁矿、砂锡、铜、镍、铅锌、金、稀土、黄铁矿等为越南队矿产研究和勘探的主要对象。

1、能源矿产

(1) 煤

主要有无烟煤和褐煤两种。无烟煤主要分布在越北广宁省东北部的鸿基、锦普一带。广宁煤田做过较详细的勘查工作, 现探明埋深在400m以上的无烟煤储量达35亿吨, 400~1000 m埋深的资源储量超过70亿吨含煤岩系的总厚度为800~2200 m, 煤层数量一般9~15层, 最多61层, 最厚的煤层达92 m。褐煤主要产于越北的红河盆地, 煤层主要分布在第三系地层的中段, 煤层最多的河内盆地达105层, 含煤岩系厚度100~3500m, 单层煤层厚度0.1~21 m, 估计储量超过2000亿吨并伴有丰富的煤层气。

(2) 石油、天然气

越南的石油、天然气探明储量石油为2.5亿吨, 前景储量约5亿吨, 天然气储量约3000亿 m^3 , 前景储量约9100亿 m^3 , 伴生气储量约1300亿 m^3 。已发现的石油、天然气主要分布在东南沿海和红河、湄公河三角洲地区, 初步预测在大约100万 km^2 的陆地、大陆架和海域可能蕴藏着石油。

2、金属矿产

(1) 铁矿

已探明储量13亿吨, 前景储量约23亿吨。现已发现3个铁矿区。一是西北地

区的宝河、贵乡、娘媚、兴庆等地，其中贵砂铁矿储量为1.25亿吨，主要是褐铁矿，品位为43%~52%；二是北部地区太原、河江、北干、高平省境内，储量为5000万吨，主要是磁铁矿，品位60%以上；三是中部的顺化、义安、河静等地，已发现多种类型的铁矿，其中石溪矿床储量最大约5亿吨。目前越南全国约有216个铁矿山和矿点。其中储量在200万吨以上的铁矿有13个，1亿吨以上的有2个，即石溪（Thạch Khê）铁矿和贵乡（Quý Xa）铁矿。

（2）铝土矿

铝土矿矿石类型以三水铝矿为主，质量上佳。目前已发现矿床30多个，有11个为大型矿，主要分布在北部高平、谅山省和西原地区林同省（宝禄、新来）、达农省、多乐省以及嘉莱省和昆高省境内。已探明储量45亿吨，前景储量约60~70亿吨。2001年越南已把西原地区三水型铝土矿的开发列为国家鼓励引资的项目（第33项），引起了很多外国公司的兴趣。

（3）铬矿

分布在清化省挪山区古定等地，储量约2000万吨，适合露天开采，精选后，三氧化二铬含量可达46%以上。

（4）钛矿

越南目前经初步探明的钛矿储量约2000万吨，可开采量约1500万吨。主要分布在越北的太原和宣光（约600万吨）、中部沿海地区的河静省（约500万吨）、清化省（约400万吨）、平定和平顺两省（约300万吨）。现阶段越南全国年钛矿产量约15万吨。其中，越矿产总公司年产量约4万吨，河静省产量约5万吨，其他地区产量约6万吨，产品全部出口，主要出口到泰国、日本和中国等。

（5）锆矿

锆矿储量约450万吨，主要分布在北干、太原省

（6）铜、镍矿

探明铜矿储量为795万吨，前景储量为1000万吨；探明镍矿储量为152万吨，前景储量为500万吨。老街生权铜矿矿床储量为51.1万吨，混合金35吨，银25吨。镍矿主要分布在班福地区，镍铜储量为19.3万吨，其中镍12万吨。

3、非金属矿产

（1）磷矿

已探明总储量为14亿吨，其中质量好的一类矿约3000万吨，主要分布在老街省到安沛省的红河流域，谅山、青冒、如春、水静等地区也有磷矿床分布，年开

采能力为1000万吨。

(2) 硫矿

已探明储量860万吨，估计储量为5.6亿吨，主要分布在河西省境内（现在属于河内市）。

(3) 高岭土矿

已探明储量2000万吨，估计储量约10亿吨，主要分布在林同省。

第二章 区域地质

包括越南在内的中南半岛地处环太平洋构造域、特提斯-喜马拉雅构造域的叠接部位。以红河断裂为界，南北在地层发育、岩浆活动、构造演化和成矿作用等方面具有很大的差异。

第一节 地层

在越南领土上有元古代、原生代、古生代、中生代及新生代的沉积岩、火山沉积岩和变质岩。

越南地层区分布为：东北地区、越北地区、西北地区、中部北区、中部中区、中部南区、和南部地区、芒提（Mường Tè）地区（图2—1）。以上提到的地区是地质性质分区，与地理分区不完全统一。

一、元古界

在中部中区的卡纳类型沉积带长4000米以上，主要包括了含铝量很高的二辉石斜长石片麻岩、夹有片麻岩薄层的二辉石粒变岩，二辉石粒变岩、紫苏花岗岩、二辉石粒变岩片页岩间隔花岗岩。按岩石成分，由上到下可分成四组：昆葛组（Kon Cot）、沙蓝洁组（Xa Lâm Cô）、达锣组（Đak Lô）和金山组（Kim Sơn）。主要分布于昆嵩隆起、越北隆起、富和地块、鸿岭地块、红河两侧及马江上游（图2-2）。有两套变质岩系：下部为一套深度变质岩系，包括昆嵩杂岩、玉岭杂岩、红河杂岩及春大杂岩等。各岩系厚度8000-9000米。据安沛附近的混合岩同位素年龄值为2080-2300Ma，属于古元古代，大致相当于我国云南的大红山群和哀牢山群。

二、元古界-古生界（未分）

1、古元古界-中元古界地层

下部是西北部象山组（Núi Voi）和水展组（Suối Chiềng）的片麻岩、斜长石片麻岩、角闪岩、石英-长石-堇青石-硅线石页岩。在中部中区的涌河江层序，（Sông Re）的角闪岩，厚达1000米。上部特征为中部中区则蒲层序的片麻岩、页岩、石墨、透镜状或薄层状的透闪石花岗岩的增加。总厚度4000-6000米。层序的同位素龄值约为2070-2300Ma。

2、新元古界-下寒武统地层

按相关层序和岩石学特点来划分。包括斋江群（Sông Chảy, 越北），纳古组和沙巴组（Sa Pa, 西北部）、布康群（Bù Khang, 中部北区）等的石英-云母页岩、绢云母、碳酸盐岩、石英岩，达丁组（Đá Đình, 西北部）、调莲组（Đèo Sen, 中部北区）的石灰石、花岗岩化灰岩、石灰岩。在中部中区，新元古界-下寒武统地层有仙安组（Tiên An）中的碳酸盐岩-石英页岩、阳起石、夹透闪石的角闪石斜长石片麻岩、角闪石。在此之上是乳山组（Núi Vú），此层序的角闪石、石英岩和橄榄石花岗岩都有所增加。这两个层序局部在钦德列组（Khâm Đức）中并合。

属新元古界-下寒武统的各层序厚1000-3000米。角闪石的同位值年代是550Ma，片岩是1231Ma。

三、古生界

于古生代形成的岩石分布很广，特别是在越南北部。

1. 寒武系

寒武纪早期岩石有含纤核磷灰石的碳酸盐-陆源沉积岩，只见于覆盖在达丁组（Đá Đình）之上的属甘塘组（Cam Đường, 西北部）的一个狭长带中，由片岩、砾岩、白云岩、石墨片岩、石英岩及磷矿层组成，厚600-800米。

寒武纪中期沉积岩有莫洞组（Mỏ Đồng, 越北）的砂岩、粉砂岩、页岩、含钙质砂岩。在此基础上，河江组（Hà Giang, 越北）还有绿色页岩、石灰岩、硅质灰岩，在马江组（Sông Mã, 西北部）剖面中有重叠在新元古代-寒武系早期岩石上的含沙砾的页岩层。梅溪组（中部中区）的绢云母石英片岩、长石-石英片岩、云母石英片岩、阳起石、透镜状薄层斑岩也归为寒武纪中期岩石。厚度400-500到1000米。寒武纪晚期，主要包括长丰群（Chang Pung, 越北）、咸龙组（Hàm Rồng, 西北部）的石灰岩和陆沙群（Thần Sa, 越北）的页岩、砂岩、粉砂岩、透镜状石灰岩。厚约1000-1400米（如图2-1）。

2. 下寒武统-奥陶系

形成于寒武纪-奥陶纪的岩石（混合）包括边溪群（Bến Khê, 西北部）的石英砂岩、页岩、石英状砂岩，阿寿群（中部北区）的绢云母石英页岩、硅质岩、夹有绿页岩的石英岩状砂岩、石灰岩薄层，厚1300米到2000-3000米。

按岩石学成分和地层来分有：龙带河群（中部中区）的石英岩、页岩、石灰

岩花岗岩和兰江群（中部中区）的泥质页岩、斑状玄武岩、石英岩、石灰岩都归为寒武纪—志留亚纪时期。厚约1000米。

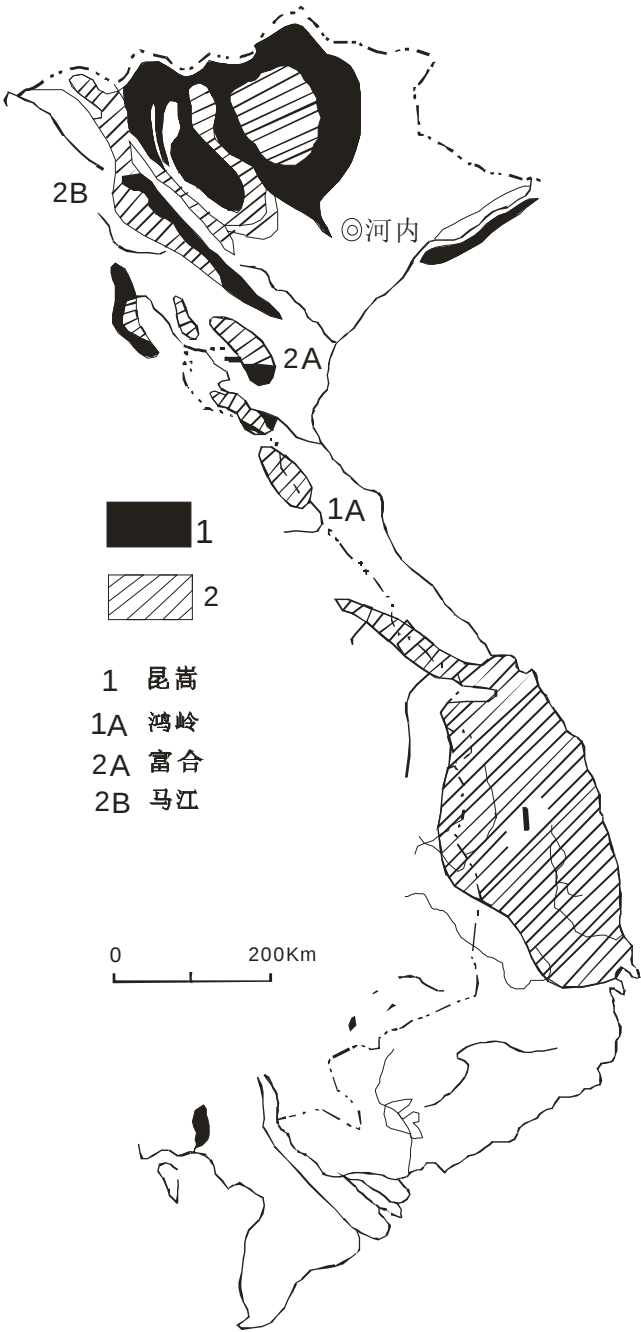


图2-1 越南前寒武纪和早古生代地层分布略图（据D·R·沃克曼，1977）

1. 寒武—志留纪 2. 元古宇

3. 奥陶系

把奥陶系沉积岩独立划分出来，包括陆社组（Lutxia，越北）的砂岩和泥质页岩转换成的石灰岩、鱼卵状石灰岩，那莫组（Ná Mọ，越北）的砂岩、石英状

砂岩转换成的页岩和东山组 (Đông Sơn, 西北部) 的砂岩、石英砂岩。厚300-500米, 多化石。

4. 上奥陶统-志留系

奥陶纪晚期-志留纪形成的岩石在越南北方四个区都有分布。生荣组 (Sinh Vinh, 西北部) 的砂岩覆盖层与上面的边溪群 (Bến Khê, 西北部) 不重叠, 在其上是灰岩、白云质灰岩、钙质页岩厚800米。其他三个区: 东北部的新梅群 (Tân Mai)、必苏组 (Cô Tô), 越北的富五组 (Phú Ngũ), 中部北区的大江群 (Sông Cả)、会二群等层序的砂岩、石英状砂岩、局部有泉华砂砾的泥质页岩、流纹岩或安山石、流纹岩。砂岩和页岩部分与上面的两个层序重合。所以按岩石学特征将那两个层序单独分为溪竹 (Khe Tre) 和审坑 (Thâm Hang) 组。厚度1000米以下到3000米。

5. 上志留统-下泥盆统

志留纪晚期沉积岩主要是博贤组 (Bó Hiềng, 西北部)、春山组 (Xuân Sơn, 东北) 层序的石灰岩和泥质灰岩和达江组 (Đại Giang, 中部北区) 的砂岩、钙质页岩、透镜状灰岩。厚几百米到2000米。

志留纪晚期-泥盆纪早期岩石包括重叠在大河组 (Sông Cả) 之上的海珉组 (Huồi Nhị, 北中部) 中的砂岩、石灰页岩。厚100-200米。

6. 泥盆系

在越南泥盆纪的岩石主要是碳酸盐-陆源沉积岩。分布于谦河带、下凉、范士版及长山山脉等地区。(图2-3)

泥盆纪早期沉积岩包括越北的西卡组 (Si Ka) 和北本组 (Bắc Bùn) 和新林 (Tân Lâm, 中部北区) 两个层序和裘江组 (Sông Cầu) 的砂岩、陆相页岩。东北部眉离组 (Mia Lé) 和大侍组 (Đại Thị), 西北部莫江组 (Sông Mua)、版外组 (Bản Nguồn)、南斐组 (Nậm Pía) 和饶占组 (Rào Châu中部北区) 的海相类型泥质页岩、砂岩、少量钙质页岩、石灰岩。厚700-800米到1000米以上。另外派方组 (Pia Phương) 的凝灰岩、页岩、石灰岩、花岗岩、钙质砂岩、含岩浆岩的硅质页岩有时还含有少量流纹岩、钠长斑岩和派犒组 (Phia Khao) 的石灰岩、花岗岩、钙质页岩归为泥盆纪早期, 但不排除含少部分属志留纪岩石。

泥盆纪早期-中期: 有氧侗组 (Dưỡng Động, 东北) 和海雷组 (Huồi Lôi,

中部北区)的砂岩、石英砂岩、粉砂质页岩、少量石灰岩,那馆组(Nà Quản, 越北)大部分为石灰岩,厚800-1000米。谢科组(Tạ Khoa, 西北部)也属相同地层,但主要为石英砂岩、页岩、硅质页岩、绿色页岩、基性喷发岩,变质程度低,厚2000-3000米。

泥盆纪中期的岩石有鲁山组(Lỗ Sơn, 东北)、南茛组(Nậm Cắn, 中部北区)层序厚达1000米的石灰岩层。穆排组(Mục Bài, 中部北区)的砂岩、页岩厚500-600米。

属泥盆纪中期-晚期是有茶山组(Đồ Sơn, 东北)红色的陆源沉积岩,三华湖层序组(Hồ Tam Hoa, 越北)的砂岩、钙质页岩,犒禄组(Khao Lộc, 越北)和劬沛组(Cù Bai, 北中部)层序的石灰岩。

奉洞层序(Động Thờ, 中部北区)属泥盆纪晚期的页岩、钙质页岩换变成的砂岩夹页岩,厚600米。

7. 上泥盆统-下石炭统

泥盆纪晚期-石炭纪早期沉积岩包括下龙层序(Hạ Long, 东北部)的石灰岩,版改组(Bản Cải, 西北部)、速萨组(Tốc Tát, 越北)和吉腾(Cát Đằng, 中部北区)层序的泥页岩、硅、钙质页岩、条纹状石灰岩,厚400-500米。另外,鸿豪层序(Hòn Heo, 中部南区-南部)的砂岩、石英砂岩、硅质页岩(如图2-2)。

8. 石炭系-二叠系

石炭纪-二叠纪的沉积岩含石炭纪早期的罗溪组(La Khê, 北中部),有砂岩、泥质页岩、煤页岩、硅质页岩、厚600-700米。按年代的差异,石炭纪沉积可分石炭纪-二叠纪的北山组(Bắc Sơn, 越北)、两奇组(Lưỡng Kỳ, 东北部)、孟隆组(Mường Lông, 中部北区)达磨组(Đá Mài, 西北部)等,和二叠纪的中部南区-南部的河仙组(Hà Tiên)和诸明组(Chư Minh)。形成于石炭纪晚期-二叠纪的特殊构造包括版灭组(Bản Diệt, 西北部)的砂岩、页岩、石灰岩和基性喷发岩或沱江组(Sông Đà, 芒提)和多灵组(Đắk Lìn, 中部南区-南部)层序的中性、氧化喷发岩。形成于二叠纪晚期的基性喷发岩在锦水组(Cẩm Thủy)下部,上部是安悦组(Yên Duyệt, 西北部)泥质页岩、硅土、砂岩和煤层。在这个区域喷发成分复杂。有些地方有三叠纪岩石,将归为院南组(Viên Nam)。除了玄武岩、橄榄玄武岩、还有气孔状玄武岩、粗面、霏细玄武岩,厚300-400

米到1000米以上。二叠纪晚期的碳酸盐化陆源岩在斜切（Tà Thiết, 中部南区）和同登组（Đồng Đăng, 东北部）层序中有描述。属二叠纪晚期的还有溪若组（Khe Giũa, 中部北区）的石灰岩和博利组（Bo Lếch, 芒提）、鸿昂组（Hòn Ngang, 中部南区-南部）的陆源岩和杂少量陆源喷发岩，都归为二叠纪-三叠纪。各个层序一般厚度约400-600米。

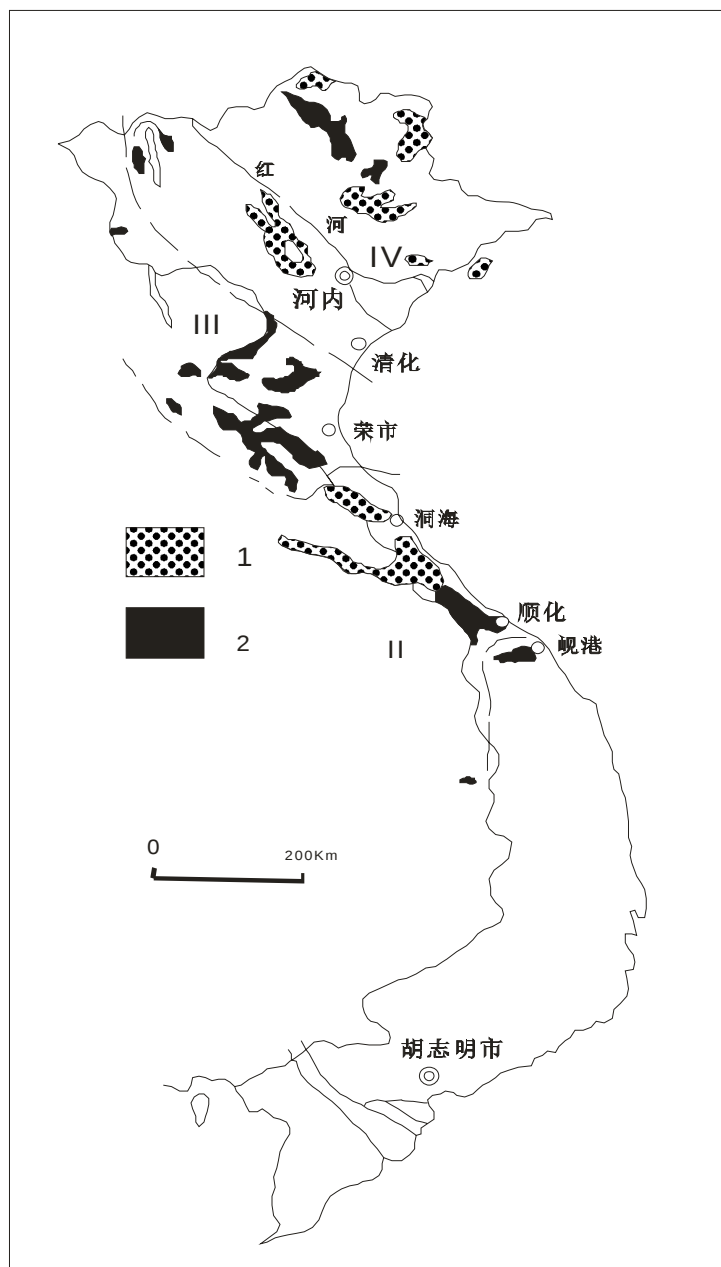


图2-2 越南泥盆纪地层分布略图

据D.R.沃克曼, 1997

1. 有化石依据的泥盆系 2. 缺乏化石依据的泥盆系

四、中生界

1. 三叠系

三叠纪早期的岩石有谅山组 (Lạng Sơn, 东北部)、鹤苗组 (Cò Nòi, 西北部)、西贡河组 (Sông Sài Gòn, 中部南区) 等的含少量碳酸盐的陆源岩, 鸿碍组 (Hồng Ngải, 越北) 的碳酸盐岩, 宪江组 (Sông Hiến, 越北) 和北水组 (Bắc Thủy, 东北部) 层序的陆源夹喷发岩。各个层序厚400-500米到1000米。属三叠纪中期的氧化喷发岩很多, 产在越北的坤朗组 (Khôn Làng)、邻仿组 (Lân Páng), 中部北区的同宙组 (Đồng Trầu)、蓬河组 (Sông Bung), 中部中区的芒杨组 (Mang Yang) 和中部南区-南部的泰州组 (Châu Thới) 等层序中。同交组 (Đồng Giao, 西北部)、黄眉组 (Hoàng Mai, 中部北区)、鸿艺组 (Hòn Nghệ, 中部南区-南部) 等层序以碳酸盐岩为主, 那屈组 (Nà Khuất, 东北部)、西北部的归凌组 (Quy Lăng)、南深 (Nậm Thăm) 等以沉碳酸陆源岩为主。除了覆盖在一些较老地层上的喷发岩外, 陆源岩和碳酸盐岩与其接连的地层重合。厚1000-3000米。

三叠纪中-晚期与三叠纪中期没有清楚的界限, 包括有西北部的杯河组 (Sông Bôi) 和莱州组 (Lai Châu) 砂岩、页岩, 在西北部一些地区还有基性喷发岩, 所以将其单独划为孟斋组 (Mường Trai)。

属三叠纪晚期的有卡尼时期牡山组 (Mẫu Sơn 东北部)、南幕组 (Nậm Mu 西北部) 层序的陆源岩, 与更老地层不重叠的诺利克-Ret含煤层。已分出各个陆相含煤构造: 在鸿基层序中有30层煤层, 中部北区同朵组 (Đồng Đỏ)、农山组 (Nông Sơn) 层序所含煤层相对少些。海相含煤构造分属文朗 (Văn Lăng, 越北) 和水榜组 (Suối Bàng, 西北部) 层序。在这两层序的一些地区发现肥煤层。各含煤建造厚400-500米到3000米。

2. 侏罗系

侏罗纪-侏罗纪中期的岩石有下居组 (Hạ Cối, 东北-越北)、南铺组 (Nậm Pô, 西北部) 和油庭组 (Dầu Tiếng, 中部南区-南部) 等的陆相陆源岩和红色陆源岩, 友年组 (Hữu Niên, 中部北区)、达利林组 (Đray Linh, 中部中区, 南区) 海相陆源岩、碳酸盐岩。各个层序厚几百米到800米。

侏罗纪中期形成岩石与前面描述的层序重叠, 有罗牙组 (La Ngà, 中部南区-南部) 的海相泥质岩和砂岩, 亚宿组 (Ea Súp, 中部中区)、友正组 (Hữu Chánh, 中部北区) 砂岩、红色页岩, 局部高度变质。厚300-900米。

中部南区的调保禄 (Đèo Bảo Lộc) 和沙章 (Xa Lon) 层序的砾岩、砂岩、安山石、卞琳英安岩和龙平层序 (Long Bình) 的砂岩、分薄层的泥岩、安山岩都归为侏罗纪晚期岩石。

3. 上侏罗统-白垩系

侏罗纪晚期-白垩纪的岩石有三隆组 (Tam Lung, 东北部) 和孟馨组 (Mường Hình, 中部北区) 的砂岩、砾岩、流纹岩、英安岩及文震组 (Văn Chấn, 西北部) 的砾岩、砂岩、泥质页岩、石灰岩、正长斑岩、石英正长斑岩、流纹岩。各个层序厚500-600米到3000米。

白垩纪末期的有安州组 (Yên Châu, 西北部)、版坑组 (Bản Hạng, 东北、越北)、慕撒组 (Mụ Giạ, 中部北区)、多凌组 (Đắk Rìum, 中部中区) 等的砂岩、砾岩、红色泥岩和斗溪组 (Ngòi Thia) 的流纹岩、英安岩、砂岩, 丹阳组 (Đôn Dương, 中部中区、南区-南部) 的英安质流纹岩、霏细岩、安山岩。芽庄组 (Nha Trang, 中部南区-南部) 下部是安山岩和夹有少量砂岩的英安岩, 上部是流纹岩、粗面流纹岩、霏细岩都为白垩纪岩石。各个层序厚100-1000米以上。

五、新生界

1. 第三系

古新世岩石有砂岩、粉砂岩、泥岩, 主要在北部平原的庭高组 (Đình Cao)、符先 (Phù Tiên) 组, 南部的劳佣岛组 (Cù Lao Dung)、茶句组 (Trà Cú) (图2-4)。在南飞组 (Nậm Bay, 孟提) 中有描述。古新世喷发岩包括夫吒组 (Pu Tra, 西北部) 的粗面岩、白榴石、凝灰岩 (如图2-3)。

中新世构造的岩石包括中部中区波河组 (Sông Ba), 西北部文安组 (Văn Yên)、古福组 (Cổ Phúc) 和潘良组 (Phan Lương) 层序, 东北部高平组 (Cao Bằng)、那阳 (Na Dương)、同呵 (Đồng Ho) 层序, 北部平原的府渠组 (Phủ Cừ)、先兴组 (Tiên Hưng), 南部的白虎组 (Bạch Hổ)、前江组 (Tiền Giang)、奉协组 (Phụng Hiệp) 中的砂岩、砾岩、泥岩。各个层序厚100到400-500米。

在东北部永保组 (Vĩnh Bảo)、宵交组 (Tiêu Giao)、喧庙组 (Rinh Chùa), 越北宣光组 (Tuyên Quang), 中部南区-南部的芹苴组 (Cần Thơ)、雅贝组 (Nhà Bè) 的上新世岩有砂岩、砾岩、泥岩, 层序在此基础上还有硅藻土、玄武岩薄层。各个层序的平均厚度为200-300米。

新第三纪 (混合) 岩石包括西北部行门组 (Hang Môn)、中部北区溪博组

(Khe Bô)、同海组 (Đồng Hới) 层序中的砂岩、砾岩、泥岩、褐煤、高岭土。在中部中区的貽林组 (Di Linh) 中在以上基础上还有火山灰风化的胶状粘土、玄武岩，在富国主要是含碧玄玉的砂岩。厚几十米到500米。

在审山组 (Sầm Sơn, 西北部)、石罕组 (Thạch Hãn, 中部中区) 和苗婆组 (Bà Miêu, 中部南区-南部) 等中属上新世-更新世早期沉积的有砂岩、砾岩、灰岩、砖红壤，厚10-70米。

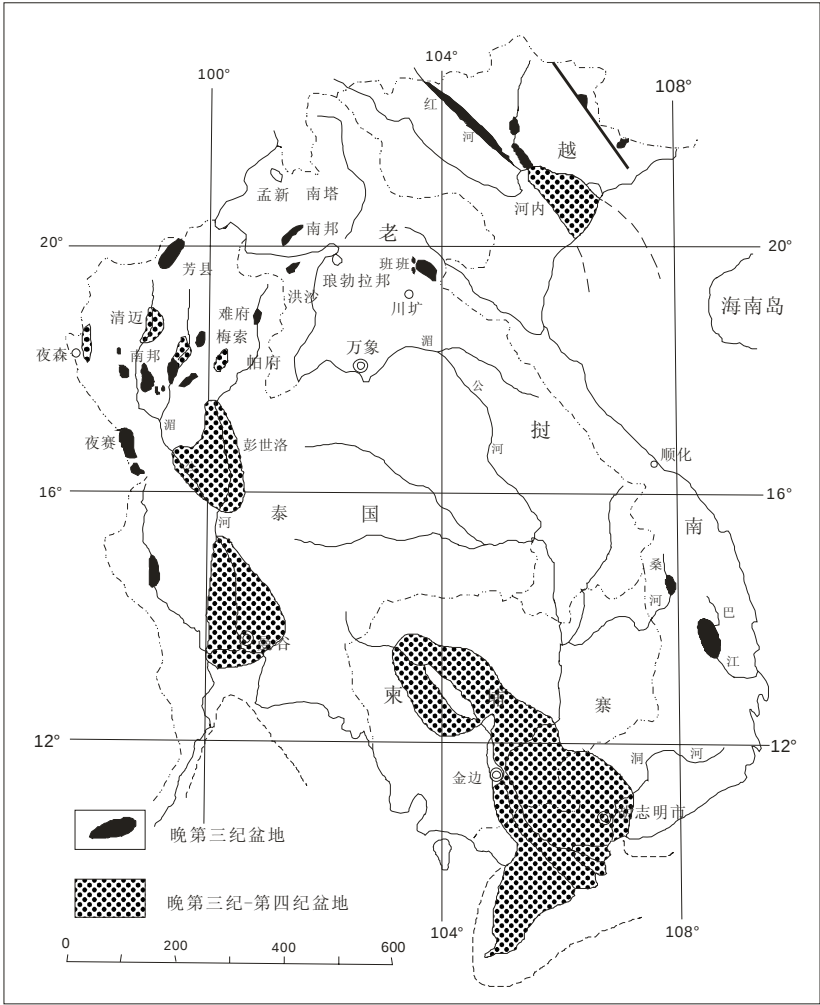


图2-3 越南及邻国第三纪-第四纪盆地分布略图 (据D·R·沃克曼, 1977)

2. 第四系

第四纪按年代和成因划分范围，散布在山区盆地，集中在北部平原、南部平原和中部海港 (图2-4)。

有更新世早期的海、江河-海、海成因的砂砾、泥沙等；更新世早- 中期江河、江河-海、海成因的砾砾、砂、泥、高岭土；更新世中期的江河-海、海成因

的礫砾、砂、泥、高岭土；全新世早期的江河成因的砂、礫砾、泥；全新世中期的海-风成因的砂砾，海-潭泥成因的有机沉积物、泥、泥砂，海成因的泥砂、砂砾；全新世中-晚期潭泥-海-江河成因的泥砾、海-风成因的砂；全新世晚期海-风、潭泥、江河、海成因的砂砾、泥砂、泥煤。大部分狭窄的第四纪沉积盆地都有局部并合。第四纪火山运动主要发生在上新世、更新世早期、更新世中-晚期和整个全新世形成了玄武岩、拉斑玄武岩、硷性橄榄石玄武岩。

第二节 区域构造

越南及其附近包括前寒武纪陆地板块，古生代、中生代岩石地带，各种中新世火山结构和亚欧板块东南地区的海岸线。从元古代进化到现在，在不同的地质背景下，岩层经过了裂变、下陷、冲击、碰撞，形成石山。经过复杂的延伸、变化、位移形成多种多样的矿产资源。

越南虽然不同地区的发展过程不同，但有如下共同特点：

1. 元古代的变质岩系组成了褶皱带的基底；
2. 加里东期构造运动影响较普通；
3. 海西期造成长山和大叻海西期褶皱带；
4. 印支运动发生于晚三叠世卡尼克期，典型沉积和火山活动区分布于西北部；
5. 燕山运动发生于侏罗纪—白垩纪，形成断陷盆地和岩浆活动，同时，也波及已固结稳定区；
6. 喜马拉雅期构造运动发生于晚第三纪到更新世，主要表现在陆壳拉张，形成断陷盆地和中南部玄武岩的喷发。

各个时期的构造单元的主要特征简述如下：

一、前寒武纪的地块

在越南前寒武纪，有小陆地或基底上升形成外来岩体出露区。

1. 印尼地块

占据了东洋半岛中心，包括的东部昆嵩的前寒武纪结晶基底和西部显生宙（Phanerozoic）沿线带泰国Khorat盆地。

昆嵩板块出现的中部中区，包括两个带：卡纳类型带，主要是元古代辉石二

云片麻岩、白粒岩，同位素年龄值23亿年；玉灵带（Ngọc Linh）有原生代角闪岩相结晶页岩，可能是从岗瓦那大陆分裂出来的小板块。板块北沿和西北沿是古生代岩石逐渐青年化联结成的。

古生代晚期和中新生代岩石，经过板块碰撞后变化过程使昆嵩板块产生剧烈变化，在前寒武纪地表上形成凹陷处。

2. 黄沙地块（Hoàng Sa）

分布在越南东海北沿，基底是原生代结晶页岩、花岗片麻岩。覆盖在期上面的是第三系碳酸盐-陆源沉积。因黄沙板块北沿与海南加里东造山带接连，可把黄沙板块视为从印尼板块分裂出来的小板块。

3. Phan Si Pan 地块

包括片麻岩、角闪岩复式，其夹有少量透明状大理石，黄连山板块可分成春台（Xuân Đài）、旭溪（Ngòi Hút）、红河（Sông Hồng）复式岩体，都归其属原生代，同位素年龄值23亿~20亿2千万年，造就了山脉走向为西北-东南走向的红河流域。据最新资料，从英闪岩分离出来的锆石U-Pb同位素，嘉荣复式（Ca Vĩnh）斜长花岗岩属约283.4千万年前的元古代晚期，最早形成于31-34亿年前。从资料看来越南北部地区的进化很早，覆盖在上面的是文德期-古生代碳酸盐-陆源沉积，其中老街沉积为磷钙土。

从结构上看，黄连山地垒（凸起）状复式与西南面的范士版（Phan Si Pan）山脉不对称。象山（Núi Voi）夹在两个带中间，截断了东北部红河（Sông Hồng）和斋江（Sông Chảy）。分析结构体系和建造位置特点，可把黄连山地块看做是扬子板块（Dương Tử）分离出来的外来地域。它主要是从渐新世到中新世前期变化形成上百公里的山脉截断了红河和斋江。

二、古生代早期-中期的中-越交接地区

此地域占北部大部分面积。从北方的马江衔接处到中国的东南部，形成联片区域。它形成于古生代早期-中期，包括以下几个部分：

1. 越北带

越北带，位于斋江（Sông Chảy）和襄江（Sông Cầu）之间，基底为元古代晚期-志留纪早期活火山-沉积复式。越北、东北部被A·E·Dovjikov归其为弯曲地貌。其中卢江（Sông Lô）中游的一些地方可以见到古生代早期的变玄武岩、多超基性体的硅质页岩，反映了古代大洋地壳的变化属河江省的北光（Bắc Quang）、

南布（Nậm Bút）蛇绿岩带，因这两岩带碰撞而产生了富语带（S₁ Phú Ngữ）。

懂拔（Tòng Bá）火山洞沿边的硷性石灰火山岩及斋江凸起处S形混合花岗岩都表明该地壳的碰撞过程形成于早期加里东造山运动期。从而形成红色磨拉石碎片（D₁）、陆源-碳酸岩（D）和碳酸岩等矿物覆盖层。

地区西部地形凹凸不平，中间是斋江（Sông Chảy）的凸起部分，东部是怒江（Sông Gâm）凹处，两侧底部是长丰（Chang Pung）和河江市寒武纪-奥陶纪沉积。

2. 西北带

此地带主要分布在马江流域和红河的部分流域。复式基底是活火山沉积（PR₃-PZ₁），其中变玄武岩同位值年代为45亿年，与含铬铁矿的基性和超基性体相仿。下陷地带（消减作用）的碳酸岩形成马江衔接处，蕴藏蛇绿岩、滑积岩体复式，分布次序从清化平原东北-东南走向逐渐转为东-东北走向，一直延伸到北部湾。

各个盖层主要是陆源-碳酸盐岩，属古生代中期-晚期。

3. 东北带

此地带主要是各陆源复理层（PR₃-PZ₁），形成板栗状蜿蜒地貌，一直延伸到中国东南部。弯沿地带的变动形成高北谅（Cao Bắc Lạng）复凸起的褶皱，菊苏（Cốc Xô）、北山（Bắc Sơn）弓背斜及广宁（Quảng Ninh）复凸起的褶皱和新梅（Tản Mai）、必苏（Cô Tô）弓背都是东南走向。在它们中间有许多凹处被中生代安州（An Châu）裂缝覆盖。

在志留纪晚期，版若蛇绿岩带变玄武岩和西向下陷带的富五（Phú Ngũ）沉积带的复理石、浊积岩相互挤压形成加理东晚期造山运动碰撞带高山类型的超基性岩。

大陆架各陆源-碳酸盐覆盖层复式中大部分磨拉石碎片（D₁）和碳酸岩（PZ₁）层形成近似于简单S形的岩脉，其中高平的硅化碳酸盐岩含泥盆纪相岩浆岩。

三、古生代中期-晚期越老交接地区

这地区位于马江流域南面，占长山（Trường Sơn）北部大部分，一直延伸到印泥板块的西沿，向西南部延伸路经柬埔寨、泰国，是中南半岛联合区的古新世-特提斯期的分支。

1. 岬港（Đà Nẵng）-斯班（Sepon）带

分布在昆嵩高地板块北部和西北部的活火山-陆源岩和硅质页岩形成新元古代-古生代早期的基底陆架。

在高地板块边沿蛇绿岩带的辉绿岩及超基性岩的出现是由于三奇 (Tam Kỳ) 和帕姑 (Pa Kô) 结合带碰撞形成的两个分支, 近南北向穿过广南省转向西北沿越老边境延伸, 再拐近南北向到沙师河 (Sông Sa Thầy) 和帕姑盆地 (Pa Kô)。下陷到昆嵩板块的过程形成安第斯山脉类型的板块边沿, 期成分主要是茶蓬 (Trà Bồng)、延平 (Diên Bình) 复式的侵入性花岗闪长岩-花岗岩。同位值年代为4.18 亿年。在加里东期的碰撞和以后的改变过程中在前寒武纪结晶层上的大洋板块的水平移动使地架卷翘。

2. 长山带 (Trường Sơn)

此带占据中部北区大部分面积, 老挝东北部连着莱州 (Lai Châu) 西北部。在平治天 (Bình Trị Thiên) 活火山岩-浊流复理岩组 (主要成分为硅质页岩 (PZ₁₋₂)、安山石、凝辉陆源岩逐渐形成呈西北东南走向的蜿蜒的浊流岩-复理石体, 广泛分布在红河流域。在海西期, 长山 (Trường Sơn)、同海 (Đồng Hới) 等层序的花岗岩贯穿整个地架, 反应了寒武纪早期的撞击过程。

覆盖层是古生代碳酸盐-陆源岩体, 下部多处是含煤沉积, 如河静、老挝中-南部的沙拉弯 (Salavan)、义安 (Nghệ An) 的罗溪 (La Khê)。

3. 河仙 (Hà Tiên) - 柬埔寨带

此带主分布在西南部边缘到柬埔寨东南部。因证明材料不足, 暂时将岩石地层年代归为古生代中期。二叠纪碳酸盐岩体大陆架露出地表的许多地方集中在河仙-柬埔寨地及局部一些凸起岩体也可能是中生代形成的。

四、中生代早期东洋地区

这一地区主要在湄公河流域和西南部形成两个支干。因撞击而形成的印支山脉把东洋板块和山泰 (Shan-Thai) 与中越板块连接在一起, 所以也可以把越老地区长山北部归为三叠纪时期。

出现在天刃 (Thiên Nhân) 地区的古生代富放射虫类硅质页岩, 义安省安成 (Yên Thành)、河静省石溪 (Thạch Khê) 的蛇纹岩化基性、超基性岩体是古新世-特提斯期遗留下来的。岑葛 (Sầm Nưa) 的侵入岩-火山岩带、奠边 (Điện Biên) 花岗岩带的特征显示在印支早期地层下陷后地架向西南延伸埋在长山下面。

1. 南乌带 (Nậm U)

此带沿着孟提地区陀河上游经过老挝的帕莱（Paklay）和泰国的罗依（Loei）后在越南的莫边-莱州地区被截断。

复理石建造是在古生代晚期-三叠纪形成的弓形活火山-沉积岩。在很多地方都可见到硅质碳酸盐岩、安山岩，如孟提（Mường Tè）、朗布拉邦（Luang Prabang）地区。印支运动形成的花岗岩和变质岩等侵入岩体、有含煤的磨拉石（ T_3n-r ）陆源岩（J）、有盐田的红土及石膏（K）等在老挝、柬埔寨、泰国克拉特高原（Khorat）和越南西沿都有分布。

2. 斯列邦带（Srê Pôk）

从邦美土（Buôn Ma Thuột）呈楔子状延伸到柬埔寨东北部。在斯列邦河下游流域（柬埔寨）的含放射虫类碳酸盐沉积岩、硅质页岩（lidién）及硅质碳酸岩、泥质页岩、硷性石灰喷发岩形成古生代晚期弓形火山与活动陆地板块边缘相连接。在它们上面的是三叠纪中期的活火山-陆源岩及侏罗纪陆相沉积建造。

3. 西南部带

从竖江延伸到泰国东南部近海的巴落（Bà Lụa）、鸿岸（Hòn Ngạn）、南俞（Nam Du）、海特（Hải Tặc）、鸿邦（Hòn Bông）、鸿槌（Hòn Chuối）等群岛。二叠纪-三叠纪浊流层-复理层陆源-碳酸盐岩的成分是古生代晚期含放射虫类的硅质页岩、以弓形火山为背景的安山石-英安岩体。撞击过程发生在三叠纪晚期，形成西南部印支构造，与柬埔寨和泰国东南部相连。覆盖在其上面的是近海或陆上的中生代-新生代沉积。

五、中生代的隆起-凹陷地区

古生代晚期和中生代，特别是中生代板块活动强烈撞击在不同大陆架上形成内陆凸地和裂谷。

1. 沱江裂谷（Sông Đà）

沱河裂谷的发展受沿西北部西北-东南走向的各断裂带控制。在二叠纪-三叠纪的强烈分裂过程中涌现了玄武岩、斜长斑岩、辉绿岩、粗面玄武岩和碳酸盐-陆源沉积，局部有含镍铜矿侵入性基性、超基性岩。

三叠纪晚期沱河裂谷合拢引发陆地间相互碰撞，形成沿海西北-东南走向的崎岖山脉和许多位移或被弯曲的地裂的含煤的磨拉石（ T_3n-r ）、陆源岩（J）、红色碎砾（ K_2 ）等盆地沉积。

2. 宪江裂谷（Sông Hiến）

在越北、北部东北区呈弯曲的叠起，为各个层序断裂带控制。

三叠纪喷发岩-陆源岩复式不对称，其中沿高平-谅山带东北翼还有相反的喷发岩和在长玄武岩中的含Cu-Ni的性基性、超基性小侵入岩，可能是古新世-特提斯期遗迹。

不重合覆盖在其上面的侏罗纪晚期-白垩纪的流纹岩和陆源沉积。

3. 安州裂谷 (An Châu)

由于太原 (Thái Nguyên) - 谅山 (Lạng Sơn) 和三岛 (Tam Đảo) - 晋麦 (Tầm Mai) 的两条裂缝影响，安州裂缝呈楔子状，其成分是很丰富中生代活火山-沉积。三叠纪的沉积层特厚，主要是在安尼西阶的喷发岩。

在它们上面的是含煤的陆源沉积 (T_{3n-r})、陆相碎砾 (J_{1-2}) 和红土 (K_2)。

4. 岑葛裂谷 (Sầm Nưa)

其分布在义安-河静东北部到老挝，形成蜿蜒曲折的褶皱，主要成分是三叠纪中期硷性石灰列的活火山陆源岩、碳酸岩。

覆盖在它们上面的是含煤的陆源沉积 (T_{3n-r})、喷发岩 (J_3-K) 和局部有红土沉积 (K_2)。

在北长山的弓形火山 (Pa_3-T) 和大洋类型的构造仍须进一步研究。

5. 安溪裂谷 (An Khê)

在昆嵩板块的前寒武纪陆相建造上，为三叠纪活火山-陆源岩构造，其中主要是喷发岩多处还可见到花岗斑岩。

6. 秀丽裂谷 (Tú Lệ)

分布在陀河裂谷东北沿和黄连山南部，主要是侵入岩-火山岩 ($J-K$) 和硷性 (K_2-P) 侵入岩复式形成了潘士邦 (Phan Si Pan) 高山脉。

7. 鸿基 (Hòn Gai) 和宝台 (Bảo Thái) 地堑

主要分布在广宁，受下陷幅度大的断层控制，含煤的陆源沉积层 (T_{3n-r}) 前景很好，粗砾陆相层厚 (J_{1-2}) 上千米。

8. 侬山地堑 (Nông Sơn)

分布在广南西部，包括不整合重叠在不同地层之上的含煤陆源沉积 (T_{3n-r}) 和陆相、海相沉积 (J_1)。

9. 大叻陆缘带

大陆建造和浅海环境下形成在越南东部外海下沉带上属安第斯山类型，普遍为侏罗纪晚期-古新世硷性-石灰列硅铝质火成岩-火山复式。主要形成锡、钨、黄金、辉钼矿等。

六、新生代隆起-凹陷地区

印度陆地和亚洲陆地撞击引发越南地壳变形，按西南-东北走向的断层张裂形成第三纪江、湖洼地或三角洲和海湾。

1. 江、湖洼地

江、湖洼地沿上面的断层分布，呈地壕状或移动、分裂块状。主要是含长效煤的灰色磨拉石岩体，如：高平（Cao Bằng）、那阳（Nà Dương）、斋江（Sông Chảy）、红河（Sông Hồng）、大河（Sông Cả）、波江（Sông Ba）等地区。河内内陆断裂洼地呈地壕状，新生代沉积厚4000米以上，含褐煤、油气。此煤带一直延伸都北部湾，属红河盆地。

2. 海湾、三角洲盆地

分布在越南陆地阶梯上的呈地壕状或堑壕，如：红河（Sông Hồng）、富庆（Phú Khánh）、九龙（Cửu Long）、南昆山（Nam Côn Sơn）、马来（Malay）土州（Thổ châu）等。云顿盆地（Vũng Mây）、私正滩（Tư Chính）、黄沙（Hoàng Sa）、长沙（Trường Sa）等地含油气盆地。

七、越南东部沿海

最新资料显示，距今32-16亿年前由于形成沿海的过程中引发东海海底地裂从而形成了新大洋。同时，红河断裂向左伸展，顺时针转动对越南东海陆架的形成有一定影响。

八、西原新生代玄武岩

东洋南部的岩体在西原高原上形成各种U或S形弯曲的第三纪中新世-全新世玄武岩列，一直延伸到沿海地区。玄武岩经过风化形成丰富的红土带铁铝氧石。

第三节 岩浆岩

在越南的岩浆活动（侵入、喷发岩）主要分七个活动阶段：古元古代、中元古代、新元古代、古生代早-中期、古生代晚期-中生代早期、中生代晚期-新生代和新生代晚期。主要分布于昆嵩、越北、富和等古隆起，黑水河、马江、兰江、

朱江等河谷，以及长山山脉和大叻等地区（图2-5）。

另外还有一些地区的年代未能确定，虽分布面不广，但是否含矿仍需进一步调查。

一、古元古代岩浆岩阶段

现只发现分布在昆嵩上升板块旁，属元古代的Kan Nack类型，高度变，质岩紧密相连。可分成以下几个复式岩体：

二、昆卡蓬复式（ v_1 Kon Kbang）

昆卡蓬复式的主要岩石为苏长岩、辉长岩-苏长岩，钠含量高于钾（钠型），钙盐含量很高。为岩浆岩根源，属Kan Nack 类型的基性喷发岩。

1. 波河复式（ $\gamma\delta_1$ Sông Ba）

波河复式成分变化：从闪长岩、石英闪长岩逐渐演变为斜长花岗岩（紫苏花岗闪长岩）。可分为2种：暗色紫苏花岗闪长岩（成分变化：从闪长岩到石英闪长岩）和亮色紫苏花岗闪长岩（主要成分为斜长花岗岩）。夹在此复式中的紫苏花岗岩是钾变质后的产物（微斜长石化），此变质过程比派曼郭复式（Plei Manko）的花岗闪长岩。

2. 派曼郭复式（Plei Manko）

派曼郭复式包括穿过Kan Nack类型变质岩的花岗岩、黑云母-花岗岩。此复式最主要的岩石是：云雾状的花岗岩、黑云母花岗岩和块状的亮色花岗岩、黑云母花岗岩。黑云母-花岗岩-堇青石类型的只夹在本复式的相同深度相的褶皱里，已石化（如图2-4）。

三、中元古代岩浆岩阶段

总体上属这一阶段的岩浆岩活动规律性很强，特点清晰，主要可分成以下几种岩浆岩组合（喷发岩-侵入岩）：

1. 玄武岩-辉绿岩和辉长岩-角闪岩组合

此组合包括有象山（Núi Voi）、水展（Suối Chiềng）、拉班（La Ban）等层序断面中的正角闪岩和宝夏（ v_2 Bảo Hà）、焦尧（ v_2 Cheo Reo）、芙美（ v_2 Phù Mỹ）等复式中的辉长岩-角闪岩体。

2. 斜长花岗岩-英云闪长岩

包括袞荣（ $\gamma\delta_2$ Ca Vĩnh）、涌江（ $\gamma\delta_2$ Sông Re）复式，其成分变化：从石英闪长岩到英云闪长岩、斜长花岗岩。局部岩石微斜长石化，其相应成分为：石英

正长岩、石英二长岩。

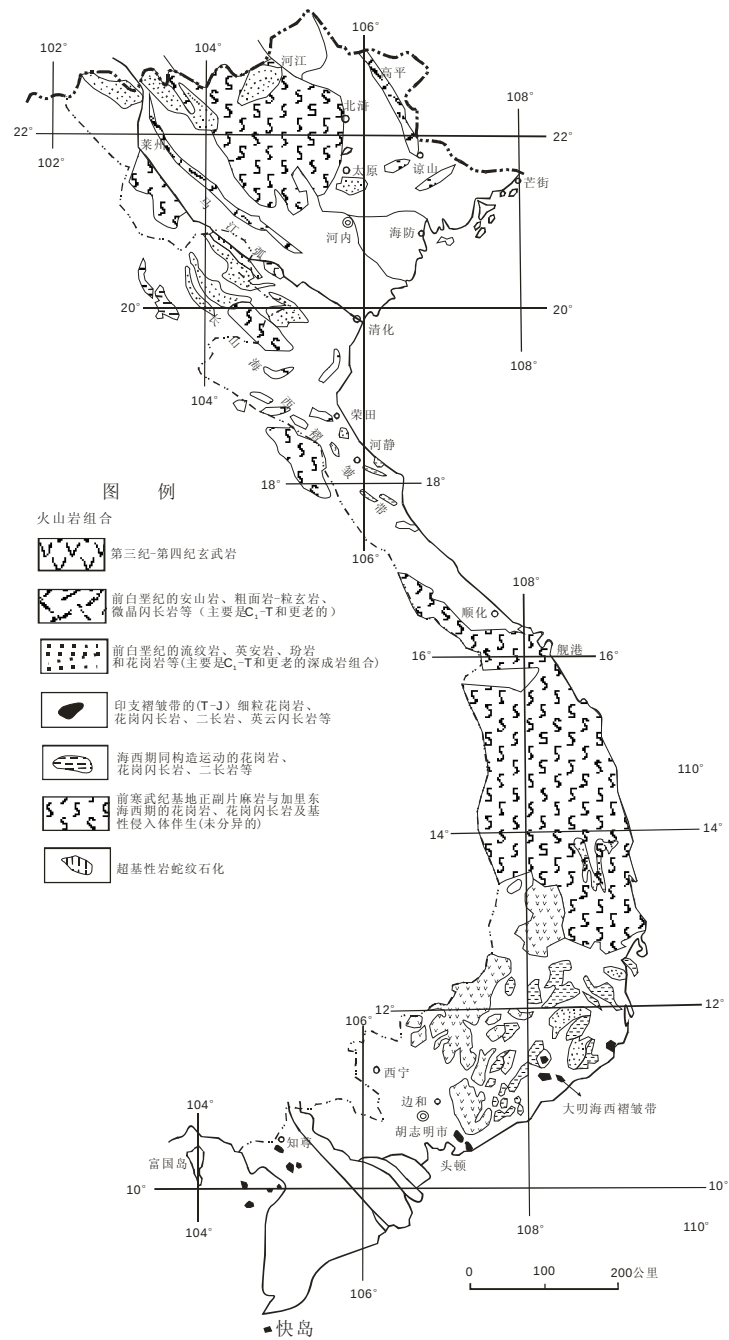


图2-4 越南岩浆岩与变质岩分布略图（据D·R·沃克曼，1977）

四、新元古代-古生代早期岩浆岩阶段

中元古代岩浆岩阶段相仿，属此阶段的岩浆岩成分从基性到硅铝质转化，与仙安、乳山、钦德层序的变质基性喷发岩空间有紧密关联。因此这一阶段有代表性的侵入喷发岩浆岩组合是以下各复式的玄武岩-辉绿岩和辉长岩-角闪岩：

陀韦复式 (v_3 Tà Vi)，主要成分是辉长岩-角闪岩。

南宁复式 ($\gamma\delta_3$ Nậm Nin)，主要成分是辉长岩-角闪岩-斜长花岗岩。

朱莱复式 (γ_3 Chu Lai)，主要成分是花岗岩-混合岩、花岗-片麻岩。

属此岩浆岩活动阶段在北部西北区板块中有：婆莲复式 ($\delta\gamma_3$ Po Sen)，主要成分是石英闪长岩、花岗闪长岩、花岗岩；隐屯复式 (γ_3 Xóm Giầu)，有浅红色富钾长石花岗岩、结晶花岗岩；孟鸿复式 ($\gamma\zeta_3$ Mùòng Hum)，硷性花岗岩、硷性花岗正长岩和少量石英正长闪长岩（混合性）。

与这一阶段形成的岩浆岩相关的矿产未能进一步研究，没有详细资料。

五、古生代早-中期岩浆岩活动阶段

可分成以下几种组合：

1. 玄武岩-辉绿岩和纯橄榄岩-橄榄岩-辉石岩组合

古生代早的玄武岩-辉绿岩和纯橄榄岩-橄榄岩-辉石岩组合，包括：马江群 (C_2 Sông Mã)、河江群 (C_2 Hà Giang)、乳山组 (PR_3 - C_1 Núi Vú) 等的辉绿岩-玄武岩、喷发岩；葛山 (σ_4^1 Núi Nưa)、派南 (σ_4^1 Pắc Nậm)、南钵 (σ_4^1 Nậm Bút) 等复式的纯橄榄岩-橄榄岩；协得复式 (σ_4^1 Hiệp Đức) 的纯橄榄岩-辉石岩。

与这种组合紧密接合的有西北部博兴 (v_4^1 Bó Xinh)、展姜 ($\gamma\delta_4^1$ Chiềng Khương)，东北部白沙 (v_4^1 Bạch Sa)、，中部玉山 (v_4^1 Núi Ngọc)、甸帮 ($\gamma\delta_4^1$ Diệng Bông) 等复式的基性和硅铝质岩石或土壤，其特征为蛇绿岩组合。与其相关的为亲铁元素和亲铜亲硫元素矿产，特别是铂组元素矿产。

2. 安山石-流纹岩和闪长岩-花岗闪长岩-花岗岩组合

此组合包括：龙大组 (O-S Long Đại) 的安山岩、安山玄武岩、英安岩、流纹英安岩等喷发岩，大河群 (O-S Sông Cả) 的流纹岩。与其紧密接合的有茶蓬 ($\gamma\delta_4^2$ Trà Bồng)、延平 ($\gamma\delta_4^2$ Diên Bình) 复式的闪长岩、石英闪长岩、花岗闪长岩。内生矿物为Au、Pb-Zn、Cu-Mo（金矿达工业标准）。

3. 黑云母花岗岩-二云母花岗岩组合

此组合包括斋江 ($\gamma\delta_4^2$ Sông Chảy)、大禄 ($\gamma\delta_4^2$ Sông Chảy) 复式，岩石主要是花岗闪长岩和二云母花岗岩（局部有斜长斑岩）。为硷性碳酸盐岩浆系列特征，属S-花岗岩类型，典型矿是Sn-W-Mo，稀土。

4. 花岗闪长岩-黑云母花岗岩-二云母花岗岩组合

此组合包括银山 ($\gamma\delta_4^3$ Sông Chảy，包括严山Nghiêm Sơn、螺山Loa Sơn板块)、

孟喇 ($\gamma\delta_4^3$ Mường Lát)、长山 ($\gamma\delta_4^3$ Trường Sơn) 等复式, 主要岩石成分是黑云母花岗闪长岩、斑状黑云母花岗岩、含花岗岩-堇青石的二云母花岗、亮色的花岗岩、甚至还有斜长花岗岩。

孟喇和长山的似花岗石属硷性碳酸盐列 (CA), S-花岗岩类型, 典型矿是 Sn-W-Mo, Au。

银山和螺山的花岗岩属亚硷系列 (SA), A-花岗岩类型, 主要矿是 Pb-Zn、Sn、Au、RE。两种都可能产宝石 (红宝石、蓝宝石), 资料不足, 须进一步研究。

5. 英安岩-流纹岩和正长岩-硷性花岗正长岩组合

此组合包派锋层序 (D_1 Pia Phương) 的硅铝质亚硷性喷发岩如: 粗面岩、流纹岩, 派玛复式 (ϵ_4^2 Phia Ma) 的亚硷性-硷性侵入岩, 硷性正长岩、霞石正长岩、硷性花岗岩。属 A-花岗岩类型, 主要矿是 Pb-Zn、Sn、Au、REE 以及宝石。

六、古生代晚期-中生代早期岩浆岩阶段

1. 玄武岩-安山玄武岩-安山石和纯橄榄岩-辉石岩组合

此组合包括夹在沱江 (C_3-P_1 Sông Đà)、版灭层序 (C_3-P_1 Bản Diệt)、多灵 (C_3-P_1 Đăk Lin) 层序碳酸盐岩-陆源沉积岩中的玄武喷发岩、安山玄武岩、和安山岩; 版商 (σ_5^1 Bản Xang)、版忍 (σ_5^1 Bản Rịn) 复式的基性和超基性侵入岩。与此组合相关的矿产丰富多样, 有 Au、Cu、Ni 和铂组元素。

2. 玄武岩-流纹岩-粗面岩和辉长岩-橄榄岩、闪长岩-花岗闪长岩-花岗岩组合

此组合为基性喷发岩, 包括锦水组 (P_2 Cẩm Thủy) 的斑状玄武岩、细碧岩; 圆南组 (P_2-T_1 Viên Nam) 的玄武岩-粗面岩; 鸿昂组 (P_2-T_1 Hòn Ngang) 的玄武岩-安山岩-流纹岩。与它们紧密接连的是巴位复式 ($\sigma-v_5^2$ Ba Vi) 的基性-超基性侵入岩; 高平 ($\sigma-v_5^2$ Gao Bằng)、莫边 ($\gamma\delta_5^1$ Điện Biên)、滨江-桂山 ($\gamma\delta_5^1$ Bến Giằng-Quế Sơn) 等复式的超基性-硅铝质侵入岩。

与此组合相关的矿产丰富多样, 有 Au、Pb-Zn、Cu-Mo、铂组元素和宝石。

3. 流纹岩、流纹岩-英安岩和花岗闪长岩、花岗岩-花岗斑岩

此组合包括坤朗组 (Khôn Làng)、邻仿组 (Lân Pảng)、蓬河组 (Sông Bung)、同宙组 (Đồng Trầu)、芒杨组 (Mang Yang) 等的硅铝质喷发岩及甸山 (γ_5^2 Núi Diêng)、马江 (γ_5^2 Sông Mã)、云庚 (γ_5^2 Vân Canh) 等复式的花岗岩类等浅侵入岩。其特征为硷性-石灰岩浆岩列 (CA), 局部是亚硷性列 (SA), 主要属 S-

花岗岩类型（混有少量I-花岗岩类型）。

与此组合相关 矿产主要有Au、Sn、W、宝石。

4. 玄武岩-流纹岩和辉长岩-花岗岩组合

此组合包括孟斋层序（Mường Trai）的喷发岩及宪江（T₁ Sông Hiến）、北水（T₁ Bắc Thủy）层序的相反玄武岩-流纹岩喷发岩。与其紧密接连的是主山（v₅² Núi Chúa）-派博（v₅² Phia Bioc）、捺万（γ₅³ Chà Vần）-海云（γ₅³ Hải Vân）等复式岩辉长岩-花岗岩等相反类型侵入岩。相关的矿产：在基性岩中含Cu-Ni，在花岗岩中表现更突出，不排除Sn-W矿化的可能（金杯、朴蚩珑类型）。

七、中生代晚期-新生代岩浆岩阶段

1. 安山玄武岩-安山石-英安岩组合

此组合所属层序有调保禄（J₃ Đèo Bảo Lộc）、龙平（J₃ Long Bình）层序；西宁复式（v₆¹ Tây Ninh）的辉长岩-辉石岩等侵入岩；定馆复式（γδ₆¹ Định Quán）的闪长岩-花岗闪长岩-花岗岩。其属硷性-石灰岩浆岩列（CA），I-花岗岩类型，主要矿化是有Au、Pb-Zn、Cu-Mo。

2. 流纹岩-斑状英安岩组合

此组合所属层序有三隆组（J₃-K Tam Lung）和孟馨组（J₃-K Mường Hình）；版莽复式（γ₆¹ Bản Muồng）的花岗岩-花岗斑岩等浅侵入岩。属亚硷性岩浆岩，形成于内陆板块（内陆断裂）。

与其相关的矿产有待进一步研究，有可能产宝石和稀有放射性元素。

3. 相反组合

文震组（J₃-K Văn Chấn）正长斑岩-玄武岩喷发岩的相反组合与南战（v₆¹ Nậm Chiến）的相反辉长岩-辉绿岩、辉长岩等侵入岩及夫沙坪（v₆¹ Sa Phìn）复式的花岗岩-花岗正长岩，属A-花岗岩类型。主要相关矿产有Au、Pb-Zn、Mo和放射性元素。

4. 安山石-英安岩-流纹岩喷发岩组合

此组合所属芽庄组（K Nha Trang）与其相应的是调甲复式（γξ₆¹ Đèo Cả）的花岗岩-花岗闪长岩；丹阳组（K₂ Đơn Dương）流纹岩局部有安山石-英安岩等喷发岩与其相应的是袞那复式（γ₆² Cà Ná）的二云母花岗岩-亮色花岗岩等侵入岩。其特征为硷性-石灰岩浆岩列，从I-花岗岩类型向S-花岗岩类型转变。主要相关矿产有Sn-W、Mo、Au、和宝石。

5. 英安岩-流纹岩喷发岩组合

此组合包括嵛溪组 (K_2 Ngòi Thia)；耶安松 (γ_6^1 Yên Sơn)、派洼 (γ_6^2 Pia Oắc)、版展 (γ_6^1 Bản Chiêng)、朱江 (γ_6^2 Sông Chu) 复式的亚硷性-硅铝质侵入岩。经过内陆板块活动，形成Sn、Mo、Pb-Zn、TR等矿产。

6. 硷性岩浆岩组合

此组合包括朴扎 (Pu Tra) 层序的各种硷性喷发岩 (粗面岩、白榴斑岩)；朴衫 (ϵ_6^2 Pu Sam Cap)、佐屯 (ϵ_6^2 Chợ Đồn) 复式和蒙新复式 (ϵ_6^2 Măng Xim) 的硷性侵入岩。其属硷性-石灰岩浆岩列 (AL)，A-花岗岩类型，主要矿化是稀土、稀有放射性元素和宝石。

八、新生代晚期岩浆岩阶段

几乎属这一岩浆岩活动阶段产生的都是基性喷发岩 (玄武岩)，可分成以下两种组合：

1. 斑玄武岩、橄榄石玄武岩组合

此组合包括速征 ($\beta_{N_2-Q_1}$ Túc Trưng)、达俄 ($\beta_{N_2-Q_1}$ Đại Nga) 层序，与其紧密接连的是福善复式 (γ_7 Phước Thiện) 相同根源的基性侵入岩 (辉长岩-苏长岩、辉长岩-辉绿岩)。其特征为拉斑岩列 (TH)，属A类型，内生成矿物主要是宝石 (蓝宝石) 和风化达工业要求的铁铝氧石。

2. 硷性橄榄石玄武岩组合

此组合属春禄层序 (β_{QII} Xuân Lộc) 属硷性碳酸盐岩浆岩列 (AL)，A型。在这中玄武岩中含多结节状手足类，也有可能宝石 (金刚石)。

九、各种不分阶段的岩石构造

过去，一些未能研究的岩石构造主要是按接近的空间分布面来划分到歌复式的侵入岩中，很少有关成分定量的标记。在南方领土上此类岩石被分为两个复式：潘扬 (亮色 Phan Rang) 和驹蒙 (深色 Cù Mông) 都归其年代为古生代。

近来，因岩石成分丰富，少数岩石构造已得到关注。特别是有可能产矿的钾镁煌斑岩类、金伯利岩。这只有些初步的资料，还需进一步研究。

第三章 区域矿产

第一节 区域矿产分布

从以上越南地壳的演变史可以看出,特殊的地质环境和区域构造格架成就了越南成矿条件的多样性,而成矿条件的多样性又构成了越南丰富的矿产资源,多样化的区域成矿环境 and 多期次的成矿作用造就了大量矿产形成,据不完全统计,越南共有矿藏资源近90种,目前已探明各种矿床和矿产地5000多处,其中铁矿探明储量约13亿吨、前景储量约23亿吨;铝土矿探明储量约45亿吨、前景储量约60亿~80亿吨,精选后该类矿三氧化二铝的含量可达47.5%,在世界上占有重要位置;铜矿探明储量为795万吨、前景储量为1000万吨;镍矿探明储量为152万吨、前景储量为500万吨。此外,铬矿、铬铁矿及稀土等矿产也具有相当的储量。这些金属矿产的分布是不均匀的,成群成带主要集中分布于越南北部、中部地区,而南部仅零星散布,北方主要以黑色、有色、稀土金属矿为主,而南方则主要以铝土矿和金矿为主,此外,越南的非金属矿产,尤其是煤亦较丰富。总的来说,越南矿产资源具有四大特点,即矿床分布面广;矿带集中,大中型矿床比例大(占一半以上);共生、伴生矿床多,富矿和易选矿比例高;邻近铁路、海港(如图3-1)。

一、黑色金属矿产

越南发展钢铁所需的矿产储量比较丰富,主要有铁、锰、铬、钛四种,共有产地一百多处,其中,铁、锰、铬等矿产主要分布在越南的北部,而钛砂主要分布在沿海滨岸带中。

1. 铁矿

已探明储量13亿吨,前景储量约23亿吨。主要集中在三个铁矿区:一是西北地区的保河勒村、贵社、娘媚、兴庆等地,其中保河勒村铁矿和贵社铁矿为大型铁矿,贵社铁矿的储量为1.25亿吨,主要是褐铁矿,品位为43~52%;二是北部地区的老街、太原、河江、北干、高平省境内,主要是磁铁矿,品位60%以上,其中老街的博萨铁矿矿石量为1.3亿吨,为大型铁矿;三是中部的顺化、义安、河静石河等地,已发现多种类型的铁矿,其中石溪矿床(河静石河)储量最大,石溪矿床的储量约6亿吨(如图3-2)。

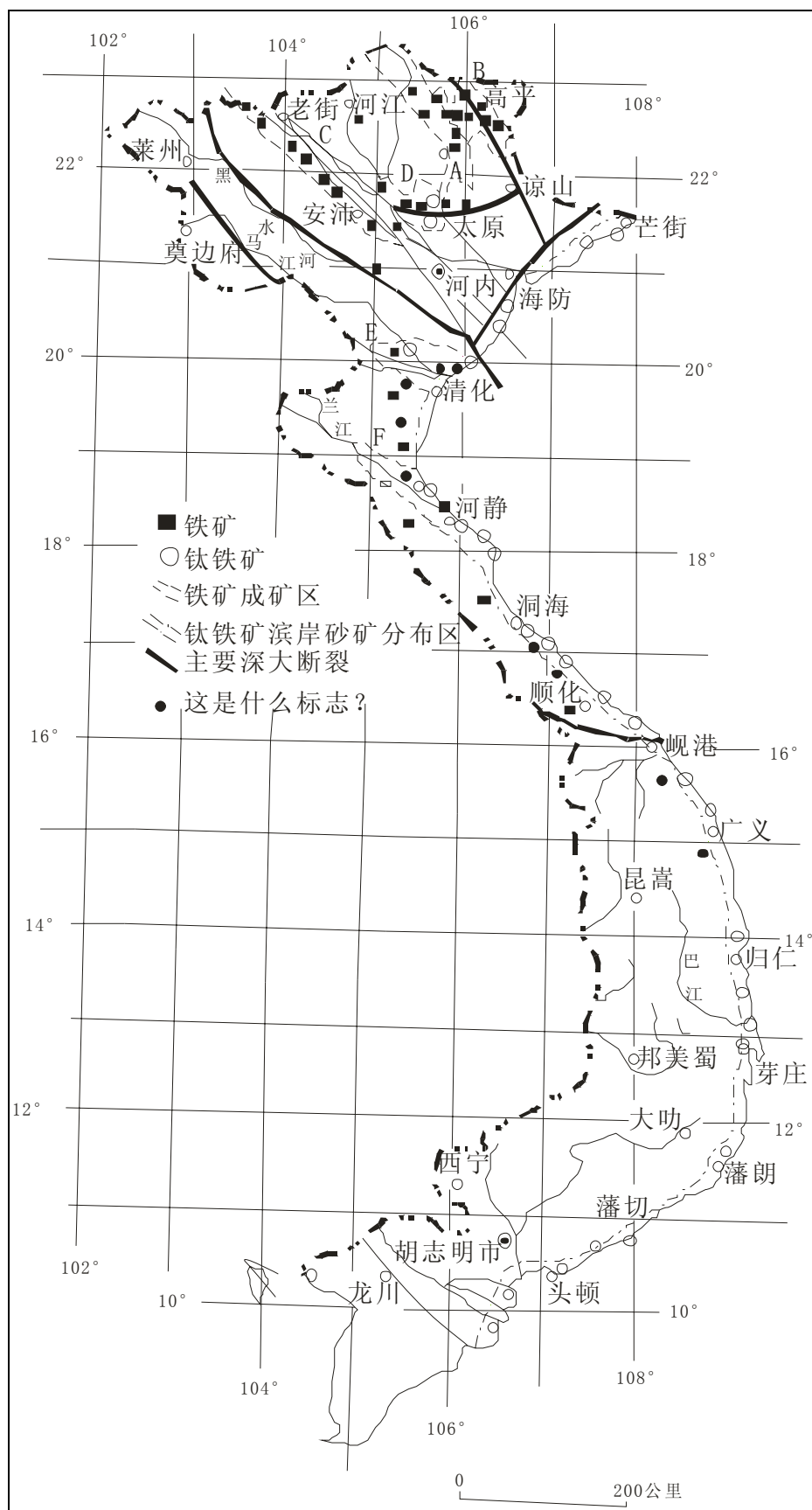


图3-2 越南铁矿、钛铁矿分布图

矿床成因类型主要分为以下几种：

（1）矽卡岩型

矽卡岩型（又分为与基性岩有关的和与花岗岩有关的两个亚类），在已知的矿床中矽卡岩类铁矿占总资源储量的大部分，此类矿床中，构成规模比较大的矿床中与基性岩体有关的高平地区慕萨、原平、博勒、和瓦隆、太原的槟榔寨等五个铁矿，储量均在数千万吨，有与花岗岩类岩体有关的岗岩类岩体有关的主要有石溪矿床，铁矿储量达 6 亿吨。

（2）沉积-变质型

又分为前寒武纪沉积-变质型和泥盆纪沉积-变质型两个亚类。属变质类型的很普遍，都集中在红河沿河一带，从老街过安沛到富寿。代表矿床有数千万吨的北干班盘铁矿。

A. 与嘉荣（Ca Vinh）岩浆岩复式岩体相关联的矿床在兴庆-媚村地区，形成宽 10~20 公里，长将近 100 公里不连续延伸矿带。矿形成于寒武纪前期斜长花岗片麻岩和斜长花岗岩中。

B. 与铁矿有关的变质沉积层有关的各种小规模矿床和矿点，在宝河地区有：急爵、巴鸿-朗勒；文排；镇安地区有：溪列-朗邦、瑞诤、溪七、溪番等；青山地区有：曾麻、嵩隆、水辛、嵩床等。矿与沙巴、辛权序层紧密相连。属石英磁铁矿或磁铁矿类型。

（3）泥盆纪沉积-淋滤型

此类矿床主要集中在文排、太原（除寨沟矿）和银山（版逢、那内）地区，矿石的主要矿物成分是水赤铁矿、水针铁矿、针铁矿、少量原生矿残余软铁矿、硬铁矿。代表矿床有太原铁矿和河江贵社铁矿，储量在数千万吨。

（4）热液型

热液铁矿分布较广，老街、安沛、太原、宣光等地都有分布。

据 H·M·贝里亚绍夫（1963）和黎太新（1982）资料，越南北部和中部可划分为六个成矿区（带），由北向南有：

A. 太原—北干—河江铁矿带，沿同名弧形断裂展布，宽 20~30 公里，长达 200 余公里，主要是泥盆纪沉积—淋滤型、沉积—变质型铁矿，它呈北西向延至我国云南、广西境内。

B. 高平铁矿区，主要是与基性岩类有关的矽卡岩型铁矿，它可能沿北西向高平—谅山断裂延至我国广西、云南境内。

C. 老街—安沛铁矿带，沿红河断带南侧呈北西向展布，宽10~15公里，长达200余公里，主要是前寒武纪沉积—变质型和热液型铁矿，它北西向延至我国云南境内。

D. 太原—宣光铁矿区，沿东西向断裂展布，主要是与基性岩类有关的矽卡岩型和热液型铁矿。

E. 马江（清化—回春）铁矿带，沿马江断裂呈北西向展布，宽50~60公里，长约100余公里，主要是与基性岩、花岗岩类有关的热液型铁矿。

F. 兰江铁矿带，沿兰江断裂呈北西向展布，宽50公里左右，长约100公里，主要是与花岗岩类有关的矽卡岩型和热液型铁矿。

2. 钛和钛铁矿

目前共发现了 66 个钛矿床和矿点（伴生锆石、独居石），其资源远景较大，是越南潜在优势矿产之一。按成因钛矿可分为 2 种：岩浆岩和砂矿。

（1）岩浆岩成因类型

除了一些矿分散在山罗顺州地区（*Thuận Châu Sơn La*）分布在太原的大慈（*Đại Từ*）定化（*Định Hoá*）等县。

岩浆岩成因的钛矿中只有针树矿床做了勘探，储量B+C₁+C₂级，钛铁矿有 483 万吨（~246 万吨TiO₂），但目前技术经济条件下尚不具备经济价值。剩下的初步评估，预计资源量约 1500 万吨钛铁矿。

总的来说，除了针树矿床和一些其他分散矿床、矿体，其他岩浆岩成因类型的钛矿都属贫矿。

（2）钛砂矿

一是分布在太原铁矿区中与辉长岩体有关的残坡积钛磁铁矿与钛铁矿共生砂矿，如潜矿床和安泰、纳华矿点；二是分布在沿海滨岸带的海滨型砂矿，又分为两个亚类，在广宁省北部湾畔海滨型钛铁矿与金红石共生的砂矿，如芒街、下居矿点；而东南沿海岬港—藩切一带的钛铁矿与锆石、独居石共生的海滨砂矿。这些砂矿未进行正是评价，但均在开采（以民采为主）。据报道金兰湾砂金矿机械化开采，主要是开采石英砂的同时回收钛铁矿。

据(越)阮基蓬等(1982)资料,越南滨海钛砂矿大部分可采砂矿主要集中在越南中部的海岸阶地,从会门到头顿,特别是从索特门至归仁一带可望找到大型砂矿。

3. 锰矿

已知锰矿床(点)产地34处,大部分分布在越北,几乎所有的工业矿都集中在重庆地区(高平),少量在占化(宣光);北江、地区。在西北部、北中部、和南中部只有一些锰矿点的出现,但很小,储量少。

(1) 形成于上泥盆统-下石炭统碳酸盐沉积中的锰: 此类锰矿形成于泥盆纪晚期-石炭纪早期的石灰岩和硅片岩沉积交错层,在泥盆纪、石炭系上部,代表的矿床有: 越北的速达(D_3-C_1 , Tôc Tát), 东北下龙(D_3-C_1 , Hạ Long), 西北部的版改(D_3-C_1 , Bản Cải), 北中部吉腾(D_3-C_1 , Cát Đằng), 其中在速达的锰矿最有价值。在速达的锰矿占现已知资源和储量大部分。属此地层的已知15个矿床和矿点; 其中有9个矿床,如速达,版墨(Bản Mặc)、那奴(Nà Num)、垄滩(Lũng Thàn)、版框(Bản Khuông)、诺鸠(Nộc Cu)、夏番(Hát Pan)、垄隆(Lũng Luông)、刻骡(Khư Khoa)都已经做过评估。

(2) 形成于沉积-喷发岩中的锰(派方序层 D_1PP): 派方地层厚1000米包括绢云母-黏土片岩、石灰片岩、石灰岩、花岗岩、砂结成的石灰石含锰的硅片岩,有的地方可见到流纹岩、钠长斑岩和凝灰岩。

派方地层锰矿表现主要集中在祖平地区(Thổ Bình, 属占化、宣光); 番郎(Phiêng Lang)、调佛(Đèo Bụt)、那便(Nà Pét)、曲负(Khúc Phụ)、尚甲(Thượng Giáp)、朗排(Làng Bài)……, 另外还有些散布在董拔地区。沉积在这一层序的锰矿含量低, 没工业价值。

朗排矿包括那便、调佛、曲负、朗珊(Làng Tân)等矿点上部风化渗入滞留矿有工业价值。矿沿褶皱延伸几十公里。渗入滞留矿主要矿物成分是软铁矿、少量硬锰矿, 水针铁矿、针铁矿、锰尖晶石和另一些含锰的矿物。

(3) 形成于寒武纪中期碳酸盐-硅质陆源沉积中的锰:

属寒武纪中期碳酸盐-硅质陆源沉积的有越北的莫洞群(C_2 , Mỏ Đồng)和河江群(C_2 , Hà Giang), 西北的马江群(C_2 , Sông Mã)中部中区的多威群(C_2 , Đắc Uy)。

现在只在北光和其他一些地方的河江群发现几处锰矿的。

(4) 其他类型的锰：被风化的锰矿分布很广，值得注意的是佛莫矿 (Pò Mò) 属谅山省老街县和各分布在义安的风化铁锰矿点。

4. 铬和铬铁矿

越南现在有 2 处罢英 (Bãi Ấng)、古定 (Cổ Định) 铬铁沙矿，2 个岩浆岩型矿点：与葛山超基性岩侵入岩相关的葛山 (Núi Nưa)、朗乌 (Làng Mun)。

(1) 岩浆岩型铬

代表矿床为葛山矿点和朗乌矿点，葛山矿点属清化省农贡县。朗乌矿点属清化省玉乐 (Ngọc Lạc) 县。铬铁矿分布在小超基体中其成分是蛇纹岩化的橄榄岩。

(2) 沙矿型的铬矿

清化省农贡 (Nông Công) 县古定地区的铬铁沙矿，分布在葛山的西南和东北处，在和安-美街 (Hòa Yên-Mỹ Cái)、晶米-安尚 (Tĩnh Mỹ)、罢英-茂林 (Bãi Ấng-Mậu Lâm) 等盆地。

古定铬铁沙矿区被分成几个矿区：古定、美街-和安、晶米-安尚、罢英-茂林，各矿体都比较厚，有的地方厚达 65 米，除了铬铁，还有 Ni、Co、Pt，属大型矿床。

二、有色金属矿产

越南有色金属矿产资源亦丰富多样，主要的有钨、铜、铅、锌、锡、钨、镍、锑、铝等九种，共有产地 120 处，探明储量的有 72 处，其中有大型矿床 10 处，中型矿床 5 处，小型矿床 65 处。他们成群、成带集中在北部，而在南部则零星分布。侧重介绍资源较丰富的几种矿产如下：

1. 铜矿

到现在以知矿化铜的成矿类型有：岩浆岩、矽卡岩、岩浆热液 (片麻状铜)，温泉、火山沉积、含铜的砂泥脉。

(1) 火山沉积铜-铁 (辛权类型)

矿化的铜-铁火山沉积主要分布在红河右边的辛权层序 (PR₁₋₂ Sin Quyền) 硅线石-石英片岩，黑云母片岩、灰岩中从中越边境一直到宝河地区长几百公里。

辛权矿床在老街省巴刹县，包括有垄坡 (Lũng Pô)、幸归 (Sinh Quyền)、谷米 (Cốc Mỹ)、微俭 (Vi Kê)、依迪 (Y Tý) ... 形成 3 个主矿带，从巴刹 (Bát Xát) 到垄富中越边境呈西北-东南向延长近 40 公里。

矿床有 3 个主要的矿带。西边是龙胜-宾银带为铜-稀土-辉钼矿的矿带。中间的是幸归-南密主矿带为铜-稀土矿带，其中辛权、谷米、水斗（Suối Thầu）、微夹（Vi Cáp）、南宅（Nậm Chạc）、南密（Nậm Mít）矿床与幸归层序各岩层重叠。

（2）与侵入超基性岩有关的镍-铜（版福类型，Bản Phúc）

为容矿矿床。矿主要集中在陀河热隆起的矿床和矿点有：谢科（Tạ Khoa）地区的版福（Bản Phúc）、版长（Bản Chạng）、版蒙（Bản Mông）、版夸（Bản Khoa）、调展（Đèo Chẹn）、版改（Bản Cải）；万安（Vạn Yên）地区的版来（Bản Lại）、版敛（Bản Lèn），其中的本福矿床已经勘探准备开采。除了越南的西北部，这种矿化的还在版若（Bản Rịn）、太原的主山（Núi Chúa），与版临序式（ $\sigma_5^1\text{br}$ ）、主山序式（ $v_5^3\text{nc}$ ）、高平序式（ $\delta\text{-}\sigma_5^2\text{cb}$ ）及水滚（Suối Cùn）、东张（Đông Chang）的基性-超基性岩有关。典型的是版福矿床。

（3）Kolchedan 铜（块状硫化物矿床）

矿化主要集中在西北部与不同成分的喷气石形成不同地质背景有关。已发现几百个矿点。可以分成几种矿化类型：

A. 在基性喷气岩中的黄铁矿-黄铜矿-斑铜矿组合：属这一类型的矿点主要集中在西北部是勃兴（Bó Xinh）、南叠（Nậm Tia）、南逢（Nậm Phủng）、万西（Vại Sài）。

B. 在沉积-中性喷气岩中的黄铁矿-黄铜矿-斑铜矿组合：此种矿化主要分布在袁南层序（ T_{1vn} ）的粗面岩-英安岩中。代表矿点是垄郭（Lũng Cua）矿点，河西省巴位县。

C. 碳酸盐岩中的黄铁矿-黄铜矿-石英组合：此类矿主要在西北部。已知的矿点有红秋（Hồng Thu）、光心斋（Quang Tân Trai）和其他一些矿点分布在莱洲达品（Tà Phình, Lai Châu）高原。

D. 在玄武岩喷气岩中的自然铜组合：在西北部自然铜矿已经开采，但此类型的资料很少。已发现在顺洲（Thuận Châu）和山罗（Sơn La）一带玄武岩中有自然铜，典型矿为山罗省扶安县本江（Bản Giàng）（春江 Xuân Giang）矿点。

E. 基性喷发岩中的黄铁矿、黄铜矿、方铅矿、闪锌石：此类的矿点沿着陀河分布在莱洲及和平地区，与锦水（ P_{2ct} ）和袁南（ T_{1vn} ）层序基性喷发岩紧密

相连。这是矿化铜-多金类，黄金量含高，前景很好，特别是在可综合利用多种元素，这类型在西北部很普遍，矿石中的S、Cu、Pb、Zn、Ag、Au可综合利用。

(4) 铜-石英

铜-石英矿散布在有发生碰撞的似花岗岩旁为背景的地质构造中，如在耶安孙序复 (Yên Sun) 的似花岗岩侵入体旁有铜-辉钼矿矿化或在断裂带的热拱中，如主山、常春 (Thường Xuân) 地区，与在辉长岩中铜矿化辉长岩或陆源岩矿化铜-多金，如牡山 (Mẫu Sơn) 地区。多数属黄铜矿-石英类的矿化是小脉和单脉，因此虽分布广含铜量高，但没有工业价值。

可以分成 3 种矿化：

A. 石英-黄铜矿-多金属类矿化：分布在东北部，代表矿是谅山省禄平县的晶崇 (Tĩnh Sùng) 矿点。

B. 辉长岩中的铜矿化：分布广，有代表性的矿点如清化省常春县梁山矿。

C. 辉钼矿-黄铜矿-石英矿组合：分布在越南西北部，代表性矿点有老街省沙巴县版舱 (Bản Khoang) 钼矿点。

(5) 含铜的砂岩和页岩

在越南的领土上，此类矿于中生代安洲盆地断裂中心，分布很广 (如图 3-3)。

海动地区含铜砂岩和页岩分布面积有 500km²，包括 2 种不同的矿化，有不同形态特点和矿物成分的，都产在牡山层序的各种岩石中，可分成 2 个分界线不清的区。

在东北部的的新山 (Tân Sơn)、朗查 (Làng Chà)、新华 (Tân Hoa)、海动 (Biển Động 即锦谭, Cẩm Đan)、昆楣 (Khuôn Mư ời)、福润 (Phú Nhuận)、交廉 (Giao Liêm)、形成一个长 70~80 公里，宽 20~30 公里的区。

在西原地区的昆硕 (Khuôn Xó)、桥那 (Cầu Nhac)、调竺 (Đèo Chũ)、红山-调王 (Hồng Sơn – Đèo Vàng)、朗街 (Làng Cai)、昆仁 (Khuôn Rậm)、调进 (Đèo Tấn)、调漓 (Đèo Lé) 和其他一些零星矿点形成一个长>60 公里，宽 30~40 公里的铜矿化区。矿化于牡山层序灰色砂岩、碳酸盐片岩中。

2. 镍和钴

除了山罗省谢夸 (Tạ Khoa) 地区的钴-铜-镍矿中镍和钴是主要成分外，其他地方的镍和钴都是副矿物。镍和钴的构造可分成几种：

(1) 容离岩浆岩的镍-铜-钴：与和超基性侵入岩有关。属这一类的镍-铜-钴矿床和矿点几乎都在山罗省谢夸地区：版夸（Bản Khoa）、版福（Bản Phúc）、吊展（Đèo Chẹn）、版源（Bản Nguồn）、版蒙（Bản Mông）、版敛（Bản Lèn）、版来（Bản Lài）、水仅（Suối Cản）；高平：水滚（Suối Cùn）、东张（Đông Chang）；太原：本临（Bản Rịn）等地。

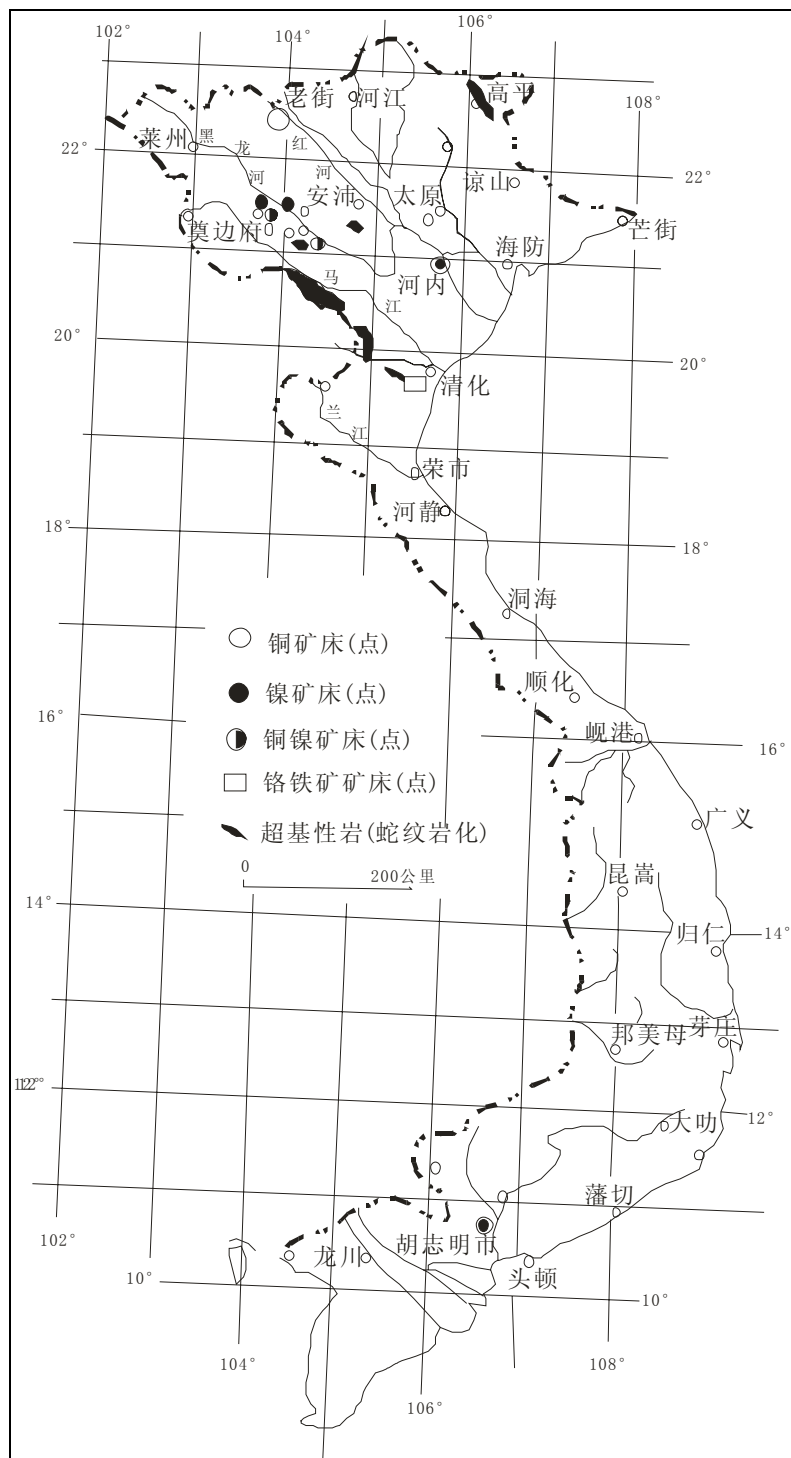


图3-3 越南铜、镍、铬矿产分布图

(2)在各铜矿床和矿点的变质石中的钴,包括有辛权矿和在溪吸-安梁(Ngòi Hút-An Lương)地区的各矿点及其他的矿点。在矿石中钴和其他矿物为副矿物(银、放射性金属、稀土)。

(3)与喷发和侵入基性岩有关的铜-镍-钴。这一类型的主要分布在北昆嵩、陀江带,马江带和太原、和平、清化等地区。尽管这样的矿分布很广,但到迄今为止尚未发现有哪个矿的镍-钴是具开采价值。属这一类型的可分为2种矿:铜-镍(钴)-黄铁矿和钛-镍(钴)矿。第一种主要分布在陀江、北昆嵩、西清化一带;第二种与钛或钛磁铁矿一起在天主山(Núi Chúa)地区。

(4)风化壳中的镍-钴。这是含有硫磺或共生矿物的含镍和钴的超基性岩风化来的产物。在葛山地区分布含镍和钴的风化物的面积很广。按晶米-安尚铬矿的资源量算有3008000吨镍矿,含量是0.51%和271000吨钴,含量是0.05%;罢英-茂林(Bãi Áng-Mậu Lâm)矿床有镍45000吨(品位是0.64%),有钴11000吨(品位是0.12%)。

3. 铅锌矿

现已发现400多个矿床和矿点,主要分布在越北地区,一些在西北部和一些分散在北中部和中中部,其中有72个矿床和矿点已做了调查评估和勘探,Pb+Zn总资源量约2100000吨(如图3-4)。

矿化的铅锌矿有3种类型:热液型、风化型、少量矽卡岩型,几个类型如下:

(1)在碳酸盐-陆原岩中的铅-锌

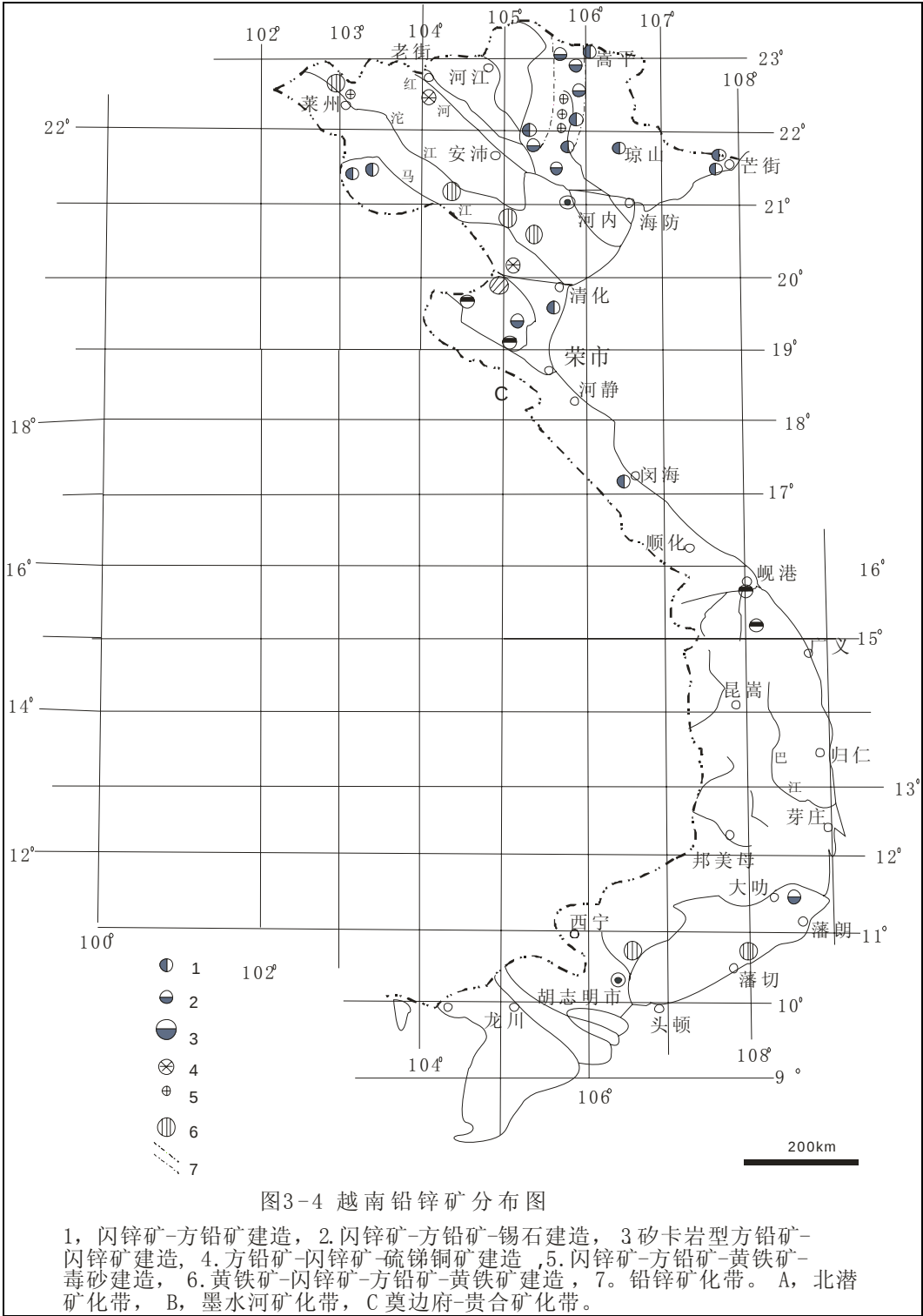
A. 闪锌矿-方铅矿-黄铁矿床类型(佐田类型)

此类型根源是热液型,主要分布在北干、宣光地区泥盆纪早期的石灰岩、灰岩、钙质片岩和页岩中,形成一个从巴别(Ba Bể)到宣光市北-东北走向,长50~60公里的矿带。各矿区和矿点都集中形成于碳酸盐岩层中,铅锌矿区中佐田(Chợ Diên)、佐顿(Chợ Đồn)、道院(Đạo Viện)等具工业价值。

北干省佐顿县佐田矿区有平斋(Bình Chai)、垄怀(Lũng Hoài)、泊湓(Po Pen)、非犒(Phia Khao)、曼朔(Mán Nguồn)、罗魄(La Pointr)、波隆(Bô Luông)、调安(Đèo An)、滩头(Than Tàu)等矿点。1995年,泰国的 Padaeng 公司对曼-朔、垄怀3个矿点做了调查评估,计算得出以下数据:

Pb+Zn 资源量:1368183吨,平均含量:Zn =8.68%, Pb=1.73%。Pb+Zn 储

量 1283817 吨，平均含量 Zn=9.34%，Pb=1.29%。



最近几年，调查评估北干省佐顿县佐田矿区外围的佐顿矿，已评估出与佐田类似的资料，为以后投资开采做好准备。阮春长的评估报告中（东北地质联团），

1994 年评估了佐顿的那屯、巴部、那泊、快江、勃非、那勃、奎王、那关 9 个矿脉为C₂+P₁级，含Pb+Zn9.61%的硫化物矿 2374000 吨；有含Pb+Zn6.18%的氧化矿 593000 吨。

在越南，佐田矿床类型是最有价值的。他们占了全国铅锌储量的 80%以上。除了佐田和佐顿还有宣光省安山地区，也有相似的地质背景。

B. 方铅矿-闪锌矿床类型（朗系类型）

该类型的矿床、矿点都为热液型，分布在北太省朗系(Lang Hích, Bắc Thái)、宣光省移仁(Ý Nhân, Tuyên Quang)、福寿省尚龙(Thượng Long, Phú Thọ)、清化省关山(Quan Sơn, Thanh Hoá)、广平省美德(Mỹ Đức, Quảng Bình)等的泥盆纪，石灰纪-二叠纪或三叠纪的碳酸盐-陆源岩中。朗系矿床区在太原省武涯(Võ Nhai)和大慈(Đại Từ)县，包括的矿床和矿点有北楼(Bắc Lô)、慕巴(Mỏ Ba)、篾(Metis)、东垄(Đông Luông)、沙隆(Xa Lung)、朗孺(Làng Nhu)、菊堂(Cúc Đường)、那瓦(Na Nhõa)、广故(Quảng Cố)等，分布在含碳酸盐夹陆源岩的隆起褶皱中，其中慕巴-篾最有价值。

关山矿床属清化省静嘉县(Tĩnh Gia, Thanh Hoá)，根据阮世福(北中部地质联团)1999 年的铅锌评估资料：Zn+ Pb 资源量 343000 吨。

C. 方铅矿-重晶石类型（禄巴类型）

方铅矿-重晶石类型矿化分布在越南北部。沿着卢江(Sông Lô)，形成了一个从宣光市地区到尚荫(Thượng Âm)地区(宣光山阳, Sơn Dương, Tuyên Quang)和禄巴(Lục Ba) 北太大慈(Đại Từ, Bắc Thái)地区西北走向的矿化带。其他地区矿化的很分散，如北江省安世(Yên Thế, Bắc Giang)、广宁省巴岬(Ba Chẽ, Quảng Ninh)、山罗省马江地区(Sông Mã, Sơn La)、义安省同汕(Đồng Sơn, Nghệ An)等。矿化集中在不同时期的碳酸盐-陆源地层的碳酸盐岩层中。

(2) 喀斯特凹地中风化的铅-锌

菱锌矿- 红锌矿-白铅矿矿化类型（非犒类型）：此种类型的在越南很普遍。如平斋(Bình Chai)、奎怀(Lũng Loài)、曼(Mán)等。

佐田(Chợ Điện)矿区探明的储量的将近 80%。矿化集中在靠近正北-东北向断层的喀斯特漏斗中，此类矿还在北干省那屯(Nà Tùm, Bắc Kạn)、太原省浦价(Phổ Giá, Thái Nguyên)、宣光省道院(Đạp Viện, Tuyên Quang)等。

(3) 火山-沉积构造中的铅-锌矿:

A. 方铅矿-闪锌矿-黄铜矿-磁黄铁矿类型 (那山类型)

此类型矿分布在古生代越北隆起带旁的河江省懂拔-北迷地区 (Tòng Bá, Bắc Mê), 在本世纪 70 年代末 80 年代初, 已在此区域进行了调查和详查, 未能对铅锌和其他矿物的潜力做出详细的评估。但按地质标志和资料来看, 该地区的铅锌和银, 前景还是好的。总的来说这个矿区在越南的铅锌潜能很大。

B. 黄铜矿-方铅矿-闪锌矿类型 (陀河类型): 此类型广泛分布在西北部各种不同种类的岩石中, 包括: 莱洲 (Lai Châu)、山罗 (Sơn La)、河西 (Hà Tây)、和平 (Hòa Bình) 等省。

C. 方铅矿-闪锌矿类型 (秀丽类型): 此类矿床、矿点主要分布在秀丽 (Tú Lệ) 内陆断裂带的火山带中, 根据阮春未 (西北地质联团) 综合评估资料, 1994 年秀丽矿床的铅锌矿资源量: 含量是 10.06% 的 Pb124000 吨; 含量是 2.08% 的 Zn82000 吨; 含量是 0.83% 的 Cd419 吨; 含量是 168g/t 的 Ag406 吨。

(4) 与侵入岩有关的铅锌矿化

A. 锡-多金属类型 (银山类型)

此类型的铅锌矿常形成于内陆断裂带的热拱旁边, 如: 北干省银山 (Ngân Sơn)、夫洛 (Phu Loi) 和义安版展 (Bản Chiềng)。它们都是热液和矽卡岩成因有关。其中银山矿床区属北干省银山县, 根据陶太北 (东北地质联团) 评估资料: 1994 年福山、方山、那耀、那内 (Nà Nội) 等矿床的铅锌矿资源量: 含量是 6.75% 的 Pb+Zn=219000 吨。夫洛矿床区属义安省桂风县、三奇和版展县, 含量是 6.74% 的 Pb+Zn=68000 吨。

B. 黄金-方铅矿类型

此类型分布于越南西北部、中部中区、中部南区。在方铅矿中含很高的黄金矿床中或在有工业价值的方铅矿矿体中, 如: 微铤-蓬妙 (Vi Kẽm-Bồng Miêu)。

4. 锡矿

为了进行研究和对比, 将锡矿分为如下几种 (如图 3-5):

(1) 富硫组

包括的成矿系列有: 锡石-硅酸盐-硫化物, 锡石-硫化物和含锡的矽卡岩, 其中只有锡石-硅酸盐-硫化物比较有工业价值。在越南多数已调查-探勘和开采的锡

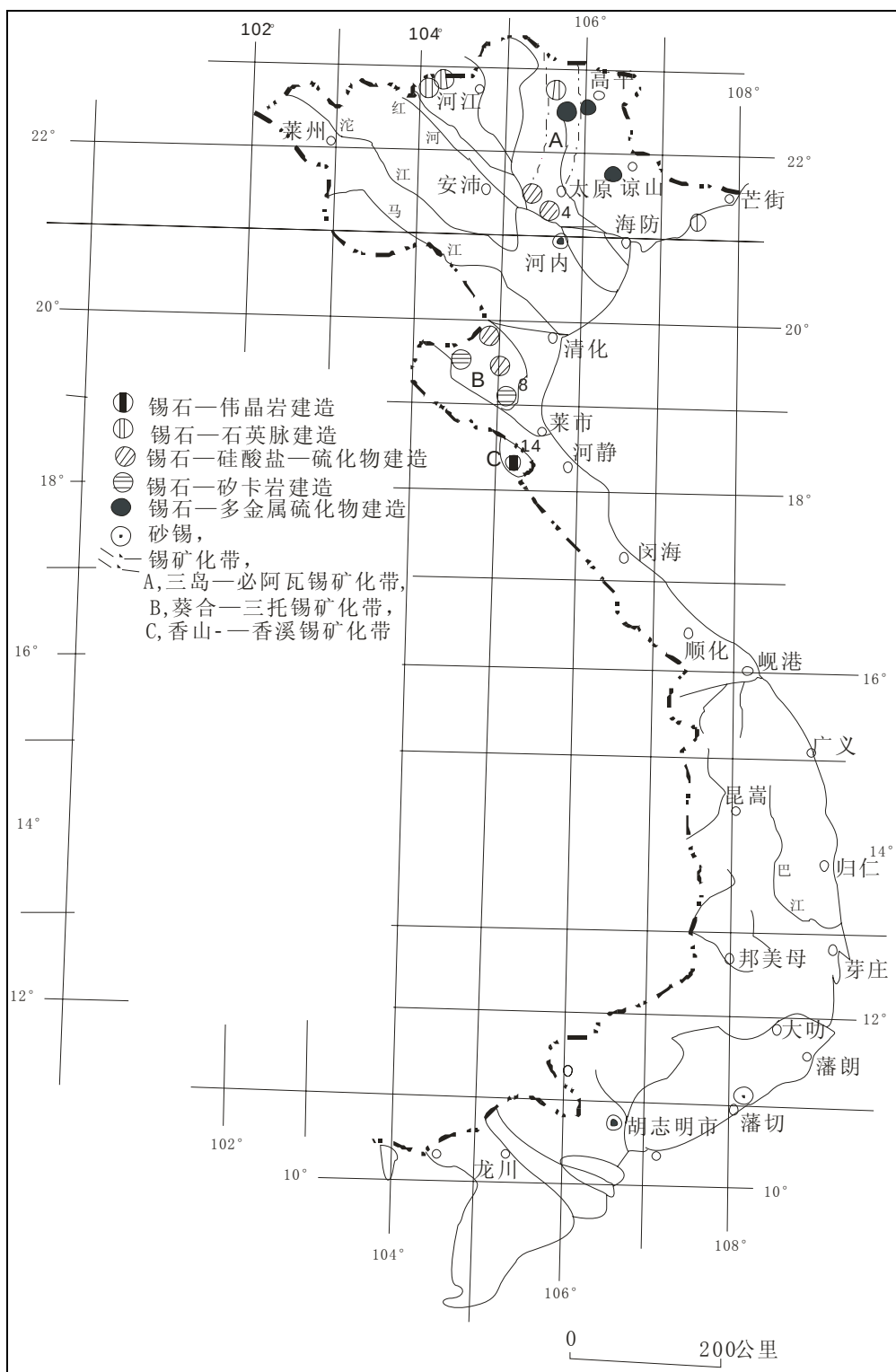


图3-5 越南锡矿分布图

矿床和矿点都属这一类型。

在越南锡石-硅酸盐-硫化物成矿系列很普遍，都分布在三岛地区(Tam Đảo)，

其矿床和矿点有：北隆（Bắc Lũng）、昆斐（Khuôn Phây）、外连（Ngôi Lẹm）、竹溪（Trúc Khê）、罗平（La Bằng）；葵合（Quỳ Hợp）的水北矿床（Suối Bắc）；林同（Lâm Đồng）的多斋（Đa Chay）、大叻（Đà Lạt）等矿点。

（2）硫化物少的组

锡石-钨锰铁矿-石英成矿系列在派洼（Pia Oắc）、太潘（Thái Phiên）、如龙（Du Long），与中生代晚期-新生代的派洼（ γ_6^2 Pia Oắc）、裂那（ γ_6^2 Cà Ná）、定馆（ $\gamma_{\xi_6}^1$ Định Quán）、把那（ γ_6^2 Bà Nà）序式中的S型和A型似花岗岩有关。

此类型提供了锡石，形成各砂矿床，如：静宿（Tĩnh Túc）、恁夹（Nậm Kép）、原平（Nguyên Bình）。太乐（Thái Lạc）、嘎咪（Ca Mi）、黎啊（Lê A）等钨矿以做了勘探，有开采价值。

含锡的结晶花岗岩成矿系列都限制分布在金刚、河静地区，与白垩纪金刚块的小粒亮色似花岗岩和古新世把那的花岗岩有关。溪四（Khe Bún）为含锡结晶花岗岩矿床，虽含锡量很低，但钽-铌比较高，有开采价值。

（3）砂矿组：对砂锡矿床类型是最有价值的，在越南是开采主要对象。越南砂锡矿床主要的在静宿、三岛、葵合。

5. 铝土矿

越南的铝土矿可分为两种成因。各沉积成因（有一些被变质）的铝土矿都集中在越南北部二叠纪晚期的石灰纪-二叠纪石灰岩腐蚀面上，分布在河江、高平、谅山、北江、其他如山罗、义安和一些小规模的形成在泥盆纪石灰岩磨损面上。风化成因的铝土矿产于新第三纪-第四纪玄武岩中，主要集中在昆嵩、多乐、林同、同耐、平阳福安等省及分散在广义的地区（如图 3-6）。

越南已探明的铝土矿资源储量是 27.72 亿吨（其中红土型铝土矿占 22.58 万吨）。预计的原矿约达 67.5 亿吨。

有些分布在玄武岩风化壳中的铝土矿矿床已做了不同程度的调查、考察和勘探，都很有开发潜在价值，其分布在以下地区：

A. 达依-福龙地区（Đak Nông-Phước Long），包括：多乐省（Đak Lak）达明（Đak Min）、达依县，同耐省富立县（Phú Lập Đồng Nai）和平福省福龙县（Phước Long, Bình Phước），是越南最大最有展望的红土型铝土矿区。

B. 保禄地区，包括保禄（Bảo Lộc）、新莱（Tân Rai）、西保禄（Tây Bảo Lộc）、



图3-6 越南铝土矿产出分布图

嘉北 (Gia Bắc)、西嘉北 (Tây Gia Bắc) 等矿床属林同省保禄和貽灵县。新莱矿床做了勘探,剩下的保禄等矿床还在调查评估阶段,达到了中型和大型的标准。资源主要集中在新莱和保禄 2 个矿床。

C. 昆峰地区 (Kon Plong) 有黑竹 (Măng Đen) 和昆河弄 (Al-234, Kon Hà Nừng) 2 个矿床分布在昆嵩省昆峰和安溪 (An Khê) 县,这 2 个矿床的原开矿资源量和储量约 98000000 吨。

D. 富安地区,包括 2 个矿床,云和 (Vân Hòa) 和美良 (Mỹ Lương) 属富安省绥安和同春县 (Tuy An、Đồng Xuân, Phú Yên),2 个矿床的原开矿储量 C_1+C_2 级达 700 万吨,达中型矿标准。

E. 广义地区 (Quảng Ngãi),包括矿床和矿点有:安恬 (An Điem)、长寿 (Trường Thọ)、天案 (Thiên Ân)、辰辰 (Thần Thần)、中山 (Trung Sơn)、啊灵 (A Lin) 都属小型矿,其中天案矿床做了调查。辰辰和天案 2 个矿床的原矿资源是 1000000 吨以上。

6. 钨矿

到现全国约有 40 个钨矿床和矿点。矿化钨主要集中在 2 个地区:老街省的沙巴 (Sa Ba Lao Cai),安江 (An Giang) 的杉山 (Núi Sam),还有一些分散在其他地区:义安省的者曾 (Kẻ Tăng)、版展 (Bản Chiềng);富安省的鸿若 (Hòn Gió)、鸿立 (Hòn Lập)、平正 (Bình Chánh);庆和 (Khánh Hoà) 的调甲 (Đèo Cả)、平中 (Bình Trung)、甘禄 (Cam Lộc);顺海 (Thuận Hải) 的达解 (Đá Chẹt)、加部 (Gia Bộ)、哈怀 (Ha Oai);宁顺 (Ninh Thuận) 的贡发 (Krông Pha)。分为 4 种构造的钨:

(1) 铜-钨-石英脉 (钨、黄金)。

这是最普遍的类型主要矿点有老街省的辛斋 (Sin Chây)、版舱 (Bản Khoang)、沙巴 (Sa Pa)、嵩瓜岭 (Tung Qua Lin)、乌辉胡 (Ô Quy Hồ)、恁馆 (Nậm Cúm)、宁顺省宁山县扬山 (Núi Yang)、安江的杉山。

(2) 石英脉或稀土-钨-长石-石英脉

这一类型主要分布在沙巴,有多个矿点。

(3) 钨-铜-放射性金属

这一类型是从垄坡 (Lũng Pô) 到巴刹 (Bát Xát),沿着红河右岸分布。

(4) 含钼的矽卡岩

发现于版展。

7. 钨矿

到现在为止全国已有几十个钨矿床和矿点或有钨共生的其他矿。按矿的构造特点和成分钨矿可成为 2 种：

(1) 与侵入岩有关的石英-钨锰铁-锡石

分布在宣光省的善计 (Thiện Kế)，平顺省的土山 (Núi Đất)，垄楣 (Lũng Mươi)；高平省派洼地区的陀嵩 (Tà Soỏng)、亚历山德拉 (Saint Alexandre)；清化省常春地区的玳传 (Đài Tròn)、补迷 (Bù Me)；广南省的把那 (Bà Nà)、同义 (Đồng Nghệ) 等，按矿的成分可以分成 2 种特征的矿石类型：

A 石英-钨锰铁，分布在善计 (宣光)，土山 (宁顺)。

善计矿属宣光省山阳县，是此类型的典型矿，资源量和储量是 WO_3 2851 吨， WO_3 的品位 1.55%。

B 石英-钨锰铁-锡石，在派洼的陀嵩、亚历山德拉 (高平)；常春的玳传、补迷 (清化)；把那、同义 (广南)；林同的风辛，宁顺的土山有矿点。

(2) 铋矽卡岩

此类型矿有达连矿床，靠近西炮山矿的北边。

三、贵金属矿产

1. 金

越南金矿的矿床类型主要是砂金和岩型金两大类型：

(1) 砂金矿

砂金矿分布在很多地方，至今已发现了近 150 个砂金矿床、矿点，其中只有 27 个矿床做了勘探。

另外在全国范围内，泸江 (Sông Lô)、支江 (Sông Con、河江的怒江 (Sông Gâm)、沱江 (Sông Đà) (山罗、莱州省 Sơn La, Lai Châu)、孝江 (Sông Hiếu)、义安全河 (Sông Cà)、沙题江 (Sông Sa Thầy)、罗牙江 (Sông La Ngà)、广南波河 (Sông Ba) 和其他江河的江中和冲击河滩中的含沙金量也很大。

各种金砂矿的成因：残积层的、洪积、洪积物、混合、矽卡岩和砂矿。另外还有一些在矽卡岩、淋溶-洪积和海边中的沙金矿点，但都没有研究和评估。

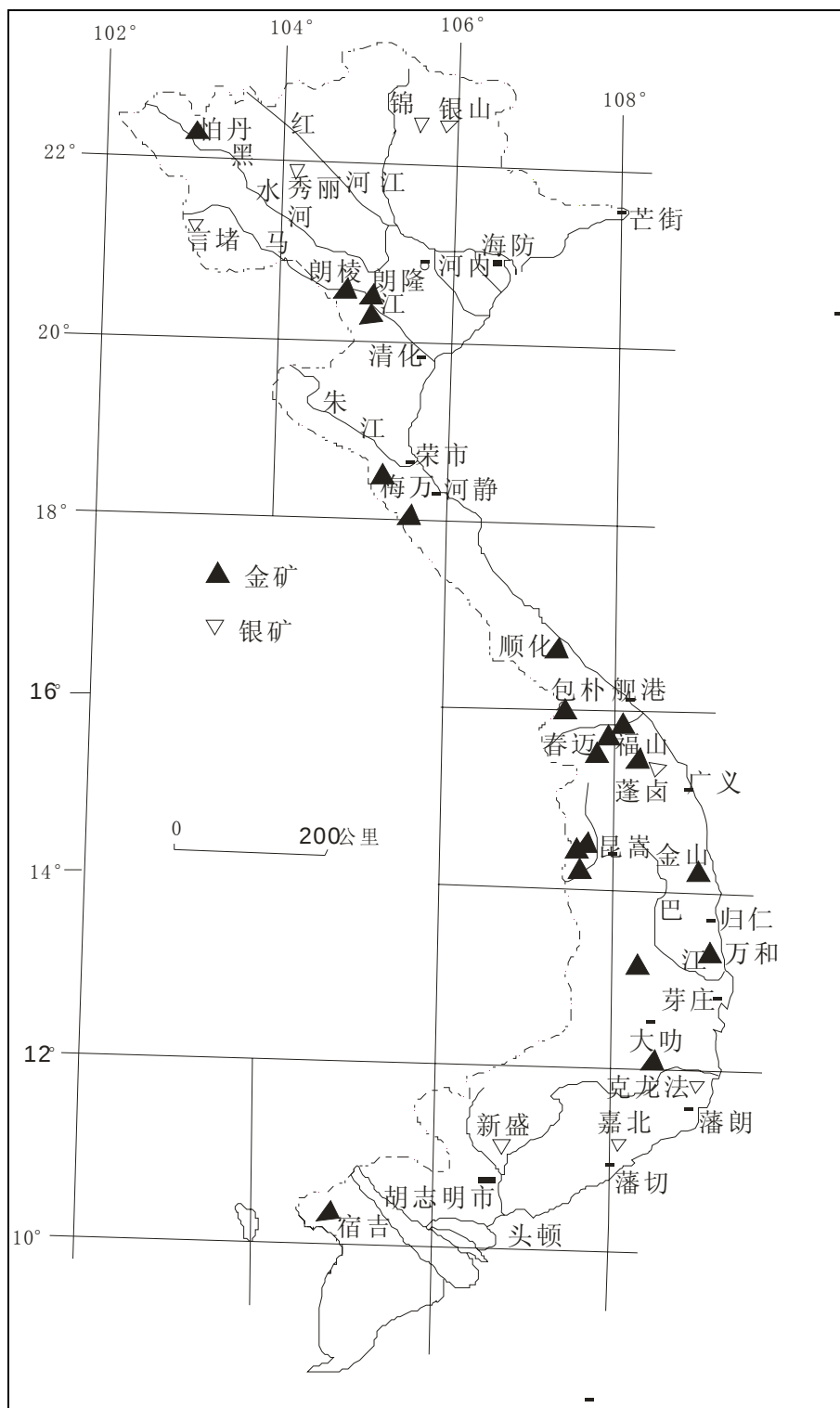


图3-7 越南贵金属分布图

A. 残积层的砂矿

分布于清化、富寿、北干、太原等的金矿区。金都聚集在风化的石脉或热液石英带中。

B. 洪积砂矿

分布于北干和太原。含金矿石被冲到山腰以后，金的含量不均，金的粒度通常都比较大，少量被磨圆。

C. 洪积物砂矿

在越北的多个省都有分布。金粒被水流冲走后沉淀在山脚。常产于各山溪的洪积层中的金粒度很大。总的说含金量不均，矿体不稳定，常是小规模矿。

D. 混合砂矿

常见的砂矿类型有洪积物-冲积，残积-洪积。它们的规模通常不大，含量不均。

E. 砂卡岩砂矿

散布在砂卡岩盆地中地形复杂的石灰岩地区，如北干、和平、清化、谅山。砂矿集中在砂卡岩盆地内地面凹凸不平的金沙层、金矿呈窝状或透镜状。

F. 冲积砂矿

这种矿最普遍和最有前景。常见于不同高度阶梯的沉积和河床中的沉积层中。典型的矿点有：山罗省木路（Mu Lu Sơn La）；和平省梅山（Au-100, Mai Sơn, Hòa Bình）；太原省的水仁（Suối Nhân）、克俭（Khắc Kiệm）、蒲古（Bồ Cu）、锦心（Cẩm Tâm）；清化锦贵（Cẩm Quý, Thanh Hóa）；义安省安那（Yên Na）、柑闷（Cẩm Muộn）、州山（Châu Sơn）；广南省扶聂（Pù Nếp Quảng Nam）等。越南沙金矿总的资源计报有几十吨。

以下是两个典型砂矿：

梁尚矿床（Lương Thượng）位于北干省那依县（Na Rì, Bắc Kạn），资源评估将近 4 吨。

柑闷位于义安省葵州县，有版柑（Bản Cẩm）、那贵-回枚（Na Quế-Huổi Mây）和版达（Bản Tà）盆地。版柑金的总资源量约 2 吨。

（2）脉型金矿

在越南构造-建造平图上看，矿化金分布在隆起区、火山盆地或沿着深大断裂散布。

A. 金-石英类型

金-石英类型的有 2 种：

金-石英-少量硫化物类型：北干侯欧（Khau Âu, Bắc Kạn）、太原蒲古（Bồ

Cu, Thái Nguyên)、宣光尚求 (Thượng Cầu, Tuyên Quang)、清化朗鸟 (Làng Nèo, Thanh Hóa)、广南三征-富松 (Tam Chinh-Phú Sơn) 金-石英-少量硫化物矿床。这类的矿床:

蒲古矿床属太原省同喜县 (Đồng Hỷ), 15 x 15km 内, 包括有朗仁 (Làng Nhân)、朗欢 (Làng Hoan)、和溪 (Hòa Khê)、巴溪 (Ba Khê)、黄柿 (Cây Thị)、寨沟 (Trại Cau)、求达 (Cầu Đá)、那良 (Na Lương) 等砂矿; 岩金矿有和溪、巴溪、荆 (Găng)、溪瑞 (Khe Dúi)、巴丛 (Ba chòm)、彦眉 (Ngàn Me), 其中巴溪、黄柿、荆、彦眉等, 其中蒲古矿做了浅部调查, 金资源量约 2 吨。

B. 金-石英-硫化物矿化类型

金-石英-硫化物类型丰富多样, 在不同地质背景的地方都有分布。矿床主要有: 宪江层序 (T_1 Sông Hiến) 的北干派凉 (Pắc Lạng, Bắc Kạn)、谅山那排 (Nà Pải, Lạng Sơn); 同宙层序 (T_2 Đồng Trầu) 的河静动朵 (Đồng Đồ)、溪忙 (Khe Máng); 广平溪囊 (Khe Nang)、溪集 (Khe Đập)、外桃 (Vai Đào)、莲乡 (Làng Sen)、合和 (Hợp Hòa 高然-和平, Cao Răm-Hoà Bình)、广治的达劳 (Ta Laou)、啊洼 (A Vao); 广南的茶阳 (Trà Dương)、蓬苗 (Bồng Miêu)、平定省仙山 (Tiên Sơn)、先顺 (Tiên Thuận); 昆嵩省空哲若 (không Chợ Ro)、富安省馨江 (Sông Hình); 山福 (Sơn Phước)、同耐省孝廉 (Hiếu Liêm)。

C. 金-银矿类型

此类矿是前景很好。已发现与龙大层序 (O_3-S_1 Long Đại) 的爆破火山岩筒空间上有密切关系的矿床、矿点。如: 饶仍 (Rào Reng)、溪折 (Khe Chứa) 微徒鲁 (Vít Thu Lu) 等, 典型的是蛇奇 (Xà Khía)。

D. 辉锑矿-金矿类型

辉锑矿-金矿类型在各个含金辉锑矿中, 有时金的含量很高。在宣光占化地区 (Chiêm Hóa, Tuyên Quang)、和平银石 (Đá Bạc, Hòa Bình)、义安达朔 (Tà Soi, Nghệ An) 和朗外-昆服 (Làng Vài-Khuôn Phục) 地区都有分布。

E. 在其他矿中的共生金矿

含金的多金属-铅锌矿, 如佐芽 (Chợ Rã)、银山 (Ngân Sơn)、西派洼 (Tây Pia Oắc)、义安 (Nghệ An)、秀丽 (Tú Lệ)、和平 (Hòa Bình) 等; 在西北部

含金的黄铁矿（含金的贝壳类硫磺），如窝果（Vọ Cỏ）、朗矩（Làng Củ）、明光（Minh Quang）等，在老街幸归（Sin Quyền, Lao Cai）含金的铜矿，在辛权地区预计铜矿里也有几十吨金，品位是 0.46~0.55g/t。

2. 银

在越南，可以分出几种含银的矿，如下：

（1）含银的铅锌矿

在那山（Na Son）、银山（Ngân Sơn）、琅稀（Lang Hít）、佐顿（Chợ Đồn）、佐田（Chợ Điền）、同慕（Đồng Mỏ）、秀丽（Tú Lệ）、荫尚（Ấm Thượng）等铅锌矿床中含 Ag 约 100g/t。

（2）含银的铜镍矿

含银的铜镍矿在山罗、广义、清化等地。

（3）金银矿和含银的金矿

金银矿和含银的金矿在沙和（Xà Khía）、溪凿（Khe Chứa）等矿床的酸性-中性喷发岩中，矿石品位 Au=10~15g/t、Ag=136~146g/t。各种含银金矿的含量约 10g/t。

（4）含银的辉锑矿

宣光的朗外（Làng Vải）、昆服（Khuôn Phục）、菊底（Cóc Táy）；清化的梁外（Lương Ngoại）、朗坚（Làng Kiên）、那柴（Na Sài）；广宁的进迈（Tân Mãi）、同慕、雀溪（Khe Chim）、阳辉（Dương Huy）；河江的茂月（Mậu Duệ）、版炉（Bản Lò）、博眉（Bó Mới）；太原大慈（Đại Từ）等辉锑矿含银 Ag10~30g/t。

（5）含银的锡矿

含银的锡石-硅酸盐-硫化物成矿系，主要包括三岛（Tam Đảo）、葵合（Qùy Hợp）、林同（Lâm Đồng）地区的锡矿床。在三岛的昆裴（Khuôn Phây）黄铜矿矿床中，银含量达 200g/t。

总之，现在银的评估只限于铅锌、辉锑矿-金、金银矿床。现有铅锌矿床的资料中算出伴（共）生银的资源量是 3559 吨。远景估计含银矿床的总资源量是 20000 多吨。所以越南的银资源比较少。

3. 铂

（1）与基性-超基性岩有关的含铂镍-铜矿

在越南二叠纪-三叠纪的基性-超基性岩中常有镍-铜矿。

1964 年已在版福镍-铜矿中发现有铂，其中确定有砷铂矿（Pt=56~58%，Pd=0.5~0.7%，As=39~43%）。据西北地质联团（1985-1986）版福（Bản Phúc）矿床的预计资源量是 30 吨。

（2）在含铂超基性侵入岩

在清化、高平、北干、太原、莱州、山罗、和平、广南、广义和西原（Tây Nguyên）地区的一些区域的地质图资料显示：超基性侵入岩中有含铂的迹象。

四、稀土金属矿产

稀土金属矿床赋存在石炭—二叠纪、三叠纪灰岩和晚二叠世块状火山岩的破碎带地区，矿石与早第三纪基性侵入岩有关：或产于前寒武纪绿色片岩带里与磁铁矿和铜矿伴生，前者为河静石河铁矿伴生稀土金属矿床，后者为老街铜矿伴生稀土金属矿床，呈板状、透镜状和复杂分支矿体，厚度由几厘米至几十米，矿石由稀土氧化物和重晶石、萤石组生， TR_2O_3 2~3%，其中重稀土元素氧化物含量 0.3~0.6%，估计储量达几百万吨。

五、非金属矿产

1. 煤矿

在已调查和考察和勘探的 272 个矿床和矿点中无烟煤矿床 82 个占 30.15%，烟煤矿床 37 个占 13.6%，褐煤矿床 17 个占 6.25%，泥煤矿床 136 个占 50%。其中只有 2 个大型矿床和 16 个中型矿床，剩下的都是小型和微型矿床占已考察勘探的 89%。在 28 个大中型中，烟煤矿床 17 个。

（1）无烟煤（高度变质煤）

期的沉积盆地中还分散分布有变质程度高，规模小的煤矿，如清化、和平、河西、太原、谅山、广宁等，其中广宁煤田的无烟煤潜能最大。

总之，确定的总储量（A+B+C1 级）在 136 个煤矿床中有 82 个无烟煤矿是 22.39 亿吨，包括河内盆地占总储量的 47.7%，或不包括河内盆地的占总储量的 94.7%。确定资源量（A+B+C1+ C2 级）是 38.285 亿吨，不包括河内盆地占总资源的 96.5%，或包括河内盆地占总资源的 29.8%。

（2）烟煤（中等变质煤）

大部分在三叠纪晚期沉积盆地中，主要在沱河流域（西北部）和少量在东北部、全河（北中部）、斋江（越北）流域和河内盆地深部的一些第三纪小沉积盆

地中。沱河诺利克-瑞替克沉积盆地大部分面积在西北部主要是滨海相含近海煤，归为水榜组（T_{3n-r} Suối Bàng）包括有琼耐（Quỳnh Nhai）、安州、山罗万安（Vạn Yên Sơn La）、和平的和平-儒关（Hòa Bình-Nho Quan Hòa Bình）。

越南 137 个烟煤组（中度变质煤）矿床中有 37 个矿床的确定总储量（A, B, C₁级）近 1900 万吨占含河内盆地的总储量的 0.4%，或不含河内盆地总储量的 0.8%。总资源量从A到P₂级，达 1.2 亿吨。

（3）褐煤组（低变质煤）

在河内盆地的属第三纪中新世中期和晚期的新第三纪煤是越南最大的现代煤聚集地。在九龙江（Sông Cửu Long）平原和陆地级也在油田中夹有煤层，但都没做过评估。褐煤矿床也沿高平-谅山深断裂带分布，如那阳（Nà Dương）矿区；红河（Sông Hồng）、斋江（Sông Chảy）、全河（Sông Cả）、波江（Sông Ba）、貽灵-保禄（Di Linh-Bảo Lộc）断裂带，都已经开采。

在越南，褐煤组的煤大部分含硫磺高，灰度从中等到高，储量 A, B, C₁ 级的达 1 亿吨以上，占 4.05%或 20 亿吨，包括河内盆地在内的占总储量的 51.9%。

2. 磷灰石

在越南唯一的磷灰石矿是老街变质成因矿床。该矿沿红河边分布，老街省西北边的中越边界到东南边安沛省的朗立（Làng Léch）地区。整个老街含磷灰石矿田可分为 3 个区：隆坡-巴刹（Lũng Pô - Bát Xát），波溪-巴刹（Ngòi Ba-Bát Xát）和波溪-保夏（áp-37, Ngòi Ba-Bảo Hà）。

4. 萤石

代表矿床是东炮矿床（TR-31）莱州省风土县（Phong Thổ）和春岭矿床，东炮萤石矿床是越南最大的大型萤石矿。储量C₁+C₂ 级是 169.2 万吨，预计资源量 616.8 万吨CaF₂；春岭矿床（F-250, Xuân Lãng）属富安省同春县。储量C₁+C₂ 级是量 17 万吨，预算资源 10.7 万吨，属小型矿。

5. 黄铁矿

到现在，在北部和中部已发现、调查和勘探 100 个以上的黄铁矿矿床和矿点，其中如富寿甲来（Giáp Lai Phú Thọ）；河西巴寨（Ba Trại）、光明（Minh Quang）、顺化的版贡（Bản Gôn）等矿床已勘探。老街朗裹（Làng Cóc）；安沛同青（Đồng Thanh）；河江潘中（Phiêng Trung）；宣光柠檬村（làng Chanh）；广宁的溪伸

(Khe Nhoi)、草村 (Làng Cỏ)、猫头鹰村 (Làng Vọ)；和平矩村 (Làng Củ)；宣光投垄 (Thầu Lũng)；北干佐田 (Chợ Điền)；山罗那朴 (Na Pheo)、莱州博星 (Bó Xinh)；清化仁让 (Nhân Nhượng) 等矿考察评估。

6. 菱镁矿

版讽矿床 (ms-88, Bản Phúng) 属山罗省马江县，是在滑石菱镁片岩化带中的变质交代成因从派南超基性岩复式 (σ41 Pắc Nam) 和马江层序 (∈ sm) 陆源沉积，也是在越南唯一做过评估的菱镁矿矿床。

7. 高岭土

越南的高岭土很丰富，散布全国。有 136 个高岭土矿床和矿点做了调查、考察和勘探，储量A+B+C₁+C₂级 314 百万吨，预算资源 16.8 亿吨。有 3 种成因类型。

8. 石墨

已发现 10 个石墨矿床做了评估和勘探，储量A+B+C₁+C₂级有 1656 万吨，预算储量 583.3 万吨，有以下几中矿化根源类型：

在越南，大中型矿床矿点主要集中在红河沿岸，除了石墨外，矿床里还有大量的高品位的硅线石。

9. 石棉

已发现 24 个石棉矿床和矿点，分布在高平、山罗、安沛、富寿、和平、清化、广南和义安等省，于断川超基性侵入岩有紧密关联。都是小规模。4 个已勘探矿点的储量C₁+C₂级有 77000 吨。

第二节 矿床类型及成矿带

一、矿床类型

越南的矿产不仅在矿种上比较齐全，储量巨大，而且在类型上更是内生、外生、变质等类型俱全，特别是砂矿型，风化淋滤型、沉积型以及热液型、矽卡岩型都有较大规模矿床产出，并且整个区域成矿作用与其地质构造演化具有一致性，并在时间上可分为如下5个成矿期。(1) 前寒武纪成矿期，主要发生在北部与中部的古陆块上，以变质成矿作用为特点，其中石墨矿和铁矿分布较广，规模也较大，其次有少量金、稀土元素和铜矿。(2) 早-中古生代成矿期，主要发生

在中、北部地区，其中华南板块与印支板块活动期间所形成的裂谷、弧后盆地和逆冲断裂等构造对成矿作用影响较大，使成矿表现出明显的多样性，其中有与沉积作用有关的铁、磷矿；有赋存于断裂带中与超镁铁质岩有关的铬矿和铜-镍矿；绿岩中黄铁矿以及含金石英脉；逆冲断裂带中与火山喷发活动有关的红宝石、蓝宝石等宝石矿等。这时期虽然矿化种类与类型较多，但富集规模不大。（3）印支成矿期：是越南重要成矿期，其中除在裂谷或拗陷带中与沉积成矿作用有关的大型煤矿外，金属成矿作用大多与印支期强烈的岩浆活动有关，以热液型、矽卡岩型以及岩浆型矿床为主，有铁、钛、铜、镍、铅、锌以及金等矿化，并大多产于构造-岩浆带上，形成具有一定规模的工业矿床。（4）中生代成矿期：成矿作用主要与侏罗纪—白垩纪火山-侵入活动有关，主要发生在近东西向的岩浆活动带上，形成了热液型、矽卡岩型和火山。

二、成矿带

越南全国分为五全成矿区（如图3-8）：北部、长山、昆嵩、大叻、龙川成矿区，彼此以深断裂为界，我们参照上述划分方案，按构造—岩浆岩（或岩相）带，结合矿床产出形态、成矿元素组合及其空间分布规律，将越南划分为六个一级成矿单元：越北、越西北、长山、昆嵩，大叻、龙川等成矿区（带），其中越北、越西北成矿区（带）可进一步分出8个二级成矿单元和3个三级成矿单元。在六个一级构造单元中，越北、越西北、长山、昆嵩成矿带为主要的成矿带，现分别介绍一下成矿区（带）成矿特征及其主要矿种：

（一）越北成矿区（I）

在构造位置上属于越北准地台范围。它位于红河以北的广大地区，北、东止于中越边界与我国云南、广西接壤，东南濒临北部湾，地理坐标约为北纬 $23^{\circ}27'-20^{\circ}$ 、东经 $104^{\circ}-108^{\circ}$ ，面积约为56800平方公里，由越北隆起，谦河拗摺带，安州盆地及沿海褶断带等四个三级构造单元所组成。在这样的地质环境中，形成了不同时代层位的沉积矿产（如铁、锰、铝），变质矿产（如含铁石英岩型铁矿、磷灰石）和与岩浆作用有关的金属矿产。越北成矿区是越南最主要的黑色、有色金属成矿区，也是越南的煤、磷矿基地。又可以将其划分为三个二级成矿单元：越北隆起铁—锡—铅、锌成矿亚区，谦河（渊河）铁〔锰、钦〕—锡（钨）—铅、锌—铝—铜（镍）—铋铀成矿亚带和沿海多金属矿化带，分述如下：

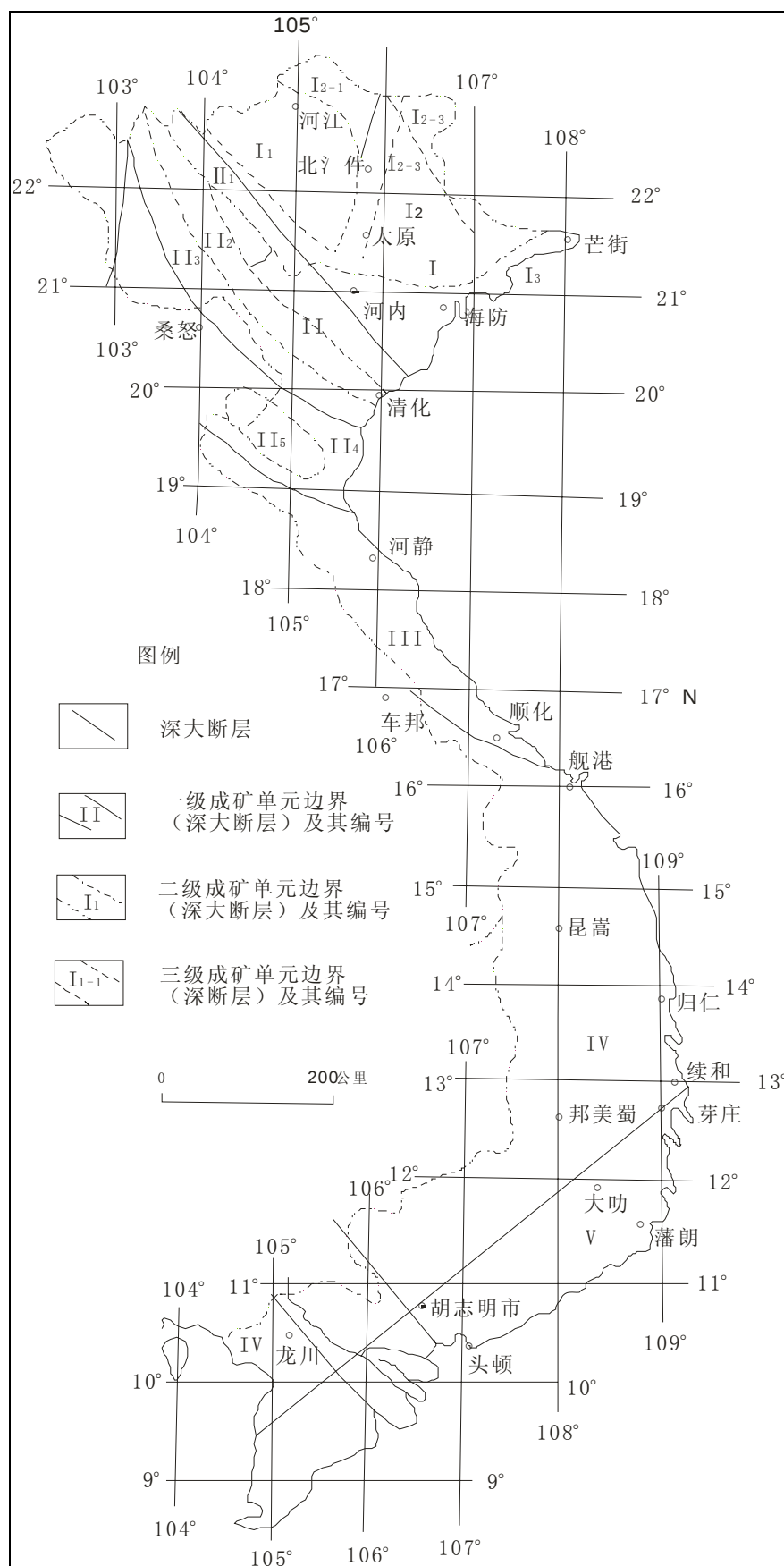


图3-8 越南金属成矿带分布图

1. 越北隆起铁—锡—铅锌成矿亚区 (I₁)

位于越北准地台西部，是其核心越北隆起，具体位置在红河深断裂与河江—北干断裂之间，金属矿产特点是Fe、Zn、Sn (W) Pb共生，有河江寿平、沽化、宣光和富寿等四个小型铁矿床，属含铁石英岩型或红土型铁矿，老街锡矿点和宣光庄达铅锌矿床，此类矿床的成因与碱性花岗岩侵入岩体有密切的关系。此外，还有非金属矿产主要是磷灰石矿床（老街磷矿）、宝玉石矿（墉巴兰宝石、萨帕萤石）和建筑材料（石英岩、大理石）、陶瓷原料等。其中磷灰石（老街磷矿）和石墨与下寒武统变质岩关系密切。

2. 谦河（渊河）成矿亚带 (I₂)

它西界于河江—北干断裂，南界于太原—同登断裂，北、东延伸于中越边界，可能至我国云南、广西境内，是越北黑色、有色金属的主要成矿区。泥盆纪陆源—碳酸盐建造是本区重要含矿层位，几乎所有的铁、锰、钦和锡多金属矿产的形成与它密切相关；其次是晚二叠世地层底部铁铝层是铝土矿的产出层位。本成矿带中矿产地48处，其中黑色金属产地23处，有色金属产地25处。此成矿带又划分3个三级成矿单元：谦河铁（铁—铝）矿区和迭加其上的高平—谅山锰铝（铁—镍）矿带、北干（丰格）锡多金属矿带。

(1) 谦河铁（铁—铝）矿区 (I_{2.1})

它夹持于NW向的高平—谅山、河江—北干两断裂间，北止于中越边界与中国云南毗邻，南界于太原—同登断裂，构造上属于四级构造单元。本成矿区中铁矿16处，钛矿3处，铝土矿1处。集中分布于河江、高平、北干、太原等的4个铁矿区，几乎都产于泥盆系中，矿床类型主要是沉积—变质型、沉积—淋滤型和矽卡岩型三种，其典型矿床是北干班盘、太原、高平慕萨铁矿。

(2) 高平—谅山锰、铝矿带 (I_{2.2})

位于高平—谅山断裂之东，且止于中越边界与中国广西相连，为长200余公里，宽约40~50公里的弓形地带。构造上属于四级构造单元，主要由泥盆纪—三叠纪陆源—碳酸盐建造组成，带内已知锰矿产地5处，铝土矿4处。锰矿赋存于上泥盆统含锰硅质岩与灰岩过渡层里，而铝土矿则产于石炭系—下二叠统灰岩岩溶侵蚀面上的上二叠统底部含铁铝土岩层中。矿床类型为沉积型和残坡积型，矿床规模以小型为主，代表有高平速作锰矿（小型）和高平塔波纳—水铝土矿（中型），

此两种矿石量均为数百万吨。

(3) 北干（丰格）锡多金属矿带（I₂₋₃）

构造上是北干（丰格）断块，它由两条微向东突出的近SW向深断裂所控制，北至中越边界延伸入中国广西，南至与中生代安州盆地彼此接合地带，长约180公里，宽约30公里左右的南北向锡多金属矿带，据统计有锡多金属矿田4处，铅锌矿床9处，锑矿点3处，镍矿床和铀矿床各1处。由北而南可划分为三个矿区：即越北锡矿区、佐田铅锌矿区和三岛锡矿区。基本上围绕晚白垩世浅色含锡花岗岩体呈水平分带。

左顿铅锌矿：Chợ Đồn 铅锌矿位于左顿县，其中铅锌矿石的勘探储量为 100 万吨，矿石的年开采量为 5~6.5 万吨，目前矿体的开采深度控制在 150 米以内，有待向深处找矿。其中容矿岩体主要为下泥盆统灰岩，脉体以似层状为主，厚度从 1-5 米不等，其间透镜体发育，主矿体矿石以块状为主，局部可见由黄铁矿、雌黄铁矿组成条带状构造（此处采样，做组构分析，估计为成矿后期的构造变形有关）。其中硫化物矿石的品味较高，铅含量往往与黄铁矿成正比，如方铅矿常常与黄铁矿共生，其中矿体北部锌的含量较高，南部却相反，铅的含量要高于锌。

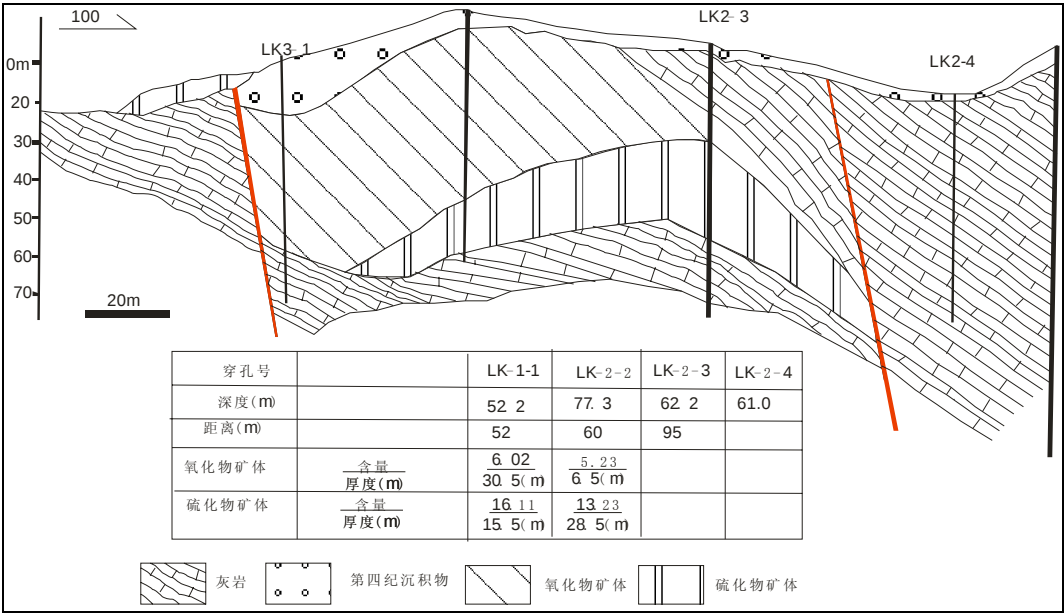


图3-9 左顿铅锌矿地质剖面图

与之伴生的元素有锡、银以及少量的金。在矿体周围，有雌黄铁矿呈小的透镜体产出，并含有少量的黄铜矿，与岩体整合接触，在雌黄铁矿内部几乎不发育方铅

矿，只在边部可发现方铅矿化。另外，矿体局部可见面理发育，剪切作用明显，为运动其间热液活动的所致。地区内的断裂褶皱构造发育，铅锌矿床的形成与就位，直接受构造作用控制，在主矿带附近可见破碎带，在断裂破碎的部位往往矿体比较富集，为断裂的活动促使成矿流体向上运移，断裂面往往发育由方解石脉胶结的断裂岩面，成矿后期的走滑断层主导了矿床的产状，为后期的找矿提供了新的思路。

3. 沿海多金属矿化带 (I₃)

它与安州盆地以近东西向弧形的东潮一芒街深断裂带为界构造上为沿海后加里东（海西期？）褶断带。由早古生代线状褶皱经过区域变质的浅变质碎屑泥质建造织成，不整合面上是晚古生代（D-P）以碳酸盐建造为主的岩层，上覆又是一个不整合面，其上为晚三叠世诺利克期含煤建造。本区岩浆活动仅有小规模零星散布，为侏罗一白垩纪花岗岩体构造形态主要为北西向断层，沿东西向断裂零星分布有铜、锡、铅锌、锑矿点和滨海型钦铁砂矿。计有7处，如锦普锡矿点、鸿基铜矿点、平辽一芒街铅锌、锑矿点和芒街一先安沿海带钦铁砂矿。此外，著名的鸿基煤田和平辽塔玛宝石矿（寿山石）也分布在此构造带。

（二）越西北成矿带（ ）

构造位置是越西北印支褶皱带（又称黑水河褶皱带）。北界红河，南止兰江、西邻老越边界，东濒临北部湾，地理座标：北纬22°56'-19°40'，东经103°-106°，面积约76000平方公里。它由三个复背斜（范士坂、马江、富和）和两个复向斜（沱江、桑怒）组成。复背斜基底元古界变质岩系出露，其上不同程度地覆盖有厚度较小的古生界及更新的地层，复向斜特点是具有巨厚的泥盆系一三叠系，基本上是从侏罗纪开始形成的上迭盆地。马江带主要是由蛇纹岩化纯橄榄岩和辉石岩组成，时代属早三叠世，其中部分属白垩纪；黑水河带主要由蛇纹岩化方辉橄榄岩和纯橄榄岩组成，其时代属晚三叠世。另外在范士坂变质带中亦有零星超基性岩体散布，范士板杂岩主要由花岗岩类和碱性岩（喷出岩或侵入岩）组成，时代属于晚白垩世一更新世。伴随这些岩浆活动的成矿作用有铁、铬、铜、镍、锡及稀土金属等，据统计这些金属矿产的产地为61处，占全国金属矿产产地总数的26%，所以本区是越南黑色金属（以铁、铬为主）、有色金属（以铜、镍、锡、铅、锌为主）和稀土金属的重要成矿带之一。

本成矿带又可划分为五个二级成矿亚区（带）：范士坂铁、铜、稀土金属成

矿亚带、黑水河铜、镍（铅锌）—铁成矿亚带、马江铁、铬、金、铋成矿亚带、桑怒、铅锌—铁成矿亚带，富和锡、铋、铬成矿亚带。

1. 范士坂铁、银、稀土金属成矿亚带（Ⅰ₁）

构造位置为范士坂复背斜，主要是以铁—铜—稀土金属为主的成矿带，矿产地10余处，均产于元古界变质岩系中，如含磁铁矿石英岩矿床。矿带分布于红河南岸由老街至安沛一带，呈北西向延伸，长达100公里以上，该带中有已知的大型铁矿床老街博萨和保河勒村铁矿，磁铁矿矿石，矿体呈层状、透镜状，厚度大（7~15米）。铁平均品位Fe47.73%，规模大，保守估计储量均达1亿吨以上，老街铜矿是由含磁铁矿、辉钼矿、稀土金属共生的铜矿床，属前寒武沉积-变质型铜矿床，它产于元古界结晶片岩、辉长—辉绿岩、大理岩、石英岩组成的变质岩系中，矿体呈层状、透镜状，与围岩大体整合一致，为细脉浸染型矿石，以黄铜矿、辉铜矿为主，斑铜矿、孔雀石、兰铜矿次之，伴生辉钼矿、磁铁矿和稀土金属矿物，平均铜品位Cu1.07%，有政权铜厂等矿床（点），探明储量为数百万吨。该成矿亚带可北西延至我国云南境内与哀牢山带相连。

2. 沱江铜、镍（铅锌）—铁成矿亚带（Ⅱ₂）

其特点是具有巨厚（达7000余米）的泥盆纪—晚三叠世沉积岩，除D₂、C₂P形成碳酸盐岩建造外，主要为碎屑泥质建造和火山沉积建造（T₁-T₂），晚三叠世为含煤建造，侏罗—白垩纪为陆相砂砾岩，西部有印支期花岗岩侵入体，沿中心轴断裂（北西向）展布的三叠纪基性—超基性岩带。在该成矿带中目前已知的铜、镍、铅、锌、金、宝石矿床（点）共23处，发育有与基性—超基性岩有关铜、镍硫化物矿床和宝石矿床，如塔布铜、镍硫化物矿田。

3. 马江铁、铬、金、铋成矿亚带（Ⅱ₃）

主要由元古界变质岩系（包括片麻状花岗岩）和下古生界的中浅变质岩系由片岩、石英岩、大理岩等组成。在复背斜轴部或其南侧有三叠纪花岗岩和基性超基性岩侵入体展布。本成矿带目前主要在复背斜东南段发现有金、铋、铬、铁和宝石矿床（点）计14处，其中铬铁矿床的形成与超基性岩体相关，如著名的清化古定铬铁矿床；金、铋矿床和红土型铁矿床的形成与泥盆纪陆源—碳酸盐建造相关，如朗隆铋（金）矿床、朗棱金（银）矿床，和营社铁矿床等。此外，宝石矿床的形成与超基性岩和花岗岩密切相关。

4. 桑怒铅锌—铁成矿亚带 (II₄)

以三叠纪火山—沉积建造为主体,不整合面上有晚三叠世至早侏罗世的含煤建造和侏罗—白垩纪陆相盆地堆积。在西部的奠边府花岗岩为碱性的二长岩质浅色花岗岩。本带仅发现铅锌、铁和宝石矿床(点)产地5处,如清化常春宝石矿床、奠边府塔富铅锌矿床、清奇铁矿床和两个铁矿点都是与三叠纪火山—沉积岩有关,且大多为小型矿床。

5. 富和锡、锑、铬成矿亚区 (II₅)

该区元古界变质岩系之上被寒武纪—泥盆纪陆源及火山—沉积建造所覆盖,下石炭统含煤建造与上石炭统灰岩间存在不整合,其上为三叠系火山—沉积建造和少量的侏罗纪陆相火山—沉积岩,侵入于元古界中的石炭纪的班华那片麻状花岗岩,早第三纪含锡花岗岩类杂岩体的侵入,使穹窿构造更为复杂,穹窿被放射状及半环状断裂和裂隙强烈分割。花岗岩体与碳酸盐岩接触处产生强烈钙质矽卡岩和矽卡岩化带,形成了矽卡岩型锡石—硫化物矿化,还有产在岩体边缘砂页岩中的锡石—石英和锡石—硅酸盐矿化。该区有班欣、福劳和班华那三个锡矿田,分别产在相应穹窿构造中的早古生代地层中。此外,还有班欣、班玉、克塘和关山等4个铅锌矿床,塔绍锑矿床和葵和、班那汤宝石矿及一个铬铁矿点。

现以福劳锡矿田为例。

福劳锡矿田:位于贵合锡矿区东南的穹窿之中,穹窿由早古生代碳酸盐岩—砂岩、页岩构成,深断裂将其分割成独立断块,穹窿中部断裂交叉处有较大的早第三纪花岗岩侵入(图3-10)。岩体成分复杂,有闪长岩、正长岩、花岗正长岩、花岗岩及白岗岩等,花岗岩类岩石与碳酸盐岩的接触带中,广泛形成有钙质矽卡岩、矽卡岩以及矽卡岩化带,其宽度约有2~3公里,整个穹窿和矽卡岩带均受半环状和放射状断裂裂隙系统强烈切割,矿田的主要矿化集中在花岗岩体北部接触带中,这些地段的矽卡岩及矽卡岩化广泛发育,其中有很多脉状和透镜状锡石—硫化物矿体,厚0.5~2米,主要产出在陡而小的裂隙系统及破碎带中。矿石中有锡石和与之共生的铁、锌、铅的硫化物,有些锡石—硫化物矿体中还含有辉钼矿。

(三) 长山成矿带 ()

长山成矿带在构造位置属于长山海西褶皱带,北界兰江,南界约在岬港至老挝车邦一线,属长山山脉地区。地理座标:北纬19°20'~16°20',东经104°~107°,面积约为28000平方公里,以铁—铜—金为特点,此带主要有越南最大的铁矿——

河静石河铁矿，储量达6亿吨，属镁质矽卡岩型磁铁矿矿床，并伴有稀土金属矿床。

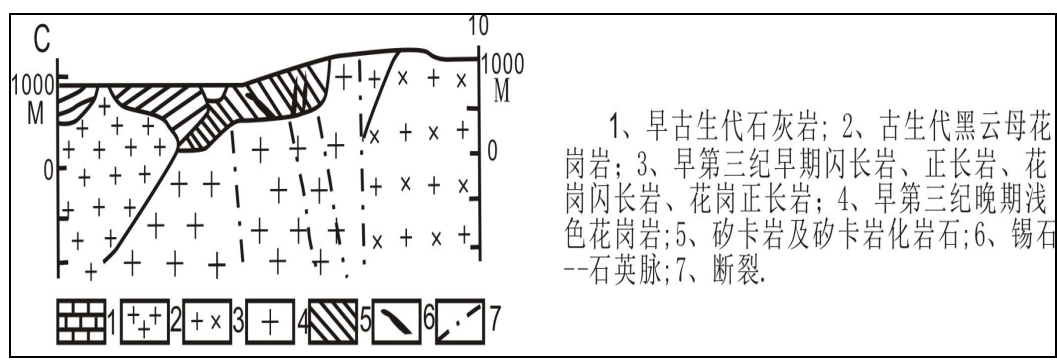


图3-10 福劳锡矿田地地质剖面图

长山成矿带由龙带河群和大江群都是浅变质巨厚的地槽相砂泥质建造与沉积间断面上的中石炭世-二叠纪碳酸盐岩建造及白垩纪陆相盆地所组成。据在龙带河群底部砾岩中发现有花岗岩砾石推断认为此地有中奥陶世花岗岩的侵入体；侵入于下古生界和泥盆系的大型花岗岩，时代可能为海西期。本成矿带已知矿产地28处，有铁矿床8处，锰矿床（点）5处，钛砂矿9处，金矿点2处和铅锌矿、锡矿、宝石、铝土矿点各1处。铁矿除河静石河矽卡岩型磁铁矿床产于海西期花岗岩体与泥盆系灰岩接触外，其余四个小型铁矿和五个锰矿床（点）均产于含铁岩石风化带，属红土型矿床。金矿点两处，产于石炭系灰岩中的海万金矿点和产于花岗岩体中含金石英脉中的顺化金矿点。稀土金属矿床是石河铁矿伴生矿，矿石与早第三纪花岗岩体有关。

（四）昆嵩成矿区（ ）

昆嵩成矿区分布于昆尚隆起区。其北界约在观港—斯班一线，南界约在绥和—大叻一线，西至与老、柬两国边界，东临南海，地理座标:北纬15°50'~13°，东经106°30'~109°31'，面积约76200平方公里。该区元古界有两套变质岩系，一套为深变质型，由角闪石、石榴石黑云母片麻岩夹角闪岩，偶见钙碱性片麻岩、伟晶质和长英质片麻岩及片麻状花岗岩组成；一套为中变质型，由各种片岩夹石英岩、大理岩和角闪岩等组成。本区已知矿产地约48处，其中铝土矿床（点）15处、金矿床（点）9处、铜矿床1处、钨矿点1处、铅锌矿床2处、铁矿床2处、钛铁砂矿5处和宝石产地13处等。本区所有的铝土矿床（点）都属玄武岩风化壳红

土型，金矿床（点）主要产于元古界变质岩系中的含金石英脉型矿床（如蓬苗金矿）和矽卡岩型金矿床（如福山金矿），而宝石则产于玄武岩风化壳中或元古界变质岩中或与花岗岩有关。至于德布铜锌矿床，奠盟铅锌矿床均产于元古界片岩中。总之，本区是个以铝土矿、金矿和宝石为主的成矿区。以万和铝土矿为典型简介：

万和铝土矿矿床：万和铝土矿床位于绥和市北西26公里处（图3-11），矿床区内由中生代杂岩构成。侏罗系班东组粉砂岩、泥岩，白垩纪花岗岩，晚第三纪—第四纪沉积物呈水平状覆盖在老地层侵蚀面上，新第三系由粘土和含褐煤夹层的页岩及粉砂岩组成，并发现放射虫，晚第三纪—第四纪玄武岩厚达150~200米构成范围较大的水平盖层。含铝土矿风化壳发育在玄武岩面上，风化壳残积层厚12~15米，赋存于隆起地形顶部，在斜坡和洼地最薄仅数米。可划分为赫石-多水高岭土-三水铝矿完整风化壳剖面 and 赫石-多水高岭土不完整风化壳剖面两种，前者与有正地形有关，后者分布在斜坡和洼地。矿床已知有两个总面积约300平方公里的矿体。矿体呈斗蓬状赋存于隆起地形顶部和上部，矿体标高为300-480米。红土型铝土矿层由石质铝土矿和疏松泥质岩围岩团块组成非均质体，大小为数毫米至20厘米或更大的块体，巢状体、团块，沿剖面自下而上，铝土矿碎块数量上逐渐增多，块体逐渐增大，甚至局部地段在上部可形成厚0.3~0.5米的铝土矿矿层。整个含矿层厚0.5~7米，平均厚2.5米。铝土矿呈浅褐灰色，矿石成分主要是三水铝石（占50%~61%，个别达81%），针铁矿、褐铁矿或赤铁矿（20%~35%），高岭石（4%~5%），石英、钛铁矿、锐钛矿（>7%），勃姆铝石和硬水铝石（1%）矿石品位 Al_2O_3 ：34.69%~47.89%， SiO_2 ：3.34%~14.08%， Fe_2O_3 ：16.42%~28.49%， TiO_2 ：2.7%~5.4%。

（五）大叻成矿带（ ）

大叻成矿带构造位置为大叻海西褶皱带，北界于绥和-大叻一线，南界于藩切-边和一线，包括林同、庆和、宁顺、平顺等省地区，地理座标：北纬 $13^{\circ}\sim 11^{\circ}$ ，东经 $106^{\circ}\sim 109^{\circ}$ ，面积约4000平方公里。该地区泥盆纪—早石炭世砂泥质与硅质岩建造的浅变质岩系不整合覆盖于基底元古界变质岩系之上，中晚石炭世陆源砂泥质建造又不整合其上，且伴随有多处花岗岩侵入。本区海西期花岗岩属于钙碱性二长岩质花岗岩、花岗闪长岩和闪长岩等。构造线不甚明显，大致呈NNE向，据物探资料推测有两条隐伏大断裂呈NE向，一为绥和-大叻断裂，一为金兰湾-

藩朗断裂。本区矿产工作程度低。发现金属矿产地约20余处，如铝土矿产地5处，主要是玄武岩风化壳红土型的巴老铝土矿床等，次为花岗岩风化壳红土型的大叻铝土矿点。边和铜矿点、嘉北铅（锌）矿床、新盛铅锌矿床、克龙法的翎犷点铅铜矿点及砂锡犷、林同铝锡矿点大叻金矿点及六个钛铁犷砂矿点等，此外还有与玄武岩、花岗岩有关的9处宝石产地。本区实为多金属和宝石的成矿带。

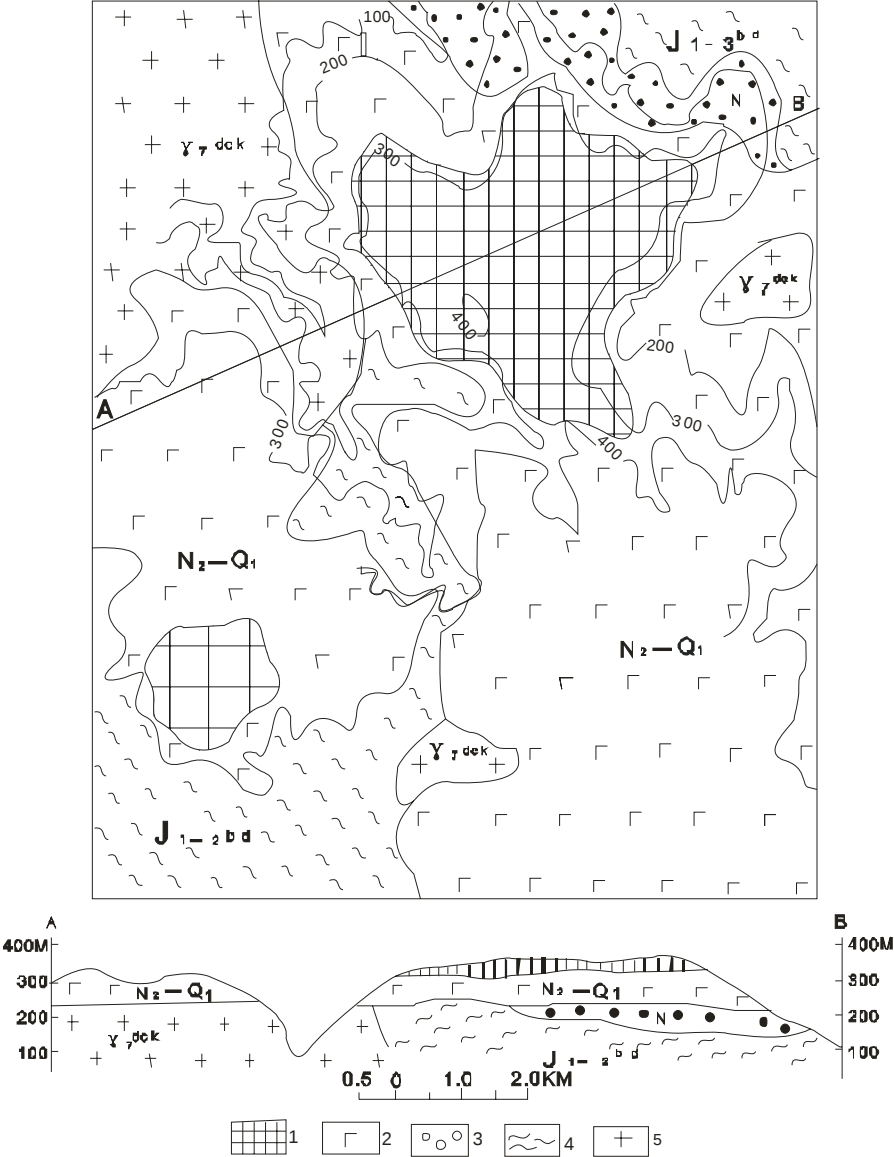


图3-11 越南万和铝土矿矿床地质和剖面图

（据阮玉建、B·M·罗维柯夫1985）

注：1.红土型铝土矿；2.玄武岩（ N_2-Q_1 ）；3.含褐煤夹层的粘土；
4.厚层泥岩、粉砂岩、砂岩（ J_1-2^{bd} ）；5.花岗岩（ Y ）

(六) 龙川成矿区

龙川成矿区位于湄公河三角洲的龙川高地，东界后江，南界龙川—迪石一线，北界越柬边界，西临暹罗湾。地理座标:北纬 $10^{\circ}40' \sim 10^{\circ}$ ，东经 $104^{\circ}28' \sim 105^{\circ}30'$ ，面积约 500 平方公里，是早小的成矿区，区内为第四纪洪、冲积砂砾石粘土所覆盖，仅有零星分布几个三叠纪—侏罗纪花岗岩体，已知仅有知尊辉钼矿点和河仙砂金点与花岗岩有关，是一个钼-金矿化远景区。

以上我们可以看出，构造—岩浆带控制成矿区（带）的规律是十分明显的，并且矿床的层控、岩控在成矿方面也起了很大的作用，在找矿方面，越南沿海滨岸带是钛铁矿砂矿远景区，点多、线长、远景大，成为其潜在的优势资源。

第四章 矿产勘查和矿业开发

第一节 矿业开发政策

一、矿业活动需要获得许可证

根据越南《矿产法》及其实施细则和《外国投资法》及其实施细则，规定外国组织和个人投资越南采矿业须按照越南《外国投资法》及其“实施细则”、《矿产法》及其“实施细则”和有关政策规定办理投资项目申请报批手续并获政府有关部门批准颁发相关“许可证”后方可开展活动，并按有关规定享受越南对外资企业提供的相关优惠政策。

二、相关“许可证”的审批权限及受理和审批部门

1、矿业公司“投资许可证”（营业执照）：根据投资项目的种类和投资额的大小由省（市）计划投资厅或国家计划投资部受理并报省（市）人民委员会或中央政府总理审批；

2、“矿产考察许可证”，由国家资源环境部（国家地质矿产局受理）审批；

3、项目“矿产勘探许可证”，由国家资源环境部（国家地质矿产局受理）审批；

4、项目“矿产开采许可证”，由国家资源环境部（国家地质矿产局受理）审批；

6、项目“矿产加工许可证”，由国家资源环境部（国家地质矿产局受理）审批；

7、项目“再生矿产回收利用许可证”，由省（中央直辖市）人民委员会（资源环境厅受理）审批。

申请上述矿产项目“许可证”需提交的文件材料包括：项目申请书，考察（勘探）方案，国家主管部门批准的勘探结果报告、可行性研究报告、环保标准报告，经过公证的外商营业执照或在越外资企业投资许可证副本等。

从事矿产开采活动项目的受理和审批时间：受理机关自接收符合要求的申请材料之日起 60 天内（不含征求有关地方和部门意见的时间）完成审查报批手续。

第二节 矿业活动

整体来说越南的经济发展比较落后，经济发展的滞后性阻碍了矿业的发展。许多矿产资源并没有得到有效的勘探和开发。近几年来，由于政府政策的支持和外资大量引入，矿业得到了较快的发展。为了保证矿产资源得到保护、节约及合理有效地开发利用，越南对矿产资源开采也征收资源税，其税率规定如下：金属矿产（黄金、稀土除外）的资源税率为 1%~5%（其中，黄金为 2%~6%、稀土为 3%~8%），非金属矿产（宝石、煤炭和石油天然气除外）的资源税率为 1%~5%（其中，宝石为 3%~8%、煤炭为 1%~3%、石油为 6%~25%、天然气为 0%~10%）。对《鼓励国内投资法》规定的优惠投资对象的投资项目，从事资源（石油除外）开发的，在开发日起三年内得减征资源税的 50%；若遇到自然灾害、战争或意外事故的情况，对已报税的开发资源部分受到损失，该损失部分可免征资源税。

铁：越南的铁矿资源及为丰富，有上百个矿场都有铁的分布，探明储量约 13 亿吨、估算储量约 23 亿吨，前景广阔，其中，越南河静省石溪铁矿是越南规模最大，含铁量最高矿藏。石溪铁矿早在 1962 年就受到国内外专家的关注，但是，由于这里的地质结构和常年气候、雨量等因素影响，客观上形成了开采石溪铁矿的困难。

铝土：铝土矿石越南的优势矿产之一，探明储量数十亿吨，从 2006 年起，越南加大了对铝土矿的开采投资，据报道，越南林同省宝禄铝矾土开采企业的加工铝矾土能力达 100000 吨/年，越南矿产总公司（VIMICO）与其总部-越南矿产煤炭工业集团一起在林同省保林（BAO LAM）林场第 448 区投资为 4.93 亿美元开采铝矾土矿，每年出口氧化铝粉 60 万吨。

煤炭：越南是一个煤炭资源丰富的国家，已探明储量达 220 亿吨，且品种多、质量好，以鸿基煤为代表的优质无烟煤举世闻名。自 2005 年以来，广西煤炭进出口公司与越南煤炭总公司正式签订了一份长期合同，由越南煤炭总公司向广西煤炭进出口公司每月供煤 12 万吨以上，对正处于能源紧缺之中的广西来说，无疑是一个好消息。这也为我国与越南的能源合作增添了新的亮点。

此外，中国自从 2006 打通了从越南进口锰矿的通道以来，共有铬矿、钛矿、

铅矿等 21 种矿产从越南进口，随着中越关系的进一步稳固，两国的贸易量会越来越大，关系会越来越密切。

表 4-1 越南矿业产值表（单位：十亿越南盾）

年份	2000	2003	2004	2005	2006	2007
开采矿业	53035.2	84040.1	103815.2	110949.0	123716	141635.8
煤炭开采	4143.1	8168.6	12295.1	15589.2	19551.9	26116.6
原油和天然气开采	45401.5	68903.3	84327.5	86379.1	93645.7	102775.1
金属矿开采	427.0	926.7	1259.4	1440.2	1852.7	2293.9
石头和其它矿产开采	3063.5	6041.5	5933.2	7540.5	8665.7	10450.2

资料来源：中越科技贸易网，2006

第三节 部分中资企业在越投资

矿产资源开发项目概况（已备案项目）^①

一、清化省铬矿精选联营公司

合资中方：中国哈尔滨环保制氢设备工业公司
合资越方：越南清化省矿产开发加工与进出口公司
公司地址：清化省古定
经营范围：合资开发古定铬矿
投资方式：合资
投资总额：186 万美元
注册资本：186 万美元
越方出资 30 万美元，占注册资本的 16%；
中方出资 156 万美元，占注册资本的 84%。
批准时间：2000 年 7 月 20 日
合资期限：8 年
项目执行情况：不详

二、越中（矿产）责任有限公司

投资主体：中国广西南宁长丰贸易责任有限公司
公司地址：北干省者屯（CHO DON）县蓬弄镇
经营范围：铅锌矿开采、精选、加工和销售
投资方式：独资
投资总额：49.8 万美元
注册资本：18 万美元
批准时间：2002 年 2 月 4 日
投资期限：10 年
项目执行情况：申请到部分矿区的勘探和开采权并投产，产品销往国内。目前正在办理

^①资料来源：中国驻越南使馆经商处网站，2004-05-11

新的矿区开采申请手续。

三、太原华恒钛业责任有限公司

投资主体：中国云南省昆明道森经贸公司

公司地址：太原松功一工业区

经营范围：收购钛矿和铁矿加工生产和销售

投资方式：独资

投资总额：100 万美元

注册资本：70 万美元

批准时间：2003 年 9 月 15 日

投资期限：30 年

项目执行情况：正在建设厂房，安装设备和办理行政手续。

四、北干矿产联营公司

合资中方：中国湖南省株洲湘江实业发展公司

合资越方：北干矿产公司

公司地址：北干省北干市德春坊

经营范围：铅锌矿勘探、开采、精选、加工和销售

投资方式：合资

投资总额：285.7 万美元

注册资本：285.7 万美元

越方以铅锌矿勘探许可证、铅锌矿开采许可证、矿区厂房及附属工程土地使用权等作价 85.7 万美元投入，占注册资本的 30%；

中方以现金、机械设备、技术工艺等作价 200 万美元投入，占注册资本的 70%。

批准时间：2002 年 10 月 18 日

合资期限：20 年

项目执行情况：申请到少量矿山开采权，目前正在申请新的矿山开采权。

五、老街（矿产）开发联营公司

合资中方：中国云南昆钢矿业开发有限公司

合资越方：老街矿产公司

公司地址：老街省老街市黄联路 151 号

经营范围：开采和精选铁矿

投资方式：合资

投资总额：52.4 万美元

注册资本：46.17 万美元

越方以土地使用权、公司办公楼、现金和其他财产等作价 13.85 万美元投入，占注册资本的 30%；

中方以现金、机械设备及其他财产等作价 32.32 万美元投入，占注册资本的 70%。

批准时间：2003 年 8 月 12 日

合资期限：15 年

项目执行情况：正在办理矿山勘探和开采申请手续

六、河江北迷县大班铅锌矿勘探、开采、精选加工及销售

合作中方：中国云南省众韬经贸有限公司

合作越方：河江省机械矿产公司

公司地址：河江市阮斋路 390 号

经营范围：铅锌矿勘探、开采、精选、加工和销售

投资方式：合作经营

投资总额：108.3 万美元

越方以现金、矿山资源及其他财产等作价 32.49 万美元投入，占注册资本的 30%；

中方以现金、机械设备、技术工艺及其他财产等作价 75.81 万美元投入，占注册资本的 70%。

批准时间：2003 年 11 月 3 日

合作期限：5 年

项目执行情况：已申请到部分铅锌矿山的勘探和开采权并投入生产。目前正在申请该省渭川县董坝那山铁矿的开采权。

七、清化农贡铬矿精选加工及销售合作经营项目

合作中方：中国广西长丰商贸有限公司

合作越方：越南清化省农贡商贸综合股份公司

公司地址：清化省农贡县农贡镇

经营范围：铬矿精选加工和销售

投资方式：合作经营

投资总额：50 亿越盾（约合 33.3 万美元）

越方以土地和办公用房等作价 5 亿越盾投入，占注册资本的 10%；

中方以机械设备、厂房及其他财产作价 45 亿越盾投入，占注册资本的 90%。

批准时间：2004 年 2 月 20 日

合作期限：10 年

项目执行情况：正在做工厂建设的前期工作，合作双方正在办理农贡县两个铬矿开采权报批手续。

八、义安省葵州和葵合县孝河沿岸沙金矿开采加工项目

合作中方：中国云南金平锌业有限责任公司

合作越方：越南第四矿产开发公司

公司地址：义安省荣市兴禄乡

经营范围：沙金矿开采加工和销售

投资方式：合作经营

投资总额：86.7 亿越盾（约合 54.5 万美元）

越方以土地、矿产开采权等作价 26.01 亿越盾，占注册资本的 30%；

中方以机械设备和现金作价 60.69 亿越盾投入，占注册资本的 70%。

批准时间：2003 年 12 月 8 日

合作期限：5 年

项目执行情况：正在做项目建设的前期工作和办理矿产开采加工相关手续。

九、北干省那热县凉山乡新安沙金矿开采加工销售项目

合作中方：中国云南金平锌业有限责任公司

合作越方：越南北干矿产公司

公司地址：北干省北干市德春坊

经营范围：沙金矿开采加工和销售

投资方式：合作经营

投资总额：100 亿越盾（约合 60.6 万美元）

越方以土地、矿产考察、勘探、开采前期投入等作价 11.1 亿越盾投入，占 11%；

中方以机械设备和现金作价 88.9 亿越盾投入，占 88.9%。

批准时间：2003 年 7 月 10 日

合作期限：5 年

项目执行情况：已投产并销售部分产品。

十、莱州省矿产考察勘探开采加工项目

合作中方：中国云南金平锌业有限责任公司

合作越方：越南莱州矿产公司

公司地址：莱州省奠边府市

经营范围：铅锌矿等考察勘探开采加工和销售

投资方式：合作经营

投资总额：150 万美元

越方以土地、机械设备和现金投入 45 万美元，占 30%；

中方以机械设备和现金投入 105 万美元，占 70%。

批准时间：2002 年 4 月 10 日

合作期限：5 年

项目执行情况：由于运输等问题无法解决而难于实施。

第五章 认识和建议

一、几点认识

越南的矿产资源丰富，一些资源可以与我国具有一定的互补性，总体来说可以用以下几个方面来概括：

1. 政治经济形势稳定，且与中国的关系稳固。

2. 投资环境不断得到改善，近几年来，越南逐步重视新经济体制的立法工作，并先后颁布了《私人企业法》、《公司法》、《企业破产法》、《外国投资法》及《鼓励国内投资法》等法律规章制度，这不仅使外国投资者进入越南投资基本有章可循，而且以法律的形式保障投资者的利益。

3. 矿业投资政策透明，根据越南《矿产法》及其实施细则和《外国投资法》及其实施细则规定，越南政府欢迎和鼓励外国组织和个人投资越南矿产开采业，并保护其合法权益。

4. 矿业投资环境仍有待改善，尽管越南矿藏比较丰富，大部分矿产资源至今尚待开发，且投资环境比较有利；尽管我国在矿产开采冶炼加工方面有较高的技术水平和雄厚的技术力量，中越双方在该领域有着广阔的合作空间，但是在实践中普遍反映合作难度大。

二、几点建议

一是投资以前做好项目可行性研究。目前越南正处在一个大变革时代，各种法律体系还不够完善，相关政策变动也比较大，去越南投资矿业的中国企业，应在投资前对越南的矿业市场、矿业法及相关法律法规、政策环境等作充分的调研和科学分析，权衡利弊，制定出一套完整的投资计划，以避免盲目性。

二是我国企业或个人可以借越南国有企业改制的有利时机，购买越南矿业公司股份。我国企业或个人投资开采、加工越南矿产有明显优势，两国关系密切，越南方对我国的勘探、开采、加工技术非常信任特别是对一些中小矿山企业，西方发达国家企业极少涉足，我方竞争对手相对较少，此外我国的勘探、开采、加工技术也具有一定优势，这已经得到越南方面的认可，因此机会相对较多。这应当是我国企业或个人参与开发和利用越南矿产资源的较有效便捷的途径之一。

三是积极利用越南的矿产资源，鼓励企业到越南参股投资开采、加工，重

点关注铝土矿、铁矿和铬矿。上述几种矿产在越南比较丰富，但目前开发程度较低，有非常大的潜力。这些矿产又是我国特别紧缺的矿产，在国内会有很大的市场。

四是尽量避开单一矿产开采或简单加工项目。2005年8月2日越南工业部发布第4号《关于2005-2010矿产出口指导计划》的通知，从此结束了过去矿产出口的无序状态。通知中重要的一条是严禁原矿出口，该通知提高了矿产出口的门槛，而且以后可能会更高。因此单一矿产开采或简单加工项目存在较大的政策风险，而采选冶一条龙项目或矿石深加工项目可避开这一风险。越南矿石加工业总体比较落后，许多地方还是空白，因此，目前投资这一领域机会较多。

五是地方政府对具有潜质和规模的边贸企业予以扶持，通过市场竞争，整合优势企业资源，提高企业抵御风险能力。针对越南政策多变，为适应新政策调整，及时调整企业利用越南矿产资源的战略。

六是在国家之间谋取外贸渠道。经济全球化加深了各国经济之间的相互影响和相互依存性，政策磋商和协调已经成为国际经济关系的一项重要内容，当前各国制定经济政策正越来越多地从被动适应外部环境转向事先的、主动的相互磋商和协调，在国际经济政策协调中发达国家起着主导作用。我国参与经济全球化程度不断加深，需要在更多渠道和更深层次上参与国际经济政策协调，维护国家经济政策主动权。

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附 件：

越 南 矿 业 法

NATIONAL ASSEMBLY
OF THE SOCIALIST REPUBLIC OF VIETNAM
Term 12, Session ...
(dated from to 2010)

MINERALS LAW (amendments)

Pursuant to the 1992 Constitution of the Socialist Republic of Vietnam and its partial amendments under Resolution No. 51/2001/QH10,

the National Assembly hereby enacts this Minerals Law (amendments).

Chapter I
GENERAL PROVISIONS

Article 1. Governing scope

This Law is applicable to the administration, protection, geological baseline studies of mineral resources and mineral-related activities on land, islands, in-land waters, sea waters, areas adjacent to sea waters, special economic zones and continental shelf of the Socialist Republic of Vietnam. Mineral resources being oil and gas and other natural waters except for mineral water and natural hot water are subject to the provisions of other legislations.

Article 2. Affected parties

This law applies to state agencies in charge of mineral-related governance, entities conducting geological baseline studies of mineral resources, organizations and individuals involved in mineral-related activities and other organizations and individuals involved in the administration and protection of mineral resources.

Article 3. Definitions

In this Law, the following terms and terminologies shall have the meanings ascribed to them hereunder.

1. **Mineral resources** refer to mineral materials and substances naturally built up in either solid, liquid or gaseous form in the ground and on the surface. Mineral materials and substances disposed of as mine tailings are also deemed *mineral resources*.

2. **Mineral water** means natural ground or surface water containing ingredients, attributes and some substances with biological properties in accordance with Vietnamese standards or international standards adopted by the state of Vietnam.
3. **Natural thermal water** means natural ground or surface water, as the case may be, with a constant temperature in accordance with Vietnamese standards or international standards adopted by the state of Vietnam.
4. **Geological baseline studies** are activities of research and survey of the structure, material composition, history of evolution and development of the Earth's crust and related mineralization patterns.
5. **Geological baseline studies for mineral resources** are activities of overall assessment of mineral resources potential based on geological baseline surveys to provide scientific grounds for mineral exploration planning.
6. **Mineral-related activities** include mineral exploration, mining and processing activities.
7. **Mineral exploration** refers to activities to identify in details mineral resources, reserves, quality and any information that serves the purposes of mineral mining;
8. **Mineral mining** are activities of mine development, excavation, classification, enrichment or any other related activities to recover minerals.
9. **Mineral processing** is a process of using physical, chemical or other methods to alter the components, properties, composition and shape of mined minerals to obtain metallic materials, alloys or products of high value and socio-economic efficiency.

Article 4. State policies on minerals

1. *Entities or individuals involved in mineral exploration and mining shall be warranted by the State ownership of invested capital, assets and other legitimate rights and interests in accordance with the provisions of this Law and other relevant legislations.*
2. *The state invests in and conducts geological baseline studies of mineral resources in line with master plans and specific plans; human resources training and development; scientific researches; technological application and development in mineral resources geological baseline studies; and encourages entities or individuals to invest and cooperate with state-run geological agencies in performing mineral resources geological baseline study projects in accordance with master plans approved by relevant State authorities.*
3. *The state invests in the exploration of strategic minerals to meet the requirements of the country's socio-economic development plan or for the purposes of mining rights auctioning.*

4. The state provides incentives and encouragement for investment in mineral mining projects applying advanced technologies, ensuring environmental protection, recovering to the full useful accompanying mineral elements, and mineral mining – processing combined projects.
5. The state encourages the construction of concentrated mineral processing zones; invests in minerals processing projects to obtain metallic materials, alloys or products of high value and socio-economic efficiency. Consumption of minerals shall guarantee that the minerals are put to the best use; minerals of high value shall not be used in areas where minerals of lower values are required.
6. Exports of minerals in the form of raw materials and pure ores shall be limited. *The government specifies the list, requirements and standards of minerals eligible for export over time.*

Article 5. Principles of mineral-related activities

1. *Mineral* resources shall be protected, exploited and utilized in a rational, economical and efficient manner to meet the needs for both immediate and long term sustainable socio-economic development, national defense and security.
2. *Mineral-related activities shall comply with the strategy* and master plan approved by a competent government agency in close connection with the protection of environment, landscape, other natural resources and historical and cultural sites; and safeguard national defense, security, social order and safety.
3. Mineral mining must take the socio-economic efficiency *and environmentally protection as the fundamental* criteria for investment decision making; apply advanced technologies suitable for the size and nature of individual types of mines and minerals.
4. Mineral exploration and mining are only allowed to commence once a license has been granted by a competent authority under the provisions of Article 78, with the exceptions specified in paragraph 3, Article 58 of this Law.
Mineral processing is only allowed when the requirements specified in Article 69 of this Law have been met.
5. *Division of a potentially large scale mine into multiple areas for smaller scale development is not allowed.*

Article 6. Entities or individuals eligible for mineral-related activities

Entities or individuals having sufficient finance, human resources and technology capacity; guaranteeing to conduct overall exploration, efficient and economical mining of mineral resources and environmental protection in

accordance with this Law and other relevant legislations shall be eligible for engaging in mineral-related activities.

Article 7. Interests of local residents where mineral mining takes place

1. Entities or individuals having mineral rights shall link the needs for mineral exploitation with development of infrastructure, protection and restoration of environment in accordance with the mining proposal approved by the relevant authority when the license was granted; and give priority to recruiting local workers in the mining operation and other related services.
2. Compensation, assistance and relocation for entities or individuals having legitimate user's rights on the land reclaimed for the purposes of mineral mining projects shall be made in line with land laws and regulations and other relevant legislations.
3. Mineral mining entities or individuals are encouraged to support upgrades, maintenance and development of infrastructure, and development of welfare facilities for the local residents where the mineral mining takes place.
4. Based on state's revenue from mineral mining, on an annual basis, the state shall set aside a portion of the budget to support local socio-economic development where the mining takes place with a view to stabilizing the livelihood of the local residents.
5. The government provides in details the responsibilities of mineral mining entities or individuals and People's Committees of various levels in warranting the legitimacy interests of the local residents where mineral mining takes place.

Article 8. Prohibited conducts

1. Illegal mineral resources baseline studies, exploration and mining
2. Infringement of geological baseline studies for mineral resources, mineral exploration, mining, processing and utilization master plans; trespassing of areas of prohibited mineral-related activities and areas of temporary ban of mineral-related activities;
3. Failure to comply with the liabilities in mineral-related activities in line with the provisions of paragraph 2, Article 41, paragraph 2, Article 51 and paragraph 2, Article 70 of this Law;
4. Destruction of geological specimens and mineral specimens of scientific value or rarity;

Article 9. Archives of geological and mineral-related materials and information

1. Mineral resources geological baseline studies and mineral exploration reports shall be archived in accordance with the current archiving legislations and this Law.
2. Geological and mineral specimens shall be archived in the Geology Museum in accordance with the provisions of this Law and other relevant legislations.

Article 10. Utilization of geological and mineral-related materials and information

1. Entities or individuals are allowed to make reference to, explore and use materials and information from geological baseline studies for mineral resources and mineral-related activities appropriate with the proposed purposes.
2. The state agencies maintaining geological and mineral database are responsible for providing the information and documents to entities or individuals upon requests in accordance with prevailing legislations.
3. Entities or individuals making reference to, exploring and using information from geological baseline studies for mineral resources and mineral-related activities shall pay prescribed fees. In case the entities or individuals use mineral assessment and exploration results for mining purposes, they shall compensate the State the related invested expenses for the studies in accordance with the provisions of this Law.
4. The Government defines procedures for collection, management and utilization of the fees for referencing, exploring and using information from mineral resources geological baseline studies and mineral-related activities; and the procedures for collection, management and use of fees for using results of mineral assessment and exploration funded by the State in mine production.

Chapter II
PROTECTION OF MINERAL RESOURCES

Article 11. Protection of unexploited mineral resources

1. Entities or individuals are responsible for protecting unexploited mineral resources.
2. Provincial and centrally municipal People's Committees are responsible for setting regulations on the cooperation mechanism between the People's Committees of various levels in protecting unexploited mineral resources; leadership in leveraging and coordinating concerted efforts in addressing and averting illegal local mineral mining in their respective territories.
3. District People's Committees are responsible for:
 - a) guiding and directing enforcement of the legislations in respect of management and protection of local unexploited mineral resources;

- b)* directing commune People's Committees in taking actions to protect unexploited mineral resources; leveraging and coordinating local concerted efforts to address and avert any illegal mineral-related activities in a timely manner.
- 4. Commune People's Committees are responsible for working with the relevant authorities in protecting local unexploited mineral resources; detecting and preventing in time illegal mineral-related activities.
- 5. When submitting for approval proposed master plans for the development of concentrated residential areas and permanent structures, the proposing entities or individuals shall enclose written notes from the licensing state agency in charge of minerals as specified in Article 78 of this Law.

The government specifies the routine for preparation and approval of master plans for the development of national defense and security structures located in areas with mineral resources.
- 6. Land using entities or individuals are responsible for protecting mineral resources contained in the occupying area; and are not allowed to exploit or let other entities or individuals exploit minerals in the land they are occupying without the permission of relevant authorities, except for the cases specified in paragraph 3, Article 58 of this Law.

Article 12. Protection of mineral resources in mineral exploration and mining

- 1. Entities or individuals permitted to explore minerals shall make an overall assessment and full report on all types of minerals discovered in the licensed exploring area to the relevant mineral state governing agencies.
- 2. Entities or individuals permitted to mine minerals shall apply advanced technologies, appropriate to the size and nature of individual mines and minerals to recover to the maximum the minerals permitted for mining.
- 3. Any new minerals discovered during the process of mining shall be immediately reported by the mining entities or individuals to the relevant mineral authorities for review and decision making.
- 4. Entities or individuals permitted for mineral mining are responsible for storage and preservation of mined minerals pending consumption; and taking appropriate actions to manage and protect excavated but not yet recovered minerals.

Article 13. Financing protection of unexploited mineral resources

- 1. The government shall guarantee the financial resources needed for the protection of unexploited mineral resources through the annual budget plans.

2. Provincial and centrally municipal People's Committees shall determine the annual cost estimates for protection of respective local unexploited mineral resources.

Chapter III

GEOLOGICAL BASELINE STUDIES FOR MINERAL RESOURCES

Article 14. Geological baseline studies for mineral resources

1. Geological baseline studies for mineral resources shall be conducted by the State in line with the approved master plans. The State encourages entities or individuals with the right capacity in finances and technologies to invest in geological baseline studies for mineral resources.
2. Based on the master plan for mineral resources geological baseline studies approved by the Prime Minister and allocated state budget plan, the Ministry of Natural Resources and Environment shall implement geological baseline studies for mineral resources.
3. The Ministry of Natural Resources and Environment provides for mineral resources geological baseline studies project specifics and reporting; and ratifies standards, technical specifications, cost norms and unit prices in geological baseline studies for mineral resources.

Article 15. Description of geological baseline studies for mineral resources

1. Surveys and detection of mineral resources simultaneously with development of various types of maps for local geology, geological hazards, environmental geology, maritime mineral geology; geological and mineral-related specialized maps and researches;
2. Assessment of mineral resources potentials by type or category of minerals and promising geological structures to find new mines.

Article 16. Rights and liabilities of entities involved in geological baseline studies for mineral resources

1. Entities conducting geological baseline studies of mineral resources are entitled to:
 - a) Performing geological baseline studying activities for mineral resources in line with approved proposals and assigned plans by relevant authorities;
 - b) sending samples abroad for testing and experimenting in accordance with the proposal approved by relevant authorities.
2. The entity conducting geological baseline studies of mineral resources have the obligation:

- a) to register geological baseline studies for mineral resources at state authorities in charge of mineral governance prior to commencement of operation;
- b) to comply with the terms and conditions specified in the approved proposal; standards, technical specifications, cost norms and unit prices prescribed for mineral resources geological baseline studies;
- c) to ensure the integrity and comprehensiveness in collecting and compiling geological and mineral-related materials and information; to keep confidential geological and mineral-related information during the process of geological baseline studying for mineral resources;
- d) to protect the environment, mineral resources and other resources during the process of mineral resources geological baseline studying as required by the law;
- dd) to submit mineral resources geological baseline study reports approved by relevant authorities to the Geology Archives and geological and mineral specimens to the Geology Museum.

Article 17. Entities or individuals funding geological baseline studies for mineral resources

1. Entities or individuals are encouraged to finance geological baseline studies for mineral resources in the following principals:
 - a) The proposals for mineral resources geological baseline studies are qualified for investment incentive criteria announced by the Ministry of Natural Resources and Environment.
 - b) The mineral resources geological baseline studies proposals and reports shall be reviewed and approved by the Ministry of Natural Resources and Environment.
 - c) The project implementation shall be monitored by the state authorities in charge of mineral governance.
2. Entities or individuals funding geological baseline studies for mineral resources shall be given priority when participating in auctions of the exploring – mining rights of the new minerals found in the surveyed areas.

Chapter IV MINERAL AREAS

Article 18. Mineral areas

Mineral areas include mineral exploring and mining areas, areas of prohibited mineral-related activities and areas of temporary ban of mineral-related activities.

Article 19. Areas of mineral exploring and mining

Areas of mineral exploring and mining include:

1. Areas subject to auction of mineral exploring – mining rights, and areas subject to auction of mining rights;
2. Areas of restricted mineral-related activities;
3. Areas of dispersed, small-scaled minerals;
4. Areas of national mineral resources reserves;
5. Areas of common mineral exploring and mining, including locations not specified in paragraphs 1, 2 and 4 of this Article.

Article 20. Area of restricted mineral-related activities

1. Areas of restricted mineral-related activities include areas where mineral-related activities are limited in order to protect environment, natural landscape, historical and cultural sites, national defense and security facilities, specialized forests and infrastructures.
2. Mineral exploring and mining activities in areas specified in paragraph 1 of this Article shall be restricted in one or more of the following forms:
 - a) Limitation on who are allowed to explore and mine;
 - b) Limitation on output;
 - c) Limitation on mining duration;
 - d) Limitations on methods and depth of mining.
3. The Ministry of Natural Resources and Environment shall refer to the Prime Minister for approval of areas of restricted mineral-related activities upon the request of relevant ministries, provincial and centrally municipal People's Committees.

Article 21. Areas of dispersed and small-scaled minerals

1. Areas of dispersed and small-scaled minerals include areas where mineral resources geological baseline studies have been done and determined as containing mineral resources deposits suitable for small-scale mining in accordance with the criteria specified by the Government.
2. The Ministry of Natural Resources and Environment is responsible for locating and announcing areas of dispersed and small-scaled minerals.
3. The demarcation of areas of dispersed and small-scaled minerals are defined with lines connecting corner points identified by the planar coordinate system on topographical maps of 1:50,000 scale using the VN - 2000 coordinate system.

Article 22. Areas of banned, temporarily banned mineral-related activities

1. Areas of banned mineral-related activities include:
 - a) Areas where recognized historic and cultural sites, landscapes or protected areas decided by the Law on Cultural Heritage are situated;

- b) Areas with specialized forests, protected forests or protected forest land, natural renewable mangrove forests and geological reserves areas;
 - c) Areas specifically delineated for national defense and security purposes or where mineral-related activities may adversely affect the integrity of national defense and security missions;
 - d) Religion-specific areas;
 - dd) Safety corridors or zones of public traffic infrastructure works, safety corridors of high voltage grids, irrigation works, embankments and communication.
- 2. Areas of temporarily banned mineral-related activities include areas so defined by:
 - a) contingent national defense and security needs;
 - b) purposes of preservation of nature, historic and cultural sites, and landscapes under government's review and recognition or those discovered during the mineral exploration and mining process;
 - c) disaster preparedness and responses needs.
- 3. In case of areas where legal mineral activities are taking place being announced banned or temporarily banned areas for mineral-related activities, the Government shall compensate where applicable the damage caused by the ban to the entities or individuals with mineral-related operations in such areas in accordance with relevant laws and regulations.
- 4. In exceptional cases where mineral exploration or mining is needed in banned or temporarily banned areas as specified in paragraphs 1 and 2 of this Article, the licensing state authorities specified in Article 78 of this Law shall refer to the Prime Minister for review and decision making.
- 5. Provincial and centrally municipal People's Committees shall, in cooperation with the Ministry of Natural Resources and Environment and relevant ministries, locate and propose areas of banned and temporarily banned for mineral-related activities to the Prime Minister for review and approval.

Article 23. Areas of national mineral resources reserves

- 1. Areas of national mineral resources reserves identified using results of geological baseline studies for mineral resources and mineral exploration include the followings:
 - a) Areas containing minerals of strategic and vital importance to the socio-economic sustainable development of the country;
 - b) Areas containing minerals either not yet suitable for effective mining, processing and utilization; or if mining starts, would be at risk of the absence of effective measures to alleviate and suppress adverse impacts on the environment.

2. The Ministry of Natural Resources and Environment shall, in cooperation with relevant ministries, localize and propose areas of national mineral resources reserves to the Prime Minister for decision making; and inform the Ministry of Industry and Trade, Ministry of Construction and provincial and centrally municipal People's Committees for management and protection purposes.
3. Mineral-related activities inside areas of national mineral resources reserves shall only be allowed upon approval of the Prime Minister.

Chapter V

ENVIRONMENTAL PROTECTION AND USE OF LAND, WATER AND INFRASTRUCTURE IN MINERAL-RELATED ACTIVITIES

Article 24. Environmental protection in mineral-related activities

1. Entities or individuals permitted to conduct mineral-related activities shall employ environment-friendly technologies, equipment, materials and take actions to prevent and alleviate possible adverse effects to environmental elements in the course of operation in line with environmental protection laws; and take steps for reclamation and restoration of the environment as required.
2. Entities or individuals permitted to conduct mineral-related activities shall bear all costs related to the protection and restoration of environment and land. The costs for protection, reclamation and restoration of environment shall be estimated in the proposal, environmental impact assessment or environmental protection covenant, and post-mining environmental reclamation and restoration plan approved by relevant authorities.
3. Measures of environmental protection, waste treatment and other solutions shall be taken to avoid causing damage to other land users in the same and surrounding areas during operations.
4. Prior to commencement of mining, entities or individuals licensed for mineral mining shall pay a deposit for environmental reclamation and restoration as required.

Article 25. Utilization of land in mineral-related activities

1. Entities or individuals permitted to conduct minerals mining are required to lease land for production in accordance with the provisions of land laws and this Law.
Upon the expiry of a mineral mining license, the land lease agreement shall automatically terminate; upon partial relinquishment of the mining area, the land lease agreement shall alter accordingly. In the event of any

changes to the entity or individual permitted to conduct mineral mining, a new lease shall be required.

2. In case of mineral exploration activities with frequent use of land, a land lease shall be secured in line with the provisions of the land laws; in case of infrequent land use and if the exploration does not interfere with the utilization of the land by existing legitimate entities or individuals, the entities or individuals permitted to explore minerals are not required to lease land for the exploration area but shall pay compensation for any damage caused by the exploration activities.
3. Entities or individuals permitted to conduct mineral-related activities shall compensate any damages caused by the utilization of land for the purposes of the mineral-related activities in accordance with land laws and other relevant laws and regulations.

Article 26. Utilization of water resources in mineral-related activities

1. Entities or individuals permitted to conduct mineral-related activities are allowed to use natural water sources in their operation in accordance with presiding laws and legislations. Such utilization of water resources must guarantee rationality, economy and relevance to the scale of the mineral-related operations.
2. The water sources, volume and utilizing approach in mineral-related activities shall be defined in the mineral exploration proposal, production proposal and mine design.
3. Entities or individuals using water resources and discharging waste water in the water source are responsible to fulfill their liabilities in line with water resources legislations.

Article 27. Utilization of infrastructure in mineral-related activities

1. Entities or individuals permitted to conduct mineral-related activities may use transportation and communication systems, electricity and other physical infrastructure facilities needed in their mineral-related activities in conformity with relevant laws.
2. Entities or individuals permitted to conduct mineral-related activities are responsible for renovation, upgrading, rehabilitation or new development of physical structures and infrastructure in conformity with the exploration proposal or production proposal approved by the relevant licensing authority.

Article 28. Insurance in mineral-related activities

Entities or individuals permitted to conduct mineral-related activities shall purchase insurance for the equipment and facilities used in their mineral-

related activities; environment insurance, social security, workplace incident insurance and other types of insurance in accordance with relevant laws.

Chapter VI

MINERAL MASTER PLANS

Article 29. Mineral master plans

1. Mineral master plans shall be developed by types or categories of minerals and territorial area, including:
 - a) Master plans for geological baseline studies for mineral resources;
 - b) Master plans for mineral exploration, mining, processing and utilization.
2. Term of a mineral master plan
 - a) The term of a master plan for geological baseline studies for mineral resources is 10 years, with a vision to 20 years.
 - b) The term of a master plan for mineral exploration, mining, processing and utilization is 10 years.

Article 30. Principles in development of master plans

1. Geological baseline study planning for mineral resources shall comply with the following principles:
 - a) Relevant to national strategies, master plans for socio-economic development, zoning plans, national defense and security;
 - b) Ensuring that the result of geological baseline studies for mineral resources shall provide the scientific ground for the planning of mineral exploration and mining.
2. Mineral exploration and mining planning shall secure the following principles:
 - a) Relevant to the strategies, master plans for socio-economic development, zoning plans, national defense and security;
 - b) Ensuring rational, economical and efficient recovery and utilization of mineral resources to serve the immediate needs while taking into account the advancement of mineral-related sciences, technologies and demand in the future;
 - c) Mineral processing projects must match the supply of input mineral materials for operation.
 - d) Meeting the requirements for protection of environment, natural landscape, historic and cultural sites and other natural resources.
 - dd) Provincial-level mineral exploration, mining, processing and utilization master plans shall correspond to the national mineral exploration, mining, processing and utilization master plan approved by relevant authorities.

Article 31. Master plans for geological baseline studies for mineral resources

1. Input fundamentals for the master plan:
 - a) the country's socio-economic, national defense and security strategy, master and specific plans;
 - b) Results of completed mineral-related surveys, geological prerequisites and potential.
2. A master plan shall contain the following key information:
 - a) Geological and mineral survey mapping on the 1:50,000 scale topographic map, using the VN-2000 coordinate system, development of geological and mineral data and information systems;
 - b) Assessment of surface and ground mineral potentials for individual types and categories of minerals; identification of areas with mineral resources prospect;
 - c) Determination of development scale and needs for equipment, technology, analyzing and experimenting approach used in the mineral resources geological baseline study;
 - d) Approach and schedule of master plan implementation.
3. The Ministry of Natural Resources and Environment shall compile and submit to the Prime Minister for approval the master plans for mineral resources geological baseline studies.

Article 32. Master plans for mineral exploration, mining, processing and utilization

1. Input fundamentals for the master plan:
 - a) National socio-economic development strategies, master plans, zoning plans, industry plans, national defense and security plans;
 - b) Demand of mined minerals for mineral processing and manufacturing industries in the planning period; ability to meet mined mineral supply needs for mineral processing and input demand of manufacturing industries;
 - c) Results of mineral resources geological baseline studies;
 - d) Science and technology advancements in mineral exploration, mining, processing and utilization;
 - dd) historic outcome of the exploration, mining, processing and utilization master plans for the mineral of the same type.
2. Key information in the master plan:
 - a) Surveys, studies, reviews and assessment of natural and socio-economic conditions; current status of mineral exploration and mining activities; situation of processing and using mined minerals;

- b) The real potential of surveyed and explored mineral resources and demand for mined minerals from manufacturing industries in the planning period;
- c) Sites and types of minerals to be explored and implementation schedule; mining sites, types of mineral to be mined and implementing schedule in the planning period shall be determined based on the current potential of mineral resources and need for mined minerals from manufacturing industries.
The demarcation of the zoned sites for mineral exploration are determined by straight lines connecting corner points presented in a 1:50,000 topographic map using VN-2000 coordinate system.
The demarcation of the zoned sites for mineral mining are marked by lines connecting corner points presented in a topographic map of appropriate scale that clearly define the sites, using the VN-2000 coordinate system.
- d) Indications of banned, temporarily banned areas for mineral-related activities, areas of restricted mineral-related activities and areas of national mineral resources reserves approved and announced by relevant authorities;
- dd) Based on the ability to meet the demand for mine minerals and processed minerals, site location, processing scale; categories, quality and output of processed products and target consumers shall be defined.
- e) Approach and schedule of master plan implementation.

- 3. The Ministry of Industry and Trade and Ministry of Construction shall, with the authority specified in paragraphs 3 and 4, Article 76 of this Law, and in cooperation with the Ministry of Natural Resources and Environment and other relevant ministries with demand for mineral input, develop and submit to the Prime Minister for approval the master plans for exploration, mining, processing and utilization of minerals, except for minerals specified in paragraph 4 of this Article, once an agreement is reached with the Ministry of Natural Resources and Environment.
- 4. Provincial and centrally municipal People's Committees shall cooperate with the Ministry of Natural Resources and Environment and other relevant ministries to prepare and submit to the People's Council of respective levels for approval the master plans for exploration, mining, processing and utilization of the minerals subject to the licensing authority specified in paragraph 2, Article 78 of this Law.

Article 33. Adjustment of mineral master plans

- 1. A mineral master plan shall be adjusted when:

- a) The national socio-economic, national defense and security strategies, master plans and specific plans; and strategies and master plans for development and needs for mined minerals from manufacturing industries are changed, thus remarkably affecting the nature and contents of the master plans.
 - b) New discoveries of mineral resources are made;
 - c) For the interest of the nation and community.
2. The agency authorized for approving mineral master plans shall make decision on adjustments of the approved master plan.

Article 34. Consultation and announcement of mineral master plans

1. In the making of a mineral master plan, the planning agency shall consult ministries, sectors, entities and individuals associated with such master plan prior to submission to the competent authorities for approval.
2. Within 30 days since the mineral master plan is approved or adjusted, the planning agency shall announce the mineral master plan on the Official Gazette, electronic portal of the Government and the web page of the supervising Ministry and provincial People's Committees.

Chapter VII MINERAL EXPLORATION

Article 35. Entities or individuals eligible for mineral exploration

1. Domestic enterprises of all economic sectors with mineral-related activities registered in their business lines; and foreign enterprises with representative offices or branches in Vietnam are allowed to engage in mineral exploration.
2. Cooperatives, households and individuals with mineral-related activities registered in their business lines are allowed to engage in exploration of minerals for common construction materials.

Article 36. Selection of site for mineral exploration projects

Entities or individuals specified in Article 35 of this Law wishing to start a mineral exploration project may conduct field surveys, collection and analysis of surface specimens for demarcation of the proposed site for the exploration project.

Field surveys may only commence upon the approval in writing of the provincial/centrally municipal People's Committee where the proposed exploration area is located.

Article 37. Demarcation and size of mineral exploration areas

1. The demarcation of the exploration areas is defined by straight lines connecting corner points, presented in a topographic map of scale no smaller than 1:10,000, using the VN-2000 coordinate system.
2. Size of the exploration area
 - a) The exploration area for a specific exploration license for metallic minerals (except for bauxite) and gemstone (diamond, ruby, sapphire and emerald) shall not exceed fifty square kilometers (50 km²).
 - b) The exploration area for an exploration license for coal, bauxite and non-metallic minerals (except for minerals to be used as common construction materials) on land, with or without water surfaces, shall not exceed one hundred square kilometers (100 km²).
 - c) The exploration area for an exploration license for assorted minerals (except for minerals to be used as common construction materials) in the continental shelf shall not exceed two hundred square kilometers (200 km²).
 - d) The exploration area for an exploration license for minerals to be used as common construction materials on land shall not exceed two square kilometers (02 km²), and shall not exceed one square kilometer (01 km²) for an area with water surfaces.
 - dd) The exploration area for an exploration license for mineral water or natural hot streams shall not exceed two square kilometers (02 km²).

Article 38. Mineral exploration proposal

1. A mineral exploration proposal should contain the following key information:
 - a) A relevant exploration approach shall be adopted to ensure reliable determination of mineral deposit, quality, appropriate mining conditions, processing and consumption potential for the minerals found in the exploration area;
 - b) The exploration workload, quantity and types of samples to be collected and analyzed shall guarantee full and reliable assessment of resources and mineral reserves and quality depending on the exploration objectives.
 - c) Environmental protection, workplace safety and hygiene solutions shall be in place during the exploration process.
 - d) A reserve estimation method is proposed.
 - dd) On-site operation solutions and project schedule are provided.
 - e) Exploration cost estimates are calculated based on unit prices set by relevant state authorities.
2. The exploration proposal shall be reviewed and approved by relevant state agencies in charge of mineral governance before a license is granted.

Article 39. Criteria for mineral exploration licensing

1. Entities or individuals specified in Article 35 of this Law, meeting technical capacity requirements specified in paragraph 2 of this Article and financial capacity requirements specified in paragraph 3 of this Article, and having an exploration proposal in compliance with the mineral exploration and mining master plans approved by relevant authorities shall be qualified to have their proposals for mineral exploration licensing reviewed.
In case of entities or individuals not meeting the technical requirements specified in paragraph 2 of this Article, they shall sub- contract an organization eligible for mineral exploration as specified in Article 45 of this Law for performing the exploration once the license is granted.
2. Technical capacity requirements for entities engaged in mineral exploration:
 - a) Having the technical manager being a geology engineer with hands-on experience in mineral exploration for minimum five (05) years; who understands and is well familiar with legal normative documents in respect of mineral exploration;
 - b) Having trained technical officers and workers in exploration geology, hydrogeology-engineering geology, geophysics, boring, excavation and other relevant expertise;
 - c) Having specialized equipment and tools for implementation of mineral exploration works.
3. Financial capacity requirements:
Having owner's equity equal to at least 50% of the total investment capital to implement the mineral exploration project.

Article 40. Mineral exploration license

1. Justification for granting a mineral exploration license:
 - a) National socio-economic, national defense and security strategy, master plan and specific plans;
 - b) Mineral exploration, mining, processing and utilization master plans approved by relevant authorities;
 - c) Requirements for consideration for mineral exploration licensing for entities and individuals as specified in Article 39 of this Law;
 - d) Auction outcome in case of sites subject to auction of mineral exploration - mining rights;
 - dd) With regards to toxic minerals, minerals classified as national mineral resources reserves and minerals in banned and temporarily banned areas for mineral activities, permission in writing by the Prime Minister shall be required.
2. Principles in granting an exploration license

- a) The mineral exploration license shall only be issued to entities or individuals meeting the requirements specified in Article 39 of this Law.
 - b) Mineral exploration licenses shall be issued for areas on which no entities or individuals are conducting legitimate mineral exploration or mining activities; *and which are not part of banned, temporarily banned areas for mineral-related activities or areas where geological baseline studies for mineral resources are taking place for the particular type of mineral being applied for exploration, except for the cases specified in point dd, paragraph 1 of this Article.*
 - c) An eligible entity or individual in line with the provisions of Article 35 of this Law may be granted not more than five (05) exploration licenses, not including expired exploration licenses previously granted to that entity or individual; the total area of exploration sites stated on the licenses for a specific mineral shall not exceed twice the area licensed for exploration as provided for in paragraph 2, Article 37 of this Law.
3. The valid term of a mineral exploration license shall be no longer than forty eight (48) months. The license may be extended for multiple times providing that the accumulated extended period shall not exceed twenty four (24) months.

Article 41. Rights and liabilities of entities or individuals licensed for mineral exploration

- 1. Entities or individuals licensed for mineral exploration are entitled to:
 - a) using available national mineral data and information associated to the exploring objectives and the area allowed for exploration;
 - b) conducting exploration activities in compliance with the exploration license;
 - c) taking away from the exploration area, including to a foreign country, samples with volume and types in conformity with the nature and requirements of analyses and experiments;
 - d) *first refusal right for mineral mining in the explored area in accordance with the provisions of Article 43 of this Law;*
 - dd) applying for renewal or surrender of the mineral exploration license or partial relinquishment of exploration area in line with presiding rules;
 - e) transfer of mineral exploration rights to other entities or individuals in line with the regulations of the Government;
 - g) bequeathing the exploration right in line with prevailing laws in case of individuals holding the exploration right;

- h) lodging a complaint or initiating legal actions against decisions to revoke the mineral exploration license or other sanctioning decisions of state agencies in accordance with the law;
 - i) other relevant rights in accordance with the provisions of this Law.
2. Entities or individuals licensed for mineral exploration are responsible:
- a) to pay licensing fee, exclusive exploring right fee, performance bond, compensation fee for national mineral resources data and information and other financial liabilities as specified by the law;
 - b) to comply with the granted exploration license and the approved mineral exploration proposal;
 - c) to report to the licensing authority for consideration and decision making in case of changes being made to the exploring methods or changes of exploring workload of accumulated value larger than ten percent (10%) of the approved exploration proposal;
 - d) to protect mineral resources; *comply fully with regulatory provisions* on environmental protection, workplace safety and hygiene;
 - dd) to compensate for any damages caused by the exploration act;
 - e) to inform the exploration plan to the respective provincial/centrally municipal People's Committee where the exploration is allowed prior to commencement;
 - g) to compile and preserve mineral resources data and information and report exploration results to relevant mineral authorities; and report other related activities to competent administrative agencies as defined by the law;
 - h) to submit the final report on exploration results to the authority in charge of mineral governance before the exploration license expires;
 - i) to perform the tasks required upon the expiry of the exploration license as specified in paragraph 3, Article 44 of this Law;
 - k) to abide by regulations on governance, social order and security;
 - l) to perform any other related obligations as specified by this Law.

Article 42. Toxic mineral exploration

Entities or individuals exploring toxic minerals, besides fulfillment of obligations specified in paragraph 2, Article 41 of this Law, shall take measures to prevent environmental pollution or adverse effect on human health; identify in full polluting factors in the exploration process and introduce remedies and mitigation measures.

Exploration of radioactive minerals shall simultaneously be subject to the Atomic Energy Law and relevant legislations.

Article 43. First refusal right for mining licensing

1. Within twenty four (24) months from the expiration of the exploration license, the entities or individuals granted non-auction mineral exploration licenses shall also receive the first refusal right for the mining license in respect of the mineral reserve approved by the relevant authority.

Beyond this period, in the absence of an application for a mining license from the entity or individual holding the exploration license for the explored reserve, the licensing authority shall reserve the right to grant a mining license to another entity or individual.

2. In case the entity or individual specified in paragraph 1 of this Article has applied for a mining license or been granted a mining license, however, the reserve applied for or allowed for mining under the license is smaller than the previously approved reserve, the licensing authority reserves the right to grant a mining license to another entity or individual for the remaining deposit; providing that the entity or individual so licensed compensate the respective exploration expenses to the entities or individuals that conducted the exploration.

Article 44. Withdrawal and termination of exploration license

1. A mineral exploration license shall be withdrawn upon the occurrence of any of the following circumstances:
 - a) Within six (06) months since the license comes into effect, the entities or individuals licensed for exploration fail to commence the exploration, with the exception of force majeures.
 - b) The entities or individuals licensed for exploration is in breach of one of the liabilities specified in paragraph 2, Article 41 of this Law, with the exception of those specified in point a, paragraph 1 of this Article, and fails to provide a remedy within ninety (90) days since the date of a written notice issued by the relevant mineral authority;
 - c) The area permitted for exploration is declared an area of banned or provisionally banned mineral-related activities in accordance with Article 22 of this Law;
 - d) Within six (06) months, the individual exploration right holder perishes without anyone claiming inheritance of the right or the entity holding an exploration right is dissolved or goes bankrupt without any other corporate or individual successor to take over the right and liabilities.
2. A mineral exploration license shall become invalid upon the occurrence of one of the following circumstances:
 - a) The license is withdrawn;
 - b) The license expires;
 - c) The license is surrendered.

3. Once an exploration license becomes invalid,
 - a) *any rights* in relation to the exploring license also become void;
 - b) *within six (06) months since the expiry of the exploration license*, the entity or individual licensed for mineral exploration shall remove all assets of their own and related parties from the exploration area. In case of withdrawal or surrender of the exploration license, the subject entity or individual shall duly perform leveling and filling work to render the exploration area to a safe state; protect mineral resources; reclaim the environment, habitat and land; turn in specimens and any accumulated mineral resources data and information to the mineral governing authorities.

The provisions in item b, paragraph 3 of this Article do not apply to areas that the exploration entity or individual has legitimately applied for exploration license extension or a mining license which is being under consideration by the licensing authorities.

Article 45. Entities eligible for practicing mineral exploration

1. Geology specialized entities established or allowed for establishment by relevant authorities;
2. Other business entities established under provisions of enterprise laws meeting requirements of technical capacity as specified in paragraph 2, Article 39 of this Law.

Article 46. Assessment and approval of mineral exploration outcome

1. Assessment and approval of mineral exploration outcome:
 - a) Mineral exploration outcome under the licensing jurisdiction of the Ministry of Natural Resources and Environment shall be assessed and approved by the National Council for Mineral Reserves Assessment.
 - b) Mineral exploration outcome under the licensing jurisdiction of provincial or centrally municipal People's Committees shall be assessed and approved by the respective provincial or municipal People's Committees.
2. Entities or individuals allowed for mineral exploration under the licensing jurisdiction of the Ministry of Natural Resources and Environment shall submit a mineral exploration report enclosed with the decision approving the exploration outcome to the Geology Archives of the Ministry of Natural Resources and Environment.

Entities or individuals allowed for mineral exploration under the licensing jurisdiction of provincial/centrally municipal People's Committees shall submit a mineral exploration report enclosed with the decision approving the exploration outcome to the respective Departments of Natural

Resources and Environment and the Geology Archives of the Ministry of Natural Resources and Environment.

3. The Ministry of Natural Resources and Environment provides the specifics and procedures of review and assessment of mineral exploration outcome and procedures of submitting the reviewed and approved exploration reports to the Geology Archives.

Chapter VIII

MINERAL MINING

Part 1

MINERAL MINING

Article 47. Entities or individuals eligible for engagement in mineral mining

1. Domestic enterprises of all economic sectors with mineral mining registered as a business line;
2. Cooperative, households and individuals with mineral mining registered as a business line are allowed to engage in mining of minerals for common construction materials.

Article 48. Mineral mining area

1. The demarcation of the mining area is defined by lines connecting corner points, presented in a topographic map at scale of not less than 1:5,000 using the VN-2000 coordinate system.
2. The size and demarcation defined by the depth of the mining area shall be considered based on specific proposals, in conformity with the mineral deposit allowed to be included in the mining design.

Article 49. Criteria for mineral mining licensing

Entities or individuals specified in Article 47 of this Law meeting the following criteria shall be considered for mineral mining licensing:

1. those having lodged mineral mining proposals in areas where exploration has been completed and mineral reserves have been approved, which is in line with the master plan for mineral exploration, mining, processing and utilization approved by relevant authorities;
2. those having manpower of adequate expertise, advanced and appropriate equipment, technology and mining method and environmental impact assessment or environmental protection covenant approved or certified by the relevant authorities in accordance with the provisions of environmental protection laws.
3. those presenting owner's equity equal to at least 30% of the total investment capital to implement a mineral mining project.

Article 50. Mineral mining license

- 1) Justification for granting a mineral mining license
 - a) The national socio-economic, national defense and security strategy, master plan and specific plans;
 - b) the mineral exploring, mining, processing and utilization master plans approved by relevant authorities;
 - c) The socio-economic performance of specific projects in connection with the requirements of protection of the environment, ecology, natural landscape, historic and cultural sites, and assurance of national security and defense;
 - d) Requirements for entities and individuals applying for mineral mining licenses specified in Article 49 of this law;
 - dd) In case of toxic minerals, minerals classified as part of national mineral reserves and minerals in areas banned or temporarily banned for mineral-related activities, permission shall be given in writing by the Prime Minister.
2. Principles in granting mineral mining licenses
 - a) Mining licenses shall be granted only to entities or individuals meeting the requirements specified in Article 49 of this Law.
 - b) Mining licenses are only issued for areas where no other entities or individuals are implementing legal exploration or mining activities or which are not parts of areas banned or temporarily banned for mineral activities; except for cases specified in point dd, paragraph 1 of this Article.
 - c) In case a foreign-invested enterprise applies for a mineral mining license, the mining license shall be issued simultaneously or subsequent to the issuance of an investment certificate in accordance with the investment laws.
3. The valid term of a mining license shall be set based on the mineral mining proposal but not exceeding thirty (30) years for a new issuance and may be extended multiple times; provided that the accumulated extension period does not exceed twenty (20) years.

Article 51. Rights and obligations of entities or individuals licensed for mineral mining

1. Entities or individuals with mining rights are entitled to:
 - a) using national data and information on mineral resources pertaining to the mining objectives and the eligible mining area in line with applicable laws;
 - b) conducting mineral mining activities in accordance with the terms and conditions of the mining license; more intensive exploration of

mineral resources and reserves within the licensed mining area without applying for a new exploration license;

- c) storage, transport, in-country sales and export of the recovered minerals in accordance with prevailing laws;
 - d) applying for renewal or surrender of the mining license or partially relinquishing the mining area;
 - dd) transfer of the mining right to other entities or individuals in accordance with Governmental regulations;
 - e) bequeathing the mining right under prevailing regulations in case of individuals licensed for mining;
 - g) lodging a complaint or initiating legal actions in line with relevant laws against a decision to withdraw the mining license or other sanctioning decisions by state agencies;
 - h) lease of land for mining purposes based on mining schedule stated in the mining proposal and mine design in line with land laws;
 - i) other related rights in accordance with this Law.
2. Entities or individuals permitted to mine minerals shall have the following obligations:
- a) Paying fees, taxes, royalties and fulfilling other financial obligations in accordance with relevant laws;
 - b) Ensuring the progress of mine development and production activities in accordance with the approved mining proposal and mine designs;
 - c) *recovering to the highest level the main minerals and accompanying minerals*; protecting the mineral resources; ensuring workplace safety and hygiene; taking measures to protect the environment in accordance with the approved or verified environmental impact assessment or environmental protection covenant;
 - d) fully collecting and maintaining data and information on additional exploration and mining outcome;
 - dd) registering the commencement dates for mine development and production with the mineral governing agency and inform the provincial level People's Committees in areas where mines are located of the mining plans prior to commencement;
 - e) fulfilling obligations for warranting the interests of the local residents in the areas where the mining takes place in accordance with Article 7 of this Law;
 - g) reporting mining performance to mineral governing agencies in accordance with the regulations of the Ministry of Natural Resources and Environment; and being accountable for the accuracy and authenticity of the reports;
 - h) paying compensation for any damages caused by the mining activities;

- i) facilitating scientific researches authorized by the State within the mining area; construction of transportation works, water pipelines, power grids and communication lines passing by the mine area as authorized by competent authorities provided that the legitimate rights and interests of the entities or individuals licensed for mining are secured;
- k) Submitting a summary performance report of mining activities to the mineral governing agency prior to the expiry of the mining license; implementing mine closure procedures, rehabilitation of environment and land upon the expiry of the mining license as specified in paragraph 2, Article 54 of this Law;
- l) complying with administrative management, social order and security regulations;
- m) fulfilling obligations specified in the mining license and other obligations in accordance with applicable laws and regulations.

Article 52. Mining toxic minerals

Entities or individuals mining radioactive toxic minerals, apart from the liabilities specified in paragraph 2, Article 51 of this Law, shall comply with the provisions of the Atomic Energy Law and other applicable laws and regulations.

Article 53. Workplace safety and hygiene in mineral mining

1. Entities or individuals licensed for mineral mining and any individuals working in a mine shall comply with provisions of the law on workplace safety and hygiene.
2. The workplace rules of the mine shall be developed and enacted in accordance with the provisions of the labor code. Regulations on workplace safety and hygiene shall comply with technical norms on workplace safety and hygiene promulgated by competent state agencies.
3. When the workplace safety is threatened, the mine managing director must immediately implement necessary measures to eliminate the causes of the threat.
4. When workplace safety incidents occur, the mine managing director must immediately implement emergency measures to eliminate the cause of the incidents, provide emergency care, evacuate people from dangerous areas; promptly report to the competent State agency; protect assets and the scene of the incident in accordance with the law.
5. Local governments, state agencies, socio-political organizations, economic organizations, the people's armed forces and all citizens are responsible to support provision of emergency care and repair the consequence of the incident in the mining area.

6. Entities or individuals licensed for mineral mining shall comply with the regular and ad-hoc reporting regime on workplace safety and hygiene in mining activities in accordance with the provisions of the law.

Article 54. Withdrawal and termination of mining license

1. Mineral mining licenses shall be withdrawn upon the occurrence of any of the following circumstances:
 - a) Within twelve (12) months since the license comes into effect, the entities or individuals licensed for mining fail to commence mine development, except for force majeure.
 - b) Within twelve (12) months since the proposed commencement date of production stated in the approved mineral mining proposal, the licensed entities or individuals fail to commence mining activities, *with the exception of force majeure*.
 - c) The entity or individual licensed for mining is in breach of one of the liabilities specified in paragraph 2, Article 51 of this Law, except for cases specified in items a and b, paragraph 1 of this Article, and fails to provide a remedy within ninety (90) days since the date of written notice issued by the mineral governing agencies;
 - d) The area permitted for mining is declared banned or provisionally banned for mineral-related activities in accordance with Article 22 of this Law.
 - dd) The individual mining right holder perishes without anyone claiming inheritance of the right, or the entity with the mining right is dissolved or goes bankrupt without any other entities, individuals to take over the right and liabilities.
 - e) The validity of the mineral mining investment certificate terminates.
2. A mineral mining license shall become invalid upon the occurrence of one of the following circumstances:
 - a) *The mining license is withdrawn.*
 - b) The license expires.
 - c) The license is surrendered.
3. Once a mining license becomes invalid,
 - a) any rights associated with the mining license shall also become void;
 - b) all facilities and equipment used for the purpose of mine safety and environmental protection in the mining area shall automatically belong to the government and shall not be removed or destroyed;
 - c) Apart from the assets specified in item b of this paragraph, within six (06) months since the expiry of the mining license, the entity or individual licensed for mining shall remove all assets of their own and other related parties from the mine area. Beyond the

aforementioned time limit, the remaining assets shall be in the possession of the government.

- d) Within the time limit stated in item c) of this paragraph, the entity or individual licensed for mining shall fulfill all obligations relating to mine closure, environmental reclamation and rehabilitation as provided in this law and other relevant laws and regulations.

Article 55. Mine design and approval

1. Prior to mining activities, mining eligible entities or individuals shall develop a mine design and obtain approval for the design as required.
2. Entities and individuals assessing the mine design shall be those independent in interests with the entities or individuals developing the design and take responsibility before law for their assessment outcome.
3. No later than six (06) months since the mining license enters into force, the entity or individual permitted to mine minerals shall submit the approved mine design to the mineral mining licensing body.
4. The Ministry of Industry and Trade provides specifics of the mine design.

Article 56. Mine managing director

1. The mine managing director
 - a) The mine managing director shall be a person with mining technical expertise and managerial capacity in line with the provisions of paragraphs 2 and 3 of this Article, and is appointed by the head of the entity licensed for mining to provide direct management of mining activities as specified in the mineral mining license.
 - b) The entity permitted for mining shall inform in writing the technical qualification and managerial capacity of the mine managing director to the mineral mining licensing authorities.

The mineral governing agency reserves the right to reject such appointment of the mine managing director and may request the entity licensed for mining to replace the proposed mine managing director in case the proposed director is deemed unqualified for the job.
 - c) No mineral mining activities shall be started in the absence of a mine managing director. A mine managing director shall only be in charge of management of the mining work in one mine.
 - d) In case the head of the entity licensed for mining possess sufficient capacity as provided for in paragraphs 2 and 3 of this Article, he/she may concurrently work as the mine managing director.
2. Requirements for professional qualification

- a) The managing director of a mine adopting pit mining methods shall be a mining engineer or mine development engineer having field experience in pit mines of minimum five (05) years.
 - b) The managing director of a mine adopting opencast mining methods shall be a mining engineer having field experience in opencast mines of minimum three (03) years. In case of an exploration geologist, he/she must have training on mining techniques and have field experience in opencast mines of minimum five (05) years.
 - c) The managing director of a non-metallic mine adopting the opencast mining method without the use of industrial explosives or a mine adopting rudimental manual mining methods to extract minerals for common building materials must have a qualification of at least secondary vocational training in mining or exploration geology; particularly in case of those having only secondary vocational training in mining, a minimum field experience in opencast mines of two (02) years shall be required; in case of those having only secondary vocational training in exploration geology, further training on mining techniques and a minimum field experience in opencast mines of three (03) years shall be required.
3. Requirements for governance and management capacity
- a) being well familiar with the provisions of mineral-related legal normative documents and other legislations pertaining to mineral exploration, mining and utilization;
 - b) being well familiar with industry technical standards, workplace safety and environmental protection requirements in mining;
 - c) possessing organizing, management capacity and field experience in managing mining techniques, workplace safety and environmental protection.

Article 57. Inventory and stock taking of mineral reserves, mapping mine layout

- 1. Entities or individuals permitted to exploit minerals shall develop, manage and maintain in full current maps and cross-sectional profiles of the mining site.
- 2. On an annual basis, entities or individuals permitted to conduct mining shall initiate inventory and stock taking of mineral resources and reserves in the legitimate mining area and are responsible before the law for the accuracy and comprehensiveness of the inventory and stock taking data. The annual inventory and stock taking results shall be submitted to mining licensing authorities prior to January 20 of the next year.

3. The Ministry of Natural Resources and Environment provides specifics on the development of mine status maps, and inventory and stock taking of mineral reserves.

Article 58. Mining minerals for common construction materials

1. Minerals used as common construction materials include:
 - a) Sand of various kinds (except siliceous white sand) with SiO_2 content of less than 85% and unaccompanied by cassiterite, wolframite, monazite, zircon, ilmenite and gold;
 - b) Clay used for brick and tile making in accordance with Vietnamese standards and clay of various kinds (except for bentonite and kaoline clay) unqualified for making construction ceramics and chamotte materials or cement in accordance with the Vietnamese standards;
 - c) Sandstones or quartzite stones with SiO_2 content of less than 85% do not contain metallic minerals, native metals, radioactive and rare elements or are unqualified for making ashlar paving stones and fine arts stones in accordance with the Vietnamese standards;
 - d) Sedimentary rocks of various kinds (except for stones containing keramzite and diatomite); magma rocks (except for basalt stones in form of pillar or foam); metamorphic stones containing no metallic minerals, native metals, gemstones, quasi-gemstones and radioactive and rare elements or unqualified for making ashlar paving stones and fine arts stones in accordance with the Vietnamese standards and unqualified for making feldspar or ceramic products used as construction materials in accordance with the Vietnamese standards;
 - dd) Schist in all kinds, except for table slates, oil slates and schists containing sericite, disthene or sillimanite with grade of more than 30%;
 - e) Various kinds of gravels, cobbles and grits without gold, platinum, gemstones and quasi-gemstones (quartz, topaz, beryllium, ruby, sapphire, zircon), and laterite without native metals or metallic minerals;
 - g) Various kinds of limestone, chalky clay, marble (except for chalky stalactite, chalky limestone and white marble) unqualified for making Portland cement in accordance with the Vietnamese standards or for making ashlar paving stones and fine arts stones in accordance with the Vietnamese standards;
 - h) Dolomite stones with MgO content of less than 15% or dolomite stones unqualified for making structural glass in accordance with the Vietnamese standards or for making ashlar paving or fine arts stones in accordance with the Vietnamese standards.
2. Mining minerals for use as common construction materials shall follow the

provisions of this Law.

3. Mining minerals for use as common construction materials specified below are not subject to mining license:
 - a) Mining minerals for use as common construction materials in the area of a development project approved or allowed for investment by the relevant authority and the mined products are only used for that project.

Prior to commencement of the mineral mining activities, the entities or individuals having the mining right shall register the site, capacity, volume, method, equipment and mining plan at the provincial/centrally municipal People Committee. The management and utilization of the mined minerals shall comply with presiding laws and regulations.
 - b) Mining minerals for use as common construction materials inside the residential area of households and individuals being legitimately used in line with land laws and regulations, providing that the mined minerals are only used for construction purposes of that household or individual.

Article 59. Mineral mining in areas with on-going projects of permanent structures development

1. In case of mineral-containing areas located within an area with on-going projects of permanent structures construction, the state authorities as specified in Article 78 of this Law shall decide whether exploration is required to supplement grounds for mining licensing or decide whether mining activities shall be conducted prior to the project being approved or granted an investment certificate.
2. In case of mineral-containing areas located within an area with on-going projects of permanent structures development fall under the decision making authority for investment of the National Assembly or the Government or Prime Minister; the Ministry of Natural Resources and Environment shall, in cooperation with relevant ministries, industries and provincial/centrally municipal People's Committees in the areas where the projects are located, decide whether the minerals shall be extracted to ensure reasonable progress of the construction works. The mining licensing authority is provided in Article 78 of this Law.
3. In case the mining of minerals referred to in paragraphs 1 and 2 of this Article is deemed unproductive or when corporate or individual applicants for the mining are absent, the governing state body specified in Article 78 of this Law shall issue a decision of non-exploitation and inform of the same in writing to the investment governing and licensing agencies or the investor.

4. In case of the mining of minerals referred to in paragraphs 1 and 2 of this Article and the entity or individual licensed for the mining are not the owner of the project for which land allocation or lease has been decided by the government, arrangements on how to use the land on which the mining will be conducted shall be agreed by negotiation between related parties in accordance with land laws and regulations.

Part 2

LANDFILL MINING

Article 60. Landfill mining

Landfill mining is applicable to any remaining minerals available in tailings discharged from the mining and processing of a mine that has been closed.

Article 61. Entities and individuals eligible for landfill mining

Vietnamese businesses, cooperatives, households and individuals of all economic sectors with minerals mining registered as a business line may engage in landfill mining. Priority shall be given to local resident entities or individuals where the landfill minerals are located.

Article 62. Valid term of a landfill mining license

A landfill mining license shall be valid for no longer than five (05) years, including extension.

Article 63. Rights and *liabilities* of entities or individuals licensed for landfill mining

1. Entities or individuals permitted to conduct landfill mining are entitled to:
 - a) performing mining activities in line with the license;
 - b) storage, transport, processing and sales of the extracted minerals in line with prevailing laws and regulations;
 - c) applying for extension and surrender of the landfill mining license;
 - d) lodging complaints or starting legal proceedings against withdrawal of a landfill mining license or other punitive verdicts of a government agency in accordance with applicable laws.
2. Entities or individuals permitted to conduct landfill mining shall be responsible:
 - a) to pay licensing fees, royalty and other financial liabilities as specified by the law;
 - b) to compensate for any damages caused by the mining activities;
 - c) to recover to the maximum available mineral resources; protect the related environment, land and infrastructure facilities;
 - d) to exercise workplace safety and hygiene during the mining process;

- dd) to comply with regulations in public administration, maintenance of social order and security;
- e) to record and maintain adequately data on the outcome of mining, processing and consumption of *minerals*.
- g) to facilitate scientific researches allowed by the government within the mining areas;

Article 64. Withdrawal of a landfill mining license

1. A landfill mining license shall be withdrawn upon the occurrence of one of the following circumstances:
 - a) The entity or individual licensed for landfill mining fail to perform their liabilities as specified in paragraph 2, Article 63 of this Law;
 - b) The area permitted for landfill mining is declared banned or temporarily banned *for mineral-related activities* under the provisions specified in Article 22 of this Law.
2. Once the landfill mining license has been withdrawn or expires, the entity or individual permitted to conduct the landfill mining shall remove entirely their assets from the mining area; and start environment reclamation and restoration as required.
3. In case the landfill mining license is withdrawn as applicable under item b, paragraph 1 of this Article, the entity or individual licensed for the landfill mining shall be compensated for the related damage by the Government.

Part 3 MINE CLOSURE

Article 65. Cases where mine closure is applicable

Entities or individuals permitted to mine minerals shall prepare a proposal for closure of a mineral mine in the following cases.

1. The mine closure is required to liquidate all or a part of the mining site since the entire mineral deposit has been extracted.
2. The mine closure is required for preservation purposes as a result of termination of a mining license under the provisions of paragraph 2, Article 54 of this Law while the mineral reserves in the permitted site have not been totally extracted.

Article 66. Preparation and implementation of a mine closure proposal

1. Entities or individuals allowed for mineral mining shall prepare and submit mine closure proposals to the mining licensing authority for approval prior to implementation.
2. In case the mining entity is dissolved or goes bankrupt or the individual miner perishes without an heir, or in case of non-performance, the

relevant governing body shall choose another qualified entity or individual to prepare and implement the mine closure proposal. The expenditure for implementation of mine closure proposals shall be accounted to the environmental reclamation and rehabilitation fund deposited by the mining entity or individual.

Article 67. Mine closure proposal approval and decision making

1. The agency granting the mining license for a specific mineral shall be the authority to issue the mine closure decision for that exact mineral.
2. The mining licensing agency is responsible for verifying the outcome of an approved mine closure proposal and issuing the closure decision.
3. The Ministry of Natural Resources and Environment provides specifics and procedures for review and approval of a mine closure proposal and verifies the outcome of the mine closure proposal.

**Chapter IX
MINERAL PROCESSING**

Article 68. Principles in mineral processing

1. Mineral processing activities shall comply with the master plans for processing, mining and utilization of minerals approved by the relevant authorities.
2. Advanced and appropriate mineral processing technologies shall be guaranteed to create products of high socio-economic value, recover to the maximum the minerals and associated useful elements, and in connection with environmental protection in processing.

Article 69. Criteria for engaging in mineral processing

1. Entities or individuals allowed to engage in mineral processing include:
 - a) Domestic enterprises of all economic sectors with mineral processing registered as a business line;
 - b) Cooperatives, households and individuals with mineral processing registered as a business line may engage in processing minerals as common construction materials.
2. Criteria for engaging in mineral processing
Entities, individuals specified in Paragraph 1 of this Article meeting the following criteria shall be allowed for mineral processing:
 - a) Those having investment projects on mineral processing in accordance with the master plans for processing, mining, processing and utilizing minerals approved by relevant authorities; and local land zoning plans approved by relevant authorities;

- b) Investment projects on mineral processing shall be reviewed in respect of scientific background and technologies in accordance with the legislations on science and technologies;
- c) Minerals to be processed shall be of legal origin;
- d) Presentation of environmental impact assessment or environmental protection covenant for a mineral processing project approved or verified by state authorities in accordance with the legislations on environmental protection.

Article 70. Rights and liabilities of entities or individuals permitted to process minerals

1. Entities or individuals permitted to process mined minerals are entitled to:
 - a) import of equipment, supplies and minerals which directly serves the purpose of processing;
 - b) in-country storage, transport and sales and export of the processed minerals in accordance with applicable laws;
 - c) lodging complaints or initiating legal actions against sanctioning verdicts by the governing state bodies in accordance with prevailing laws;
 - d) other related rights in accordance with the law.
2. Entities or individuals permitted to process minerals are obliged to:
 - a) pay taxes and other financial liabilities in accordance with applicable laws;
 - b) conduct mineral processing activities in accordance with the assessed and approved mineral processing proposal;
 - c) adopt measures to mitigate adverse effects on the environment in processing in accordance with the environmental impact assessment or environmental protection covenant approved or verified by relevant authorities in line with laws and regulations on environmental protection;
 - d) ensure workplace safety and hygiene;
 - dd) pay compensation for damages caused by the processing activities;
 - e) report mineral processing performance to the relevant mineral governing agency;
 - g) comply with regulations in public administration and maintenance of social order and security;
 - h) fulfill other related obligations in line with the provisions of laws.

Chapter X

MINERAL-RELATED FINANCES AND AUCTIONING OF MINERAL PROSPECTING – MINING RIGHTS AND MINING RIGHTS

Part 1

MINERAL-RELATED FINANCES

Article 71. State revenues from mineral-related activities

1. State revenue from taxes include royalties, taxes for transfer of mineral exploration and mining rights and other taxes in line with tax laws and regulations.
2. State revenue from fees and charges:
 - a) Compensation for mineral resources;
 - b) Compensation for utilization of mineral geological baseline study materials and information;
 - c) Environment protection fee in mineral activities;
 - d) Fees for exclusive exploration right;
 - dd) Fees for mineral-related activities licensing;
3. Other income from mineral-related activities:
 - a) Revenue from utilizing information, materials and results of mineral exploration conducted by the government;
 - b) Revenues from auctions of exploring – mining rights and auctions of mineral mining rights;
4. The Government defines procedures of collecting, managing and using revenue from compensation for mineral resources. The mechanism for collection, management and utilization of taxes, fees, charges and other revenues shall comply with applicable laws.

Article 72. Pricing of unexploited mineral resources

1. The State shall value unexploited mineral resources in the following cases:
 - a) Mineral mining right auctions;
 - b) As a basis for calculating mineral mining right transfer;
 - c) Determining the value of the government's contributed capital in the form of unexploited mineral resources;
 - d) Evaluating enterprises as mining businesses go public;
 - dd) Other cases as specified by the Government.
2. The authority in determining the price of unexploited mineral resources is defined as under:
 - a) The Ministry of Natural Resources and Environment shall determine the price of unexploited mineral resources under its licensing jurisdiction specified in paragraph 1, Article 78 of this Law.
 - b) Provincial/Centrally municipal People Committees shall determine the price of unexploited mineral resources under their licensing jurisdiction specified in paragraph 2, Article 78 of this Law.
3. The Ministry of Finance shall define the principles and methods of unexploited mineral resources pricing.

Part 2

AUCTIONING MINERAL EXPLORING – MINING RIGHTS AND MINING RIGHTS

Article 73. Forms of auctioning in mineral-related activities

1. Mineral exploring – mining right auctioning
2. Mineral mining right auctioning

Article 74. Principles and criteria for auctioning

1. Mineral exploring – mining right and mining right auctions shall be conducted based on the following principles:
 - a) Entities or individuals participating in the auctions shall meet the requirements on legal entity status and financial and technical capacity specified by the Government.
 - b) Auctions are only applicable for sites identified by relevant authorities as specified in paragraphs 2, Article 75 of this Law, which are announced as areas subject to mineral exploring – mining right and mining right auctioning.
 - c) Mineral exploring – mining right and mining right auction regulations shall apply.
2. The Government shall ratify the Regulation on mineral exploring-mining and mining rights auctioning.

Article 75. Locating areas subject to mineral exploring-mining and mining rights auction

1. Principles in locating and announcement:
 - a) Mineral exploring-mining, mining right auction sites shall be in line with master plans for mineral exploration, mining, processing and utilization approved by relevant authorities.
 - b) Mineral exploring-mining right auction sites shall be located based on the potentials of mineral resources as defined by geological baseline studies for mineral resources; mineral mining right auction sites shall be located based on the mineral exploration results under the ownership of the State.
 - c) Demarcation of mineral exploring-mining right auction sites and mining right auction sites shall be defined by straight lines connecting corner points presented in the topographic maps at scale of not less than 1:10,000 using the VN-2000 coordinate system.
2. Locating and announcement authority:
 - a) The Ministry of Natural Resources and Environment shall locate and announce areas subject to mineral exploring – mining and mining

- rights auctioning under the licensing jurisdiction specified in paragraph 1, Article 78 of this Law.
- b) Provincial/centrally municipal People's Committees shall locate and announce areas subject to mineral exploring – mining and mining auctions under the licensing jurisdiction specified in paragraph 2, Article 78 of this Law.
3. The list of mineral exploring-mining rights auction sites and mining rights auction sites shall be announced on the web page of the authorities specified in paragraph 2 of this Article.

Chapter XI

MINERALS-RELATED GOVERNANCE

Article 76. Responsibility of minerals-related governance of the Government, Ministries and the ministerial level agencies

1. The government exercises uniform governance of minerals.
2. The Ministry of Natural Resources and Environment is responsible to the Government in state governance on minerals on a nation-wide scale, with the following rights and obligations:
 - a) issuing or submitting to the relevant authorities for promulgation and enforcement legal normative documents pertaining to minerals;
 - b) approving or submitting to relevant authorities for approval and enforcement master plans of mineral resources geological baseline studies within the country; approving projects and reporting on results of mineral resources geological baseline studies;
 - c) announcing unexploited mineral-containing areas, areas of toxic minerals and national mineral resources reserves areas;
 - d) communicating and educating mineral laws;
 - dd) inspecting the implementation of mineral-related legislations;
 - e) granting, extending, withdrawing and allowing surrender of mineral-related licenses; approving partial relinquishment of mineral exploration and mining site; approving security of tenure for mineral-related activities rights in case of inheritance and transfer of mineral-related activities rights; holding auctions for mineral exploration-mining rights, auctioning mineral mining rights within its jurisdiction in accordance with the provisions of Paragraph 1, Article 78 of this law;
 - g) guiding and organizing registration of mineral resources geological baseline studying activities and mineral-related activities;
 - h) compiling mineral resources geological baseline study results and mineral-related activities performance nationwide; handling archives

- and maintenance of documents and specimens attributed to mineral resources;
 - i) announcing and publishing mineral resources geological baseline studying materials and information;
 - k) guiding and resolving, within its jurisdiction, disputes, complaints, accusations pertaining to mineral resources geological baseline studies and mineral-related activities;
 - l) acting as the standing committee of the Mineral Reserves Assessment Council.
3. The Ministry of Industry and Trade assumes the following jurisdiction and responsibilities:
 - a) Submitting to the Government policies and strategies on mining, processing and utilizing mined minerals, except for minerals used as construction materials and cement-producing materials;
 - b) Preparing and submitting to the Prime Minister for approval of the master plans for mineral exploring, mining, processing and consuming, except for minerals used as construction materials and cement-producing materials, upon agreeing in writing with the Ministry of Natural Resources and Environment;
 - c) Issuing technical standards and specifications on mineral mining and processing;
 - d) Issuing the list, criteria and standards for export minerals; except for minerals used as construction materials and cement-producing materials.
 4. The Ministry of Construction takes responsibilities of and jurisdiction over:
 - a) Submitting to the Government policies and strategies on mining, processing and utilizing minerals as construction materials and cement-producing materials;
 - b) Preparing and submitting to the Government for approval the master plans for exploring, mining, processing and utilizing minerals as construction materials and cement-producing materials after agreeing in writing with the Ministry of Natural Resources and Environment;
 - c) Issuing the list, criteria and standards for export minerals used as construction materials and cement-producing materials.
 5. Ministries and ministerial-level agencies are responsible to cooperate with the Ministry of Natural Resources and Environment, Ministry of Industry and Trade, Ministry of Construction, provincial/centrally municipal People's Committees in mineral-related governance.
 6. The National Mineral Reserves Assessment Council established by the Prime Minister takes jurisdiction over:

- a) Assisting the Government in assessing and approving natural resources, mineral reserves stated in mineral exploration reports, except for minerals under the licensing jurisdiction of provincial/centrally municipal People's Committees as specified in paragraph 2, Article 78 of this law;
- b) Conducting statistic estimation of mineral reserves, except for minerals under the licensing jurisdiction of the provincial/centrally municipal People's Committee as stipulated in Paragraph 2, Article 78 of this Law;
- c) Approving criteria applied to mineral reserve calculation under the jurisdiction of assessment and approval specified in item a, paragraph 6 of this Article.

Article 77. Responsibility of mineral-related governance of the People's Committees of various levels

1. The responsibility of mineral-related governance of provincial/centrally municipal People's Committees includes:
 - a) Issuing, within their jurisdiction, implementing documents for the State's regulations on administration and protection of mineral resources and administration of mineral-related activities at sub-national levels;
 - b) coordinating with related ministries in locating and submitting to the relevant authorities for approval of areas of banned and temporarily banned mineral-related activities in accordance with the regulations of this law;
 - c) preparing and submitting to the People's Council of respective level for approval of the master plans for exploring and mining of minerals under the jurisdiction specified in paragraph 2, Article 78 of this Law;
 - d) communicating, disseminating and educating mineral legislations; taking measures in protecting mineral resources, environment and other natural resources in accordance with applicable laws; ensuring social security and order in areas where minerals are found;
 - dd) recognizing mineral reserve calculation criteria; approving mineral resources and reserves reported in mineral exploration results under their licensing jurisdiction specified in paragraph 2, Article 78 of this law;
 - c) Issuing, extending, withdrawing; accepting surrender of mineral-related licenses, partial relinquishment of mineral exploring and mining site; approving security of tenure for mineral-related rights in case of inheritance, transfer of mineral-related activities rights; holding auctions for mineral exploring - mining rights and auctions of

- mining rights under their respective jurisdiction, in accordance with the provisions of paragraph 2, Article 78 of this law;
- g) directing audit and inspection of local compliance with mineral-related laws and regulations; resolution within jurisdiction or participation in resolving mineral-related disputes, complaints and accusations and addressing local mineral-related offences;
 - h) leasing land for local mineral-related activities in accordance with land laws;
 - i) regularly compiling and reporting the performance of mineral activities at the sub-national levels to the relevant mineral governing agency.
2. The responsibility in mineral-related governance of district, town, provincial city People's Committees; and commune, township People's Committees includes:
- a) exercising measures for management and protection of unexploited mineral resources and environment; maintaining social security and order in areas where minerals are found;
 - b) within their power, handling procedures of land lease, utilization of infrastructure and other related issues involving local entities or individuals allowed for mineral-related activities in accordance with applicable laws;
 - c) communicating, disseminating and educating mineral-related laws; addressing mineral-related offences in line with presiding legislations;
 - d) regularly compiling and reporting to the respective People's Committee local mineral-related activities performance.

Article 78. Jurisdiction and procedures for mineral exploring and mining licensing

1. The Ministry of Natural Resources and Environment issues mineral exploring license and mining license, except for the cases specified in paragraph 2 of this Article.
2. Provincial/centrally municipal People's Committees issue mineral exploring and mining licenses for minerals used as common building materials and peat, and minerals occurred in dispersed and small-scaled areas defined and announced by the Ministry of Natural Resources and Environment; and landfill mining licenses.
3. Mineral-related licensing authorities have the right to extend, revoke, accept surrender of mineral-related licenses; accept relinquishment of a part of the licensed exploration and mining areas; approve security of tenure in cases of inheritance and transfer of mineral exploring and mining rights.

4. The application files and procedures for implementing mineral-related activities in accordance with provisions of this Article are provided for by the Government.

Article 79. Mining industry auditors

1. The mineral governing agencies shall assume the role of a specialized auditing agency for the mining industry.
2. Coverage of specialized mining audit:
 - a) Preservation of state secret related to mineral resources;
 - b) Protection and rational utilization of mineral resources;
 - c) Compliance to the regulations in mineral resources geological baseline studying; the terms and conditions of mineral exploring and mining licenses; mineral processing regulations;
 - d) Compliance with workplace safety and environmental protection provisions in mineral exploring and mining activities.
3. The Government defines the organization and operation of mining industry audit.

Chapter XII IMPLEMENTING PROVISION

Article 80. Enforcement

This Law comes into effect from July 01, 2011 and supersedes the Mineral Law of March 20, 1996 and Law No. 46/2005/QH11 of June 14, 2005 providing partial amendments and supplements to the Mineral Law.

Article 81. Transition provision

1. Mineral-related activities licenses granted by relevant authorities before this Law comes into force shall remain valid and are not subject to bans specified in this Law, and shall maintain their validity until the licenses expire; except in case entities or individuals voluntarily wish to adopt the provisions of this Law.
2. Mineral landfill mining licenses in mines closed for liquidation shall maintain their validity until the expiry date specified in those licenses and shall not be extended or renewed.

Article 82. Implementing guidelines

The government shall provide details and implementing guidelines for paragraph 6, Article 4, paragraph 5, Article 7, paragraph 4, Article 10, paragraph 5, Article 11, paragraph 1, Article 21, item e), paragraph 1, Article 41, item dd), paragraph 1, Article 72, items a), paragraphs 1 and 2, Article 74,

paragraph 4, Article 78, paragraph 3, Article 79 and other provisions as needed in this Law for state governance purposes.