西昌——滇中地区地质矿产科研丛书

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地质矿产部成都地质矿产研究所

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内 容 简 介

本书详细论述了西昌—滇中地区沉积盖层——从震旦系至侏罗系——各时代地层的空间分布、沉积特征、生物面貌及其演化规律；论述了盖层的形成及其在这一地质历史阶段的演化概况；讨论了康滇古陆的形成、发展及其东西两侧的沉积分异特征；分析了各时期古地理环境对地层、沉积的控制作用；在此基础上探讨了本区地壳运动的性质及其运动方式。本书还首次系统地描述了美姑觉洛洼萨洼至地木沟侏罗纪双壳类化石。

本书对某些有争议的地层问题作了讨论，对各时代地层的划分及与邻区的对比都有所建树。本书内容丰富，资料翔实，可供广大地质工作者及有关研究人员参考。

序

西昌—滇中地区，位于我国西南腹地，纵贯川、滇两省，北起康定，南迄元江，西以锦屏山-玉龙山为界，东及昭觉-东川一带，面积近10万平方公里。该区系分隔我国南部东西构造区的有特色的构造带和矿产资源重要远景区之一，也是我国西南的重要经济开发区。

经地矿部门和兄弟部门几十年尤其是近二十多年来的共同努力，完成了1:20万区测填图，部分地区开展了1:5万区测工作，并进行了大量的普查勘探工作，探明有储量的矿种71种。其中，铜矿、钒钛磁铁矿、铅锌矿、镍矿、磷矿等，为区内特色矿产，早已驰名中外。该区交通方便，建设条件好，目前已形成初具规模的，以冶金工业为主的我国重要工业基地。

为进一步满足经济建设对矿产资源的需要，开拓区内地质找矿的新局面，解决区内长期争论的一些关键性的基础地质问题，加深区域地质研究程度，地质矿产部于1980年下达了"西昌—滇中地区地质构造特征及其对铁、铜等矿产的控制关系"重点研究项目。

成都地质矿产研究所从1981年开始，组织了所内有关研究室对区内地层、构造、岩石、矿产等关键性的基础地质问题进行了研究，开展了野外考查；同时，在室内进行了大量的分析和测试。对争议较大的前震旦纪含铁、铜的变质地层层序及对比方面的问题，地矿部门与冶金地质部门和有关院校联合组织了攻关。在开展横向联合，组织多学科、多手段联合攻关的同时，又在"双百方针"指引下，尊重各学科，各课题按其各自独具的特色开展了多视角研究，并普遍采用区域性宏观地质与个别地区、个别问题重点解剖相结合的方式，深入进行了命题范畴的整体性综合研究，在项目所涉及的各个领域内都取得了显著的进展。

地层研究方面：前震旦系部分，在详细研究剖面地层组合标志、构造界面、接触关系的基础上，应用微古生物、叠层石、重矿物组合特征及同位素地质年代学等多种手段相结合的方法，弄清了主要地质事件，首次建立了全区性统一地层柱(划分为5群19组)。震旦系的研究，首次论述了早震旦世存在后造山型大陆裂谷；在盐边地区发现南沱期冰成岩，

并命名为惠民组；在上震旦统中首次发现大量蠕虫类、藻类及遗迹化石，命名为金沙江生物群。古生代部分，全面了解和掌握各时代地层的空间分布、沉积特征、生物面貌及其演变规律，进而探讨古生代的地史演化，划分出三介沉积发展阶段，是对西昌—滇中地区古生代地层及古地理概况的又一次全面系统的探讨。中生代地层的研究，证实了祥云地区云南驿组之下确有中三叠世地层的存在，明确了三叠纪时期全区的三个地史演化阶段。

构造研究方面：根据该区晚三叠世以来的中、新生代地质构造的特点，提出了地块边缘构造带的新概念。运用板块构造与多旋回构造相结合的地质理论，对该区地史演化、地质构造特征和铁铜等矿产的分布与成矿规律进行了全面系统的深入讨论，进而指出了找矿方向。在研究过程中，首次鉴别出二叠纪碳酸盐重力流沉积，并由此引申出对该区古构造格架及地史演化的广泛讨论。同时从另一种学术观点出发，对"裂谷作用"的研究，也较前深入了一步：提出本区是裂谷作用与造山作用多旋回发展的典型地区，修正了"攀西大陆裂谷带"的概念，指出真正的裂谷期在晚三叠世早-中期。

岩石学研究方面，首次发现和提出了麻粒岩。将本区片麻状杂岩命名为"康滇灰色片麻岩"，指出其原岩是一套以变质基性火山岩为主的岩石组合，兼有绿岩带和高级变质区的双重特征，属晚太古代和早元古代的产物。同时将其成岩过程分为前构造、同构造和后构造三大变质期，说明康滇灰色片麻岩是这三期变质的综合产物。基性超基性岩研究方面，提出了以物质成分为主的新的岩体类型划分方案，指出各类岩体具有不同的成矿专属性，探讨了有关矿产在岩体中的分布规律，指出康滇地区基性超基性岩是在区域上隆、压力降低及不同深度地慢熔融的产物。根据构造与花岗岩类时空分布和成因的依从关系，划分了与本区构造单元相应的混合花岗岩带，重熔花岗岩带和慢源型碱性花岗岩带。其中混合花岗岩带的提出，突破了本区花岗岩类为唯一岩浆成因的传统观点。基于成矿特征及专属性的研究，预测了与各类花岗岩带有关的矿产。

矿床研究方面：从构造演化入手，通过各时代矿床成矿特征，成因机制的研究，阐明了不同时期控矿构造及矿床的空间分布富集规律，划分了七个构造成矿带，对钒钛磁铁矿、

铜矿、铅锌矿、锡钨矿、菱铁矿、岩浆硫化铜镍矿等，都分别建立了新的矿床成因模式。对层控铜矿提出了沉积-成岩-生物、火山喷发沉积-变质、火山喷气沉积-生物、构造-再生等矿床成因模式，在易门铜矿中首次发现了多种生物成矿标志。同时，还提出了"相序结构"、"地球化学障壁"控矿等论据，以大量资料充实了多成因多方式成矿理论。对岩浆型铜镍矿，提出了四种与过去不同的成矿作用方式，建立了三种矿床成因模式。从矿石学、成因矿物学的角度，对区内富铁矿床的成因进行了研究，不但充实了矿床成因论据，而且提供了矿床成因研究的新途径。研究成果还表明，分布于地壳不同层圈的矿产，是地壳演化过程中不同阶段的产物。成矿是在浅部构造与深部构造紧密结合下，在岩浆活动、变质作用和成矿作用的综合地质作用下形成，具有多元成矿的特点，成矿受特定的构造环境控制，不同特点的构造控制了不同类型的矿床。

上述研究成果，经地质矿产部科技司委托地质科学院，于1986年6月20—24日在北京通过评审。评审员有：学部委员、教授郭令智，学部委员、教授董申葆，学部委员、研究员程裕淇，学部委员、教授王鸿祯，研究员路兆冶及同行专家17人。评审认为：这是一份具有国内先进水平的研究成果，是当前西昌—滇中地区地质资料全面系统的总结，反映了最新研究水平；立论新颖、观点明确、逻辑推理严谨、有创新的认识和新的发现，结论可信。建议公开出版，相信这对科研、生产、教学均有重要的参考意义和使用价值。

研究成果，为区内成矿远景区划、矿产预测和新的一轮普查找矿，提供了科学依据。研究中所取得的成绩，是区内广大地质工作者长期辛勤劳动的结晶，是与川、滇两省地矿局、两省地质勘探公司、有关院校和地质队的大力支持分不开的。在此，谨向他们表示感谢！

上述研究成果，分别按地史演化、成矿规律、构造、前震旦系、古生界、中生界、花岗岩、变质岩、基性超基性岩以及铜铁矿床等专题，辑成《西昌—滇中地区地质矿产科研》丛书，分为13个分册陆续出版。丛书在撰写过程中，由于时间短、经验欠缺、不免有错，望读者指教。

徐振新

1986年10月

前　言

本书论述了区内震旦纪至侏罗纪地层的空间分布、沉积特征、生物面貌、地层划分和对比关系、以及有关这一地质历史时期内各阶段的地史演化过程，是一本全面综合和深入研究本地区沉积盖层及其地史演化的专著。根据地质历史的发展顺序，全书共分四部分。

第一章至第三章由杨遐和编著，第四章由李善姬编著，第五章和第十章由王汝植编著，第六章由赵裕亭编著，第七章由何原相编著，第八章由陈继荣编著，第九章由佟正祥编著，第十一章至第十三章由徐星琪编著，第四部分由刘协章编著。王汝植负责了第一、第二部分的编纂工作。外文摘要分别由俞汝龙、邓明先、牛坤芳、刘协章编译。

在开展古生代专题研究期间，王树碑、钱泳蓁、江新胜、张克信等同志，以及成都地质学院段丽兰、时言和八一届部分毕业生参加了野外工作和室内化石鉴定工作。尤其需要说明的是，在编写过程中，本书参考和应用了许多未曾正式发表或公开发表的资料，如《西南地区地层总结》、《云贵川三省分别编写的断代总结》、《康滇地轴北段地层表》、以及区内有关的"区测报告"等。由于出版要求的规定，不能一一列出这些内刊资料，在此恳请有关作者谅解。

三叠系由饶荣标和王吉礼进行审阅，侏罗系由罗建宁审阅，他们均对有关部分提出了宝贵意见。

本书的第一部分至第三部分在定稿前由肖有钧副研究员进行审定，并提出了宝贵意见。第四部分先后请中国地质科学院北京地矿所李子舜和于箐珊同志、中国科学院南京地质古生物研究所陈竞华同志审定。遗迹化石蒙杨式溥教授、吴贤涛副教授指导，蠕虫类及宏观藻类的研究得到汪贵翔和阎永奎的帮助。

本书的插图由郭曼郎、杨俊清、吴剑、孙燕鸣等清绘，何军负责插图的植字，部分图版照相由王允年负责。

本书作者对曾给予研究工作支持、帮助和指导的上述人员表示深切谢意。

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The Covering Strata and Geohistoric Evolution in Xichang—Central Yunnan Region

Abstract

I The Sinian and Palaeozoic Stratigraphy and Geohistoric Evolution in Xichang—Central Yunnan

The Xichang—Central Yunnan region, from Kangding(north) to Yuanjiang (south), is bounded on east by a line of Leshan-Yanjin-Xuanwei-Qujing-Yiliang and on west by Lijiang area. It includes an area between 24°N and 30°N and between 100°E and 104°E.

The paper is part of the research project "Geological and Structural Feature and Its Control on Fe-Cu Metallogenesis in Xichang-Central Yunnan Region". A formation of sedimentary cover and a outline of geological development during Sinian-Permian times are discussed,on the basis of well-established sections and regional correlations.

Geotectonicly, the Xichang-Central Yunnan region was variously considered as "Kangdian Axis", "Kangdian Platform Uprises","Kangdian Anteclise", "Sichuan-Yunnan Meridional Structural System" or "Panxi Continental Palaeo-Rift". It is certainly a specific geotectonic unit, although various opinions on its geotectonic affinity. It is suggested that expressions of uplifted "Kangdian Axis" in various geological periods was a change, which had a close relationship with a change of palaeogeographical outline and sedimentary condition in this region. The uplifted north-south trending Kangdian axis had a greater influence on sedimentary processes of both eastern and western sides. As table 8-1 indicated, a distribution area of Sinian—Ordovician strata increases from west to east, and the stratigraphical section of eastern part is more complete than that of western part. For Silurian—Permian sequence, the central part of Kangdian axis is poorer development than both eastern and western sides, and the northern part poorer than the southern part.

Generally, it is divided into three sedimentary stages, Sinian—Ordovician,

Silurian—Carboniferous and Permian stages.

1. Late Sinian—Ordovician Large-scale Transgression-Regression and First Formation of Kangdian Oldland

The Lower Sinian consists of continental-facies sediments filled in two N-S trending downfaulted basins associated with a continental rifting. The widespread Late Sinian transgression has resulted in a formation of stable marine-facies sediments, which were overlapped on various levels of Lieguliu, Nantuo, Chengjiang Formations and Pre-Sinian Huili (Kunyang) Group. The lower part of Upper Sinian, Guanyinya Formation, includes a fining-upward transgressional sequence, from clastics and clay rocks changing into carbonates. The overlying No. 1-2 members of Dengying Formation is simply shallow-water facies limestones and dolomites, and lithological feature may be correlated in lateral direction, indicating a sedimentary condition of more stable carbonate platform. The distribution of No.3 member decreases, and argillaceous or dolomitic limestones and phosphoric dolomites intercalated with clay shales and phosphorites occurred, suggesting a marine regression after the maximum transgression of early-middle Dengying time.

The lower part of Cambrian is predominated by sandstones, siltstones and sandy shales, which is upward changed into banded argillaceous limestones and dolomitic limestones with sandstones or shales. Finally, Upper Cambrian is characterized by dolomites, argillaceous dolomites or dolomitic limestones. A major transgression-regression sedimentary cycle may be generally established. Laterally, to the west of Xichang-Huili area, there only are Qiongzhusi and Canglangpu Formations. In Kunming, Yiliang and Malong areas, no post-Shuanglongtan Formation is found. A well-developed section occurred in eastern area. A stratigraphical development shows a increasing trend from west to east and from south to north. The increase of early Cambrian sedimentary area and the decrease of late Cambrian one are a response to a extensive vertical move ment of crust. With this widespread transgression, marine invertebrates was becoming more thriving. In Kunming and its adjacent area, well-developed arthropods are represented by trilobites, which is characteristic of North China-type fauna (Oreintal realm). To west of Xichang-Huili area, the limited trilobites are known from Huaping and Ninglang. The above fauna distribution indicates also different sedimentary environment.

Immediately after the Cambrian, except for Emei and Ebian located at northeastern limit of Xichang-Central Yunnan region, the rest area has been uplifted and changed into a land. During Middle Ordovician, marine waters of westward transgression crossed over Huili and Miyi, through to the southern part of western area, and was connected with marine waters in Bar Har-Qinglng and Eastern Tibet-Western Yunnan areas. Central-Yunnan oldland has reduced the scope and has moved back to the south of Yongren-Kunming line. A ssmall oldland remaining between Kangding and Xichang, named Kangding-Xichang Island, has been surrounded by marine waters. Main clastic sediments of early Middle Ordovician have thickened from east to west. The sedimentary feature of late Middle Ordovician made a distiction between western and eastern areas. During Late Ordovician, dolomites and dolomitic limestones were deposited in eastern area (Ninnan and Qiaojia), i.e., the Baota, the Jiancaogou and the Wufeng Formations. There only is an incomplete section in western area.

From Late Sinian to Ordovician, three cycles of transgression and regression may be established. First two cycles have been terminated with large-scale uplift of western area. Third cycle has resulted in a first formation of Kangdian oldland generated by the unity of Kangding-Xichang island with Central -Yunnan oldland. Then, there was no direct connection between eastern and western sedimentary provinces.

2. Development of Kangdian Oldland and Sedimentary Differentiation of Both Sides During Silurian-Carboniferous Times

In early Early Silurian time, the Longmaxi Formation, consisting of slaty siliceous rocks, carbonaceous shales, marls or siliceous siltstones, was deposited in western area, and the highest biozone is *Spirograptus turriculatus* Zone. In eastern area, the equivalent layers mainly is argillaceous or carbonaceous shales, and the highest biozone is *Monograptus sedgwicki* zone. from late Early Silurian to Late Silurian, a well-developea section in the southern part of western area is predominated by carbonates, only producing rare conodonts. However, an incomplete section in eastern area is characterized by limestones, sandstones and mudstones, bearing a variety of fossils, such as corals, brachiopods, cephalopods, gastropods, trilobites and rare graptolites. It must be emphasized that from Middle Silurianonward, Chengdu and Central Guizhou

oldlands expanded outward and connected with Kangdian oldland on the west and occupied main scope of Upper Yangzi Sea on the east, leading to southward transfering of marine water.On the other hand, the original Yunnan-Guizhou oldland has been transformed from a terrigeneous provenance into a new sea area, as indicated by late Middle Silurian and Late Silurian sediments directly overlapping on Cambrian strata in Qujing and adjacent area. While, an area previously accepted sediments has successively appeared hiatus, as evidented by a lack of upper part in Silurian section. It can be seen that the crustal movement during Silurian time may be a major phase of Caledonian tectonic stage. A crustal activity of eastern area was more intensive than that of western area.

In Devonian and Carboniferous times, there still are both eastern and western sedimentary provinces separated by Kangdian oldland. The sedimentary scope was no obvious change. The observed stratigraphical distribution and lithofacies change show they have been often associated with faulting activities, though an influence of vertical movement and transgression-regression on sedimentations. This is a new nature of Devonian and Carboniferous sedimentary history.

In the eastern area, Devonian section is incomplete, with frequent hiatus and alternation of marine-facies and alternating marine-continental facies sediments, suggesting a frequency of vertical movement. The Devonian sequence is generally found in an area to east of Puxionghe, Zemuhe and Wuding-Luoci Faults, to west of Zhaojue Fault and to south of Lianhuashan Fault, consisting of sandstones, shales, mudstones and knotty limestones and producing fossils of corals, brachiopods, pelecypods, trilobites, fishes and plants. The Carboniferous distribution is similar to the Devonian one, although no sediments are found between Puxionghe and Zhaojue Faults. The Lower Carboniferous is predominated by limestones intercalated with shales or coal-beds (Jiusi Member). The well-developed Middle-Upper Carboniferous is mainly carbonates, bearing abundant fossils, such as fusulinids and corals.

In the western province, more perfect Devonian section is known between Qinghe and Chenghai Faults, which is a conformable contact with the underlying Silurian strata. When Middle Devonian transgression spreaded, sedimentation has also occurred in some places to east of Qinghe Fault. There is possibly Late Devonian hiatus to west of Chenghai Fault. The Devonian of this province consists mainly of carbonates, containing more siliceous components, parti-

cularly siliceous rocks and slates or siliceous limestones in the western flank. The fauna is prodominately conodonts and *tentaculites*, though corals and brachiopods often found in the lower series. The Carboniferous, lacking basal level, has begun with the Daitang stage, and is characterized by thick carbonates. In Waluo area, Yibian, the Middle and Upper Carboniferous contains very abundant fossils, such as brachiopods, fusulinids, corals, gastropods, cephalopods and conodonts. Three formations, the Daitang(Lower), the Weinin (Middle) and the Maping(Upper), are established in Waluo section, Yibian, correspondingly with three fossil assemblage zones. Westward to Ninlang area, the fauna is represented by some fusulinids and brachiopods.

In short, from Silurian to Carboniferous, both western and eastern sedimentary provinces were separated by N-S trending Kangdian oldland, which have experienced different sedimentary history. Faulting was greater influence on sedimentation and stratigraphical development, which is a difference from simple transgression-regression processes during Late Sinian-Ordovician times.

3. Extensive Permian Transgression and Change of Kangdian Oldland

With an extensive transgression in early Permian time, a palaeogeographical outline and sea-continent arragement in this region have been changed again, showing an abrupt turn in the palaeozoic geohistory. This transgression has led the oldland occurred since the Silurian to submerge again, and sea waters crossing Kangdian oldland have extended through to the western area. This palaeogeographical change, though similar to the palaeogeographical outline caused by Middle Ordovician transgression, has resulted from faulting activities.

The early Permian transgression has brought a blanket of carbonates to overlap on the different underlying levels in this region. In some places, basal Permian, generally named Liangshan Member, consists of a sequence of clay sediments and occasionally coal-seam or coal-bed, as a result of the original relief intensity.

From late Early Permian to Late permian, in Yiyuan-Eryuan, Kunming-Huili and Emei-Ebian areas, volcanic activity occurred and generated marine- or continental-facies basalts. At the same time, the central part of original Kangdian oldland has accepted continental facies sediments, which, to both sides, has gradually passed through alternating marine-continental facies and marine facies sediments. In Lugu Lake, Ninlang, Late Permian sequence consists