

中国科学院地质研究所

# 地质科研成果选集

(第一集)

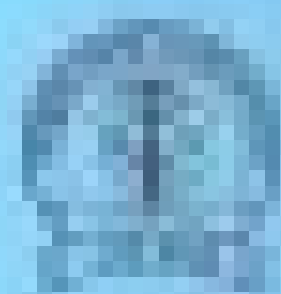


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# 物理实验教程

（第一版）

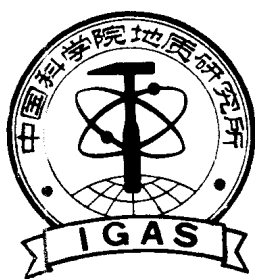


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中国科学院地质研究所

# 地质科研成果选集

(第一集)



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INSTITUTE OF GEOLOGY, ACADEMIA SINICA

RESEARCH ON GEOLOGY  
( I )



CULTURAL RELICS PUBLISHING HOUSE

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## 内 容 提 要

本选集是中国科学院地质研究所近两年来的部份科研成果。为纪念中国地质学会成立六十周年选编了包括大地构造学、地层学、沉积学、工程地质学、第四纪地质学、岩石学、矿物学、同位素地质学、地热学、数学地质学和矿物岩石化学分析的论文五十八篇。本选集内容丰富，它涉及到地质科学的大部份领域，可供从事地质生产、科研人员以及大专院校师生参考。

### 地 质 科 研 成 果 选 集

中国科学院地质研究所编著

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庆祝中国地契  
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十周年

張文佑題

# 前言

中国地质学会是我国成立最早的自然科学学会之一。在中国地质学会成立六十周年之际,我们谨向全国为地质勘探、地质科学研究及地质教育事业作出贡献的广大地质工作者致以热烈的祝贺!谨将本选集献给中国地质学会,并借这个机会向曾给予我所指导、支持和帮助的国内外地质工作者表示衷心的感谢。

六十年来,特别是新中国成立以后的三十二年来,中国地质学会为我国地质科学事业的大发展作出了重大贡献。作为我国地质科学研究的一支基本队伍,作为中国地质学会的一个积极成员,我们地质研究所在中国科学院的领导下,在中国地质事业的繁荣和发展中,如同其它单位一样,也取得了很大的发展。在这大喜的日子里,回顾过去,展望未来,总结经验,对加速地质科学事业的发展,是很有意义的。

中国科学院地质研究所是我国最老的地质研究机构之一。它是在解放前的中央研究院地质研究所,经济部地质调查所和资源委员会矿产测勘处调整后的基础上建立的。三十年来,我所先后分建了兰州地质室(即今兰州地质研究所),贵阳地球化学研究所和国家地震局地质研究所。它为我国生产、科研和教育部门输送了一大批地质科技干部,为我国地质科研队伍的建立和发展作出了一定的贡献。

现今的中国科学院地质研究所拥有职工450人,科技人员350人,包括中级以上科技人员250人,其中研究员十一人,副研究员和高级工程师三十四人。它是一个以研究地质科学基础理论为主的综合性地质研究机构,

包括矿物学、岩石学、地层学、大地构造学和构造物理学、沉积学、同位素地质学、工程地质力学、第四纪地质学、前寒武纪地质学、地热学、数学地质学、地磁学、遥感地质和岩溶学诸学科以及化学和物理分析专业。

在我国政府和中国共产党的科技政策和方针的指导下,在兄弟单位的支持和协作下,由于学科间彼此渗透和密切配合以及研究方法和技术的不断更新,我所在地质学基本理论以及与国民经济建设密切有关的重大课题的研究上,取得了一些成绩,并对我国地质科学的发展起到了一定的推动作用。

我所编绘了我国第一张1:800万和1:400万大地构造图及说明书,最近又与兄弟单位合作新编了中国及邻区海陆大地构造图。对中国东部中-新生代地质构造特征和华北断块区的形成和发展作了系统的综合研究。开展了空白和边远地区,特别是祁连山和青藏高原的综合地质考察,为这些地区的地质工作打下了良好的基础。在大量的地质和地球物理实际资料基础上,运用地质力学与地质历史相结合的方法提出了断块构造假说,在石油勘探中提出了“定注探边”的观点,同时为煤田、金属和非金属矿产的普查和预测、为地震危险区划分和工程建设提供了科学依据。这一学说正受到国内外的重视。

我所主编了中国区域地层表(草案),起草了中国地层规范草案及说明书,首编了中国地层典(石炭系),起草了以多重地层概念为指导的中国地层指南及说明书,推动了我国理论地质学的发展。

我所对我国锰、磷、铁等沉积矿床进行

了较系统的研究,总结了沉积矿床形成和变化规律,提出了“陆源吸取成矿论”,出版了中国第一套古地理图;引进并结合现代碳酸岩岩石学及沉积相环境分析理论,系统总结了华北地区的沉积建造;开展了化石岩石学和化学地史学的研究;将浊流沉积和潮汐沉积等理论用于沉积盆地分析,并结合火山岩系研究确定了元古代豫陕裂陷槽和下辽河平原——渤海裂谷盆地。

在我所建立了我国第一个同位素地质实验室;开展放射性同位素和稳定同位素地质研究;较早地建立了我国古老地质年龄和最新地质年龄的测定技术。为我国许多重要的地层、岩体和成矿期,提供了同位素地质年龄方面的基础数据。

我们在水文工程地质领域方面做过许多工作,尤其是干旱区水文地质研究和旱涝盐碱地区的井灌井排水文地质研究,取得了有实用价值的成果。系统地总结了我国岩溶发育规律,出版了“中国岩溶的研究”专著。在岩体结构形成过程及其特征研究的基础上,应用地质和力学结合的分析方法,探索了地质体结构对工程稳定性的影响和岩体结构的力学效应,为我国水电、交通、矿山和国防等许多重大建设工程项目的安全可靠和经济合理提供了科学依据,建立了新的分支学科——工程地质力学,对我国工程地质学的发展起了推动作用。

我所曾首先提倡并在我国开展了稀有金属(锂、铍、铌、钽)及稀土元素的矿物学和矿床成因的系统研究,填补了我国在稀有元素地球化学的空白领域,提出研究核子地质学的设想。

为了寻找急需的某些金属矿床,我们较全面地研究过中国基性、超基性和碱性岩的岩石学、矿物学和成矿专属性。近年来为了研究岩石圈的组成、结构和演化,着重研究了中生代火山岩、深源岩石(玄武岩、金伯利岩及其超镁铁质岩包体、蛇绿岩套、镁绿

岩)的成因岩石学,以及岩石组合与大地构造的关系。从成因观点编制了我国第一张超基性岩分布图,并从变质岩的物质来源和温度-压力平衡条件两方面着手,探讨变质相系,变质热史以及地壳演化的规律,一个新的分支学科——岩石大地构造学正在逐渐形成。

在结晶学和矿物学方面,我所在低压条件下成功地生长了水晶,为我国材料科学作出了贡献;发现了许多新矿物,编写了若干地区的矿物志;开展了“结构光性矿物学”新方向的研究;近几年来还积极地展开了矿物波谱学研究;为在我国进行现代矿物学研究创造了一些条件。为了解决国民经济的某些实际问题,我所还开展了工艺岩石学和工业矿物学的研究,例如,铸石学及沸石和粘土矿物学研究,特别是我国第一个沸石矿床的发现,取得了许多有显著经济效益的成果。

中国的黄土是我国第四纪地质的一个重要课题,我们研究所首先全面地研究中国黄土的分布规律、结构特征、物质成分和成因,出版了一系列专著,为黄土区的农田、水利和工程建设提供了科学依据;同时开展了第四纪地层、年代、古气候、古环境和新构造等研究;这些研究成果在国内外产生了良好的影响。

在地球物理学方面,中国科学院地质研究所是最早开展古地磁,大地电磁测深和地热研究的单位之一,特别是近年来,我们提供了我国第一批大地热流的数据,最近将发表一批新数据,系统地研究了华北地区的地温场,在国内首先开展了矿山热害的研究,并建立了国内第一个地热实验室。

在国内,我们首先引入了数学地质的研究方法,建立了数学地质的研究组,在矿产预测、地层划分对比,以及地质制图和地球动力学的模拟等方法都取得一些可喜的成果。

为了配合地质研究工作,我们对岩石和矿物的化学分析给了很大的重视。我所首先提出硅酸盐快速全分析以及某些稀有元素和



放射性元素的化学分析方法,对我国的地质实验室的化学分析工作起到一定的推动作用。

在中国地质学会成立六十周年的时候,我们回顾自己研究所的发展,深深地感到,取得这些成绩是与党对地质事业的领导分不开的,是与中国科学院对地学研究的重视分不开的,同时也是与全国各地地质科研、生产和教学单位的支持分不开的。

近十多年来,世界上地质学这门古老的科学经历了巨大的变革。由于学科间的彼此渗透和配合,实验技术的发展和创造,地质学研究已从定性描述向半定量甚至定量探讨方向发展。大量的矿物、岩石、地层、古生物以及地球化学资料的积累,各种地质作用的数学模拟和物理模拟,使地质科学研究领域大大地扩展,研究程度也日益深化。上天、入地、下海,既研究宏观现象,也研究微观现象,新

概念、新学说以及边缘科学不断涌现,使地质学以崭新的面貌耸立于科学之林。

中国的地质结构有中国的特点,中国地质科学的发展有中国自己的特色。以我为主,同时广集各家之长,各学科之长,各国科学之长,定能使我国地质科学取得更加迅速的发展。今后我们将同全国地质工作者一起,为发展我国地质勘探、地质科学和地质教育事业继续贡献自己的一份力量。希望国内外广大地质工作者对我们的科研工作给予关怀和帮助,提出批评和建议,以利于我们改进自己的科研工作。

张文佑(所长)

孙 枢(副所长)

孙玉科(副所长)

## Preface

The Geological Society of China (GSC) is one of the earliest societies of natural sciences in China. On the occasion of the 60th anniversary of its founding we wish to extend our warm congratulations to the geologists all over the country who have been making contributions to the cause of geological prospecting, research and education. We are cordially dedicating this Selection to the GSC while taking the opportunity to thank all the geologists both at home and abroad who have now and then offered invaluable guidance, support and help to us.

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During the six decades, especially the thirty two years after the founding of New China, the GSC has made its immense devotion to the development of the Chinese geological sciences. Under the leadership of the Academia Sinica, the Institute of Geology (IGAS) with the affiliated active members of the GSC, as an essential contingent among country's earth science research units, has also shared the great progress in prosperity and advancement of the Chinese geological undertakings. In such happy days to review the path we have gone through, to look forward to the future and to sum up the experiences accumulated would be extremely profitable for speeding up the development of the geological sciences.

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The present IGAS, being one of the oldest geological research institutions in China was rebuilt after liberation on the basis of readjusted and incorporated former Institute of Geology, Academia Sinica, the Geological Survey, Ministry of Economy, and the Mineral Exploration Bureau, National Resources Committee before liberation.

During the last three decades the Lanzhou Geological Division (present Lanzhou Institute of Geology), the Guiyang Institute of Geochemistry, Academia Sinica, and the Institute of Geology, State Bureau of Seismology had been separated successively from the IGAS. A large number of scientific and technological personnel specialized in geology has been infused from the institute to diverse production units, research and educational institutions, thus being certain contribution to the formation and growth of the ranks of geologists and related technical workers in our country.

The Institute is a multidisciplinary geological research institution dedicated mainly to research in the fundamental theories in geological science covering a wide range of subjects, such as mineralogy, petrology, stratigraphy, geotectonics, tectonophysics, sedimentology, isotope geology, engineering geomechanics, quaternary geology, Precambrian geology, geothermics, mathematical geology, palaeomagnetism, remote sensing geology, karstology etc, and specializations on chemical and physical analysis.

Under the guidance of the policy and guiding principle of our government and the CPC for science and technology, with the support and cooperation with the other related institutions, due to the interdisciplinary penetration and active interaction and the incessant renewal of the research methods and techniques, our institute has achieved some progress in seeking the basic theories in geology and investigation on some major research projects closely connected

with the national economy, thus, to a certain extent promoting the development of geosciences in China.

China's first geotectonic maps on scales of 1:8,000,000 and 1:4,000,000 and accompanying instructions were both compiled for the first time in the IGAS. Lately, in collaboration with the related institutions the compilation of the "Map of Marine and Continental Tectonics of China and Its Environs" has just been accomplished. In this institute a systematic synthetic study has been carried out on the characteristics of Mesozoic-Cenozoic geological structures in the eastern part of China, and the formation and evolution of the North China Fault Block Region. A comprehensive geological expedition program has been unfolded for years filling in the gaps in the geological survey of remote areas, such as the Chilian Mountains and the Chinghai-Tibet Plateau. As a result, a solid foundation has been laid for the further geological work for these regions. On the ground of a vast amount of geological and geophysical data, by the use of a combined method of geomechanics with geohistorical analysis, an innovative geotectonic hypothesis of fault block system has been proposed, which provides scientific basis for prospecting and predicting petroleum, coal, metal and non-metal ore deposits, for regional division of seismic risk zones, and for engineering constructions. To this hypothesis importance is now being attached both in China and out of it.

At the same time, our institute played a leading role in fabricating the Regional Stratigraphical Tables of China (draft), drawing up the Chinese Stratigraphical Code (draft) and the relevant direction. The IGAS had compiled for the first time the Dictionary of Stratigraphical Terms in China (the Carboniferous System) and drafted the Chinese Stratigraphical Guide and the instruction to it with the guidance of a multiple stratum concept. All this has given a boost to the development of theoretical stratigraphy in China.

A study here at the Institute on the sedimentary ore deposits, such as manganese, phosphor and iron has been launched rather systematically for the past years. As an ultimate result of summing up the laws of mineralization and evolution of sedimentary ore deposits, the theory of imbibition of terrestrial weathering products had been put forward. In the meantime notable events in this field included the publication of the first set of palaeogeographical maps, introduction and application of modern carbonate rock petrology and the advanced theory of environmental analysis of sedimentary phases, systematic summation of sedimentary formations of the North China, conducting research on fossil petrology and chemico-historical geology, application of the theory of turbidity and tidal sedimentation to analyzing sedimentary basins, etc. In conjunction with a volcanic rock series study a proterozoic aulacogen in Honan-Shanxi boundary and the Xialiohe-Bohai rift valley basin were identified.

The country's first isotope geology lab was set up in the IGAS in its early stage. It is specialized in geological research on radioactive and stable isotopes. The relatively early establishment of age-dating technique both for old geochronical units and the young ones has made it possible to supply umerous important strata, rockmasses and their mineralization period with many radiogenic age-dating informations.

In the field of hydrogeology and engineering geology the work done had or has spanned a wide range of aspects, in particular, research on hydrogeology of arid regions and hydrogeological investigation of well-irrigation and well-drainage in areas with arid-saline-alkaline soil ended with practically valuable results. A monograph named "the Research of China Karst" systematically summarizing the regularity of evolution of karst in the country had been published. On the other hand, the influence of the structure of geological bodies on the stability of engineering constructions and the mechanical effect of rockmass structure have been deeply explored through the agency of synthetic analysis combining geology with geomechanics. The whole study is based upon investigation of the process of formation of rockmass structure and its characteristics. It has provided scientific basis for proving the safety, reliability and the economical feasibility of many gigantic engineering projects of hydroelectric power, communication, mining and the national defense in our country. A new branch of the subject, engineering geomechanics, has thus originated which greatly pushes forward engineering geology in China.

In its early stage the IGAS took initiative to start systematic geochemical research on rare metals (lithium, beryllium, niobium, tantalum etc.) and rare-earth elements and relevant mineralogy and genesis of mineral deposits, thus having filled in the gaps in rare-elements geochemistry. In the same period, some tentative ideas of research on nuclear geology were initially formed.

In order to find several kinds of urgently needed at that time metallic mineral deposits an overall research plan has been proceeded in the IGAS concerning petrology, mineralogy and metallogenetic specializations of the basic, ultrabasic and alkaline rocks in China. Recently, to meet the need of probing into the composition, structure and evolution of the lithosphere an emphasis is put on petrogenetic research of Mesozoic-Cenozoic volcanic rocks and mantle-derived (kimberlite, ultramafic rock inclusions, ophiolite suite and komatiite etc.), as well as on the relationship between the petrological assemblage and geotectonics. The material source of metamorphic rocks and the temperature-pressure equilibrium conditions are taken as two major aspects in studying the metamorphic phases series, thermal history of metamorphism and the earth crust evolution. Therefore, another new branch of geology-petrotectonics is being gradually formed in this institute.

In the field of crystallography and mineralogy our institute rendered its contribution to the material science through successful artificial growing quartz crystal under low pressures. Afterwards, many new minerals have been discovered. For several specific regions a series of monographs of minerals were compiled. The "Structural-optical mineralogy" as a new research direction is being tested. For last a few years a study of mineral spectra has been employed vigorously providing some new approaches in the modern mineralogical study. In order to resolve some practical problems in the national economy the IGAS had initiated research on technological petrology and industrial mineralogy, such as that on petrology, zeolite and other clay minerals with certain promising achievements of remarkable economical benefits.

Loess in China has long been a significant research object in quaternary geology. A wide variety of investigations: the distribution, structural feature, composition and genesis of Chinese loess resulted in publication of a series of monographs in which significant guidance was given for farmland cultivation, irrigation and water conservancy and engineering constructions in the loess regions. The research achievements were echoed with credit both inside and outside the country.

As to the geophysical subjects, the IGAS is one of the institutions in China who began the palaeomagnetic, magneto-telluric sounding and geothermal research first. Just a couple of years ago the geothermal division of the institute published the first group of terrestrial heat flow data which will be followed by a new data set now being prepared to publish soon. In addition, the geotemperature field of the North China has been systematically studied for many years. Research on geothermal hazard in mines had been first sponsored and then accomplished by the scientific group. The first in China geothermal laboratory had been installed in the IGAS a few years ago.

The mathematical geology method had been introduced into our institute for the first time in the country by a newly set up research team of math-geologists. It is rewarded by promising achievements in prediction of mineral deposits, stratigraphical division and comparison, geological mapping and simulation of the earth's dynamics.

For the sake of coordinating the geological researches ceaseless attention has been paid to the chemical analysis of rocks and minerals. A quick total analysis method for some rare and radioactive elements had been first used in the IGAS's labs, which has, to a certain extent, enhanced the nationwide advancement of chemical analysis in geological labs.

Having looked back upon the path of growth of the IGAS on the occasion of the 60th anniversary of the GSC we have learned with deep feeling that none of the achievements listed above can ever be separated from the Party's leadership upon the geological cause, from the concerns shown by the Academia Sinica about the earth science advancement, as well as the support from the research and educational institutions and production units all over the country.

In over a decade geology throughout the world as an ancient discipline in science has undergone tremendous reformations. Due to the mutual penetration and coordination of different subjects, due to great accomplishments and renewal of experimental techniques the geological research has opened a new avenue of transformation from qualitative description into semi-quantitative, even quantitative estimation. The synthesis of a host of data accumulated in the past in the fields of mineralogy, petrology, stratigraphy, paleontology and geochemistry, with ever-extending use of mathematical and physical simulation of geological processes, has given new insights into the essence of matters. The sphere of earth science research has tremendously widened, while research extent deepened: from deep space to the interior of the Earth and profound depths of the oceans; from the macroscopic phenomena to the microscopic world of things. With the emergence of new concepts, new hypotheses and a series of frontier disciplines, geology today has taken a new look standing firm and

erect along with other disciplines of modern science.

China's geological unit has its own prominent features; so does the path of advancement of the geosciences in China. Relying mainly on our own efforts while epitomizing the strong points of diverse schools, various subjects and different countries in the world, we look forward with full confidence to an accelerating development of the earth sciences in China.

In the years to come we will stride forward side by side along with the geologists far and wide throughout the country making our bit of continuous contribution to advance the geological prospecting, research and education in China. We earnestly hope to be rewarded by incessant concerns and help, valuable criticism and suggestions from the wide range of the geologists both at home and abroad in order to further improve our research work.

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张 Wenyou Zhangwenyou

Zhang Wenyou (Director)

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孙 舒 Sun Shu

Sun Shu (Deputy Director)

孙 玉 Sun Yuke

Sun Yuke (Deputy Director)

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张 Wenyou Zhang Wenyou

Zhang Wenyou (Director)

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