西昌——滇中地区地质矿产科研丛书

康滇构造与裂谷作用

地质矿产部成都地质矿产研究所

重庆出版社

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内 容 提 要

本书系统研究康滇地区的地质构造，阐述裂谷作用与造山作用多旋回发展的基本规律；以丰富的构造学、地层学、沉积学、岩石学、地球化学、地球物理学资料论述早前寒武纪绿岩型裂谷、中元古代盐边—峨边陆间裂谷、晚元古代东川—易门拗拉槽和康滇陆缘弧带、晚震旦世石棉—澄江后造山裂谷、中生代康滇古大陆裂谷及新生代走滑—拉张盆地的地质构造特征及其演化规律；对地震、扬子地台的形成、泛扬子地块、康滇台背斜及其两侧凹(拗)陷、造山运动等问题作了概述。本书可供各专业的地质人员在科研、教学和生产实践中参考。

全书插图214个，表69个，图版16版。

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20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，又在尊重各学科及"双百方针"指引下，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，划分出三个沉积发展阶段，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，并由此引伸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"，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，重熔花岗岩带和幔源型碱性花岗岩带。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日—6月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，研究员路兆治等以及同行专家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，将分别按地史演化、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

本书以裂谷作用为主线，研究康滇地区裂谷作用与造山作用多旋回发展的地质历史及大地构造演变，共划分出五大裂谷时期，阐述了各个时期的裂谷性质、地质特征、演化规律以及构造带的空间展布。全书分九章，第三、八章的岩浆活动部分由赵济湘编写，其余部分由潘杏南撰写。

康滇地区是我国地质队伍积集区，地质力量雄厚，积累的地质资料异常丰富。成都地质矿产研究所自建所以来，一直以本区作为重点研究地区，投入了大量的科研力量，作者也一直在这里从事构造地质研究工作。研究课题建立后，作者有针对性地进行了四次、八个月的野外考察工作，采集了一千余件标本作室内研究。本书积作者二十余年的资料和经验，兼蓄并收前人的成果和丰富资料，以世界典型裂谷作借鉴，经过综合研究撰写而成。国际前寒武纪地壳演化讨论会以及深部过程和大陆裂谷国际学术讨论会所提供的学术思想和成果对本书有所影响。

在野外、室内研究及本书的成文过程中，我们得到了所内外同事的帮助和指导。刘浮然研究员、申屠保勇工程师等热情指导并帮助鉴定了部分岩石薄片，周国富工程师承担了重矿物鉴定，张选阳工程师对稀土元素作了计算机处理，翻译了英语摘要和图、表名称，许多同行为本书提供了资料，成都地质矿产研究所绘图室、化验室、编辑组、照相室、磨片室等专业人员均为本书付出了辛勤劳动。在此，表示深切的谢意。

由于作者知识范围有限，对裂谷理论猎涉不深，加之撰稿时间紧迫，不足和错误之处，敬请广大读者斧正。

目　　录

CONTENTS

TECTONICS AND RIFTING IN KANGDIAN REGION

(Abstracts)

The crustal rifting due to planetary extension and orogeny due to compression are the melody of the tectonic evolution for the Earth crust. At the same geological period, the regularly distributed rift zones and the associated basins combined with the folded mountain ranges constitute the global tectonic frame. At the same region the multicycled alternation of rifting and orogeny determines the tectonic evolution of the region. In this book, the fundamental rules control the multicycled developement of the rifting and orogeny and the basic features of different rift systems are illstrated with the tectonic evolution of Kangdian region as a concrete example.

Kangdian region is one of the typical multicycling developement. It has undergone at least 5 cycles.

1. The Early Pre-Cambrian greenstone rift cycle. During Early Proterozoic (possibly Late Archaen), a seqnence of greenstone belt was developed, namely the Kangding group(2000Ma), the lower part being mafic lavas of great thickness, the upper part being composed of greywacks and volcanics. They were formed under greenstone-type rift environment when the crust were rather thin and heat flow was rather high. Under the high temparture, there were formed small but densy convection cell in the upper mantle, which splitted the crust into small plates and the heat extrusions sprang up from the ruptures(rifts) to form the mafic lave accumulations.

In Kangdian region, the particular mini-plate underwent a transitional stage between active and rigidity stages. The Lixi group of the Late Early-Proterozoic is composed of volcanic-sediments (spilite-keratophyre interbeded with flyschoid sediments)as its lower part, flysch-like sediments as its middle part and island-arc type volcanics combined with debris flow sediments as its upper part.

The transition should be as follows: The inter-pushed and intercollided mini-plates were warped down under the drag of the down current in convection cell and trough formed with the lower part of Lixi group deposited. As the large release of the heat, suturing of the mini-plates, slowing down of the mantle convection and enlargement of the volume of convection cell, the down-warpment (subduction) was hindered and the trough was filled. Then the isostasy were causing the crust here (with thickest sediments and maximum thickness of the crust) rising. The cooling mini-plate with increasing rigidity began to be rupted at the awside of the thick crust and subduction similar to that of modern plate tectonics began, hence forming an island-arc environment the upper part of Lixi group being deposited. The strong Xiaoguanhe movement (1700Ma) at last completed the transformation to the rigid plate, and the Chuandian continent were formed.

2. The middle proterozoic intercontinental-rift cycle. Chuandian continents is the core of the Yangtze plateform, it is located at the back of a trench-arc-basin system, and was itself dissected by E-W trending Yanbian-Ebian rift into two parts (fig. 4-1).

The Yanbian group is composed of the mafic cumulates, pillow lavas with chert interbeds and intruding diabase, slate (carbonaceous, siliceous) and turbidite, olistostrome, which is typical for an eugeosyncline (fig. 4-2). But the ophiolite suite in Yanbian group is different from those representing oceanic crust, it belongs to a primitive oceanic crust, during the eanly stage of spliting of continent, similar to the setting of Red sea at its early stage.

Yanbian ophiolite is located to the north of the Early Pre-Cambrian crystalline basement, conjuncted with the Kangding group with a fault. The main members of the ophiolite are mafic cumulates, diabase and basalt with an important member (for a standard suite) being absent; There were no diabase dykes or sheets, no chert sequence; the diabase dyke occurring as small intrusions scattered in the basalts, and the chert occurring as interbeds at the top of a volcanic cycle.

The figures and tables in the book of the association and lithochemistry for comparison of the Yanbian ophiolite and Red sea ophiolite show the similarity between the two. Yanbian basalt belongs to alkalinic tholeiite, with Rittmann index (CA) averaging at 3.4; compared with MORB, it has obviously higher amount of TiO_2(1.65—2.85%, average 2.16%), 〈FeO〉 (9.04—15.65%, average 12.85%) and K_2O (0.18—1.84% average 0.6%), and lower amount of CaO (2.19—13.38%, average 9.0%), MgO(1.76—8.9%, average 5.69%) and higher 〈FeO〉/MgO and Fe_2O_3/FeO; In the Pearce's discrimimant diagram, its composition plot in the intra-plate basalt area.

The REE concentration of the Yanbian ophiolite belongs to Light-REE-enrichment type (fig. 4-12), compared with the typical ophiolite suite, it has ΣREE, LREE/HREE and La/Yb several to dozens times higher. As for other trace elements, it is characterised by its high content of Ba, Rb, Th, Hf, and low content of Ni, Cr, Sc(table 4-4).

The Yanbian paleorift was seperated from Huili-Yuanmou miogeosyncline by the Tongde horst. The configuration of three may be mistaken as a trench-arc-basin system. In fact, they were different tectonically. Tongde horst was a fault-blocked horst of only dozens Km width, composed of Kangding group, which was the main source land for the Yanbian group. Judging from the volcanic—turbidites in the Yanbian basin and the rhyolite sequence along the slope between basin and horst, there happened intermediate-acidic volcanism on the horst. The above-mentioned slope had a width of only abont ten Km, much narrower than the continental slope. The Huili-Yuanmon miogeosyncline was a rift-related fault-depressed basin, within which accumnlated huge terrigenous clastics and carbonates, with weak volcanism (with some alkaline basalt interbeds in the lower part and dacite-rhyolite in the upper part).

The Yanbian-Ebian intercontinental rift system was transformed into a fold belt during Donchuan movement (1200Ma), with mainly E-W trending linear folding and without nappes of Alpine type. The Yanbian group was in contact with Kangding group with a fanlt, and the mafic cumnlates being obducted on the Kangding group, but here no suture zone observed. The stratigraphycal seqnence of Yanbian group is rather complete, the axial planes of the folds being vertical with steep-dipped cleavage and schistosity. The metamorphism is rather low grade, usually low green schist facies, except near obduction zone, where the dynamic metamorphism causing a high greenschist facies developed. The intensity of the deformation and metamorphism is related to the energy of the orogeny, which in turn is positively related to the size of the intercontinental rift. The strength of the Dongchuan movement corresponded to the size of the rift, which could not intensively desform the Kunyang group in central Yunlan.

3. Late Proterozoic cycle. A NNE trending Dongchuan-Yimen aulacogen was formed in the early stage, which was small-scaled asymetric fault-depressed trough, with a paleo-continent to the west and a land of dozens Km width of low relief to the east to seperate the SE sea. The land was submerged under sea water from time to time, with no sediment being preserved. The trough was controlled by normal faults, and was filled with about 5000m strata of the Dongchuan group, the Dongchuan layered copper deposits being in the strata. The whole sediments of Dongchuan group constitute a Transgression-regression cycle. The olistostrome-like breccia and shallow-water turbidite in the lower part of the Yingming fm. were associated with the syndepositional faulting. The magmatism in the anlacogen was not intensive, mainly represented by the intrusion of diabase and gabbro sills and dykes accompanying the extension and by the central eruption volcanism. The volcanics were scattered both horizontally and vertically, with alkaline basalt as the early representatives and rhyolite as the late one, forming a bimodal distribution. The volcanics was mainly volcanical clastics (tuff), lavas being little developed.

The Manyinqou movement(970Ma) caused the trough closed with no intensive folding. Later on, the trough transformed into a down-warped depression—basin, then filled with the terrigenous clastics of the Dayingpang fm. At this late stage, some important events happened to the west of the basin, the western margin of the Yangtze platform developed into a arc zone of continental margin (fig. 5—1).

The Kangdian continent-marginal arc zone could be divided into three belts: Axial belt, mainly the Kangding group crystaline terrain, the upper part of axial belt being erosed away. Kangding group has undergone intensive reconstruction of tectonic-magmatism, forming complicated migmatisation zone, hence we call this axial belt Kangding-Xingping tectonic-magmatic reconstruction belt. To the front of the axial belt was an eugeosyncline belt composed of island-arc volcanics and sediments. The volcanics, mainly intermediate-acidic, was dominated with volcanical clastics. To the back of the axial belt is the remelting granite belt

The axial migmatic granite was seperated from the back-marginal magmatic granit by the Anninghe river fault zone and Luzhijiang river fault zone, but to the south of the Dukou, where the axial uprise was relatively weak, the two