

西昌——滇中地区地质矿产科研丛书

西昌—滇中地区 磁铁矿特征 及其矿床成因



地质矿产部成都地质矿产研究所

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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。该区系我国具有特色的地质构造单元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，目前已成为我国初具规模的、以冶金工业为主的重要工业基地。

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，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办法，理清了主要地质事件，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，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幔熔融的产物。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7个构造成矿带，对钨钛磁铁矿、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所控制，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、研究员程裕洪，学部委员、教授王鸿祯，研究员路兆洽以及同行专家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，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，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、前震旦纪、古生代、中生代、花岗岩、变质岩、基性超基性岩以及铜铁矿床等专题，分为13个分册，辑成《西昌—滇中地区地质矿产科研》丛书陆续出版。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

西昌—滇中地区富铁矿分布很广，许多地质勘探部门、科研单位及地质院校都进行了大量工作，取得了丰富的地质资料，对于这些矿床的成因问题提出了很多有价值的观点。本专题此次研究工作，主要是以矿床地质条件为基础，从矿石学及成因矿物学的角度，研究磁铁矿石的成分、组构、产状、磁铁矿物的物理化学特征及其铁矿的发生、发展和变化规律，从而推断矿床成因及成矿条件。

近年来国内外很多学者，运用矿石学、成因矿物学的理论，研究铁矿床成因取得了较为明显的效果，解决了一些疑难矿床的成因问题。为了使研究工作取得较好的效果，着重根据西昌—滇中地区地质条件和富铁矿床的分布特点，选择了四川盐源矿山梁子、冕宁泸沽铁矿山及大顶山、会理毛姑坝小黑箐及通安新铺子、云南武定迤纳厂以及云南罗茨鹤头厂等七个富铁矿床进行研究。通过矿石的结构构造、矿物共生组合、磁铁矿物的物理化学特征的研究，结合矿床地质条件，对七个矿床分别提出了热液交代成因和火山喷发沉积热液叠加成矿的观点。本书即在此科研成果的基础上，经补充、归纳整理而成。

研究工作由杨时惠、阙梅英二同志担任。其中，鹤头厂及新铺子二矿区由阙梅英进行研究，并担任了本书第五章的编写；其余五矿区由杨时惠进行研究，并担任前言、第一、二、三、四、六章以及结束语编写。

在研究工作过程中，曾得到成都地质矿产研究所路兆洽、刘俨然研究员的帮助与指导。四川省地质矿产局攀西大队一分队以及昆明钢铁公司地质队也给予了大力支持，并提供了一些基础资料。文中的绝大多数化学分析数据及电子探针测试数据，由我所化验室及电子探针室测定。此外，选矿、磨片、照像、复印等单位也给予了大力支持和协助。文中附图由我所九室清绘。对以上同志及单位的支持和帮助，均在此表示感谢。

由于作者水平有限，文中可能存在不少缺点和错误，望读者批评指正。

作者

1986年7月

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MINERALOGICAL CHARACTERISTICS OF MAGNETITE FROM PAY IRON DEPOSITS AND THE GENESIS OF THE DEPOSITS

(Abstracts)

Pay magnetite deposits are widely dispersed over Xichang-Central Yunnan region. The main deposits are Tiekuangshan, and Dadingshan, Lugu, Mianning, Kuangshanliangzi, Yanyuan, Xiaobeiging, Maoguba, Huili, Xinpuzi, Tongan, Huili, Etouchang, Lugu, Yunnan, Yinachang, Wuding, Yunnan, from north to south. On the basis of the association with magmatic rocks they may be divided into four types:

I. Deposit associated with ultrabasic-basic rocks—Kuangshanliangzi magnetite deposit. The deposit is confined to Permian limestone and basalt or to the contact of the limestone with picrite and diabase. The orebodies occur as stratoid, lenticular, wedged and irregular forms. The more replacement remnants of the limestone, picrite and basalt have remained in the ore bodies. The wall rocks were subjected to chloritization, magnetitization, carbonatization and so on. The main ore minerals are magnetite, siderite, pyrite, the main vein minerals are calcite, apatite, chlorite and phlogopite, olivine, barite, etc. The main textures are metasomatic relict texture and colloidal texture.

The magnetite has complicated shapes. In addition to euhedral-hypidiomorphic crystals, it exists as laths, big round grains, colloform, hexagon (the pseudomorph after olivine), irregular and isogranular round grains. The magnetite contains commonly very fine inclusions that have the sizes ranging from 1 to 10 μm and are arranged along the cleavage. The inclusions have complicated shapes

and are composed mainly of Mg, Cr, Si, Ca, etc., having the composition corresponding to that of minerals replaced. The typochemical composition of the magnetite is as follows (%): TiO_2 0.01-0.43, V_2O_5 0.05-0.07, MgO 0.29-5.6, Al_2O_3 0.04-0.86, MnO 0.037-0.22. Hardness 460-620kg/mm², specific gravity 4.74-5.08, reflectivity 18.96-20.84%. Cell parameter 8.392-8.397. The infrareds absorption spectroscopy of the magnetite has the stable frequency range ranging from 565 to 570cm⁻¹. Molecular number of FeO ranges from 0.36 to 0.39 and molecular number of Fe₂O₃ ranges from 0.43 to 0.46.

Oxygen isotope composition of the magnetite ranges from +8.6 to +10.3‰. Being similar to that (+7-+9.5‰) of initial magmatic water. Oxygen isotope composition of the siderite ranges from +15.35 to +17.92‰ corresponding to that (+12.6-+21.9‰) of a hydrothermal metasomatic siderite.

Above mentioned geological characteristics of the deposit and mineralogical features of the magnetite indicate that the magnetite deposit is a hydrothermal metasomatic deposit. Mineralization temperature of the magnetite is estimated at 325°-390°C up to 420°C by decrepitation method, Mineralization temperature of the siderite—at 315°-370°C

II Deposit associated with albite aplite—Yinchang copper-bearing magnetite deposit. The deposit is confined to Pre-sinian. The host rocks are dolomites, silty and argillo-arenaceous dolomites in the west, muscovite- and biotiteschists with a lens of calcic rock in the east. The albite aplite in the south and southwest of the mining area contains higher Nb and TR. The orebodies occur as lenticular and stratoid forms and expand or pinch along the strike and pinch out and recur along the dip. The replacement remnants of the wall rocks have remained in the orebodies. The wall rock were subjected to biotitization, magnetitization, carbonatization, albitization and fluoritization. The minerals in the ore are magnetite, siderite, chalcopyrite, torrelite, bastnasite as well as pyrite, glance cobalt, molybdenite, quartz, carbonates, phosphates, silicates. Kind of minerals amounts to 35. The ore has metasomatic relict texture, euhedral-hypidiomorphic granular mosaic texture, massive and riband-banded structures.

The magnetite occurs as euhedral-hypidiomorphic granular, dustlike, irregular vein-like, round granular (pseudomorph after fluorite) forms, Quartz, apatite, fluorite, biotite, etc. were replaced commonly by the magnetite which was replaced by veinlet magnetite, chalcopyrite, hematite, pyrite and carbonates. The magnetite contains commonly the fine inclusions which are arranged along

the cleavage or have a zonal distribution. The sizes of the inclusions vary greatly and the greatest is up to 2-3 μ m. And there are many finer impregnated inclusions between or in the coarser inclusions. The inclusions exist as prisms, lenticles, round grains and irregular relicts and consist mainly of Si, Al, secondly of K, Mg, Ca. These inclusions were absorbed on the crystal faces during the crystallization of the magnetite. The magnetite contains Nb₂O₅ 0.007-0.034%, Ta₂O₅ 0.001-0.008%, TR₂O₃ 0.01-0.025%, higher Fe, and Co, Ni, Cu, etc. as well. Specific gravity 4.79-5. Cell parameter 8.393-8.398. Reflectivity 16.83-19.04%. Hardness 464-541 kg/mm². The infra-red absorption spectroscopy has the stable frequency range ranging from 567-570Cm⁻¹.

The shapes and occurrences of the orebodies, the strong wall rock alteration, the interrelation between minerals, the dustlike inclusions replaced by the magnetite in magnetite crystals and the finer inclusions in the coarser inclusions as well indicate that the deposit is a hydrothermal metasomatic deposit.

Ⅲ. Magnetite deposits associated with granite—Tiekuangshan and Dadingshan deposits, Mianning, Xiaohaiqing deposit, Huili.

Three deposits nearby which Lugu, Changtang granite masses in Jinning period are located are confined to Presinian metaquartzsandstone or carbonate rocks. The orebodies occur as lenticular, stratoid or irregular forms. The wall rocks were subjected to more strongly alteration, principally, to biotitization, magnetitization, or serpentinization, carbonatization. Relicts of the wall rocks have remained in the orebodies. Mineral composition of the ores is simple. The main minerals are magnetite or pseudomorphic hematite, hematite, quartz, biotite, euchlorite, apatite or serpentine, talc, etc. exist in small amounts. The ores have metasomatic relict and granular mosaic textures, massive structure, in addition, laminated and breccia structures inherent in the wall rocks.

The magnetite is characterized by euhedral-hypidiomorphic crystal, individually, by the pseudomorphism after a radiating amphibole. The magnetite contains fine inclusions which are arranged along the cleavage or have a zonal distribution. The inclusions exist as round granular and lenticular forms. The magnetite in the host rock as dolomitic marble contains MgO 2.16-2.88%, MnO 1.84-2.55%. The cell parameters 8.403-8.406. Reflectivity 17.65-19.10%. The magnetite in the host rock as metaquartzsandstone contains lower MgO, MnO. The cell edge long is near to that of pure magnetite slightly prior to the ore-forming processes of this three deposits.