地质矿产部沉积盆地与流体动力学开放研究实验室简介

"沉积盆地与流体动力学"开放研究实验室是1997年地质矿产部审批的重点开放实验室，它设在地质矿产部成都地质矿产研究所内，将面向国内外开放，公开受理国内外研究人员的课题申请，为研究人员提供开放研究课题基金和实验研究条件，以促进本学科的发展和人才交流。

1 实验室的研究方向和研究内容

沉积盆地保存着地壳形成演化、海陆变迁以及岩石圈动力学机制和板块活动过程、能源及其固体矿产的形成等等大量信息。沉积盆地分析是挖掘这些信息的重要途径和手段。根据当前在这一研究领域中所提出的问题以及地壳中流体的研究进展，进一步揭示沉积盆地的生成动力学以及盆山系统与成矿流体的耦合关系；探寻沉积盆地演化过程中流体的性状及运移主控因素。开放研究实验室将围绕盆地分析、盆山系统形成转换及其地质流体作用动力学进行深入而系统的研究。其主要研究内容：

1.1 沉积盆地分析与盆地模拟

沉积盆地是能源、金属和非金属成矿物质富集的储存地。通过盆地中的地层记录，采用层序地层学、事件地层学、地震地层学等理论和方法，结合地球物理、地球化学等先进手段，研究盆地的生成、沉积充填、构造活动、盆地封闭、造山或埋藏等内容，恢复盆地发展演化的过程及其动力学条件，建立盆地数据库。在三维空间中定量模拟盆地形成演化和层序发育、盆地变形机制、盆地和山脉的耦合关系，为流体运移和富集提供定量模拟参数。

1.2 盆—山系统研究

沉积盆地与周边造山带始终是地壳演化中紧密联系的地质过程。把孤立地分别研究盆地和造山带转变到将盆—山系统作为一个整体来研究是今后的重要研究内容。结合我国独特的地质特点，探索和建立造山带沉积盆地模式、盆山转换的规律及其动力学机制等方面的理论和研究方法。

1.3 地质流体动力学研究

地质流体是沉积盆地中的一个重要地质营力。油气藏及固体矿产形成与地下流体运移有着重要联系。我国西南"三江"(金沙江、澜沧江、怒江)地区和扬子地台西缘等地区的大型、超大型矿床多属"大器晚成"，与喜马拉雅造山作用导致成矿流体运移、聚集密切相关。国外最近研究表明，大规模的高盐度地下流体横穿北美克拉通迁移了数百公里，不仅在流经的沉积盖层中留下了大量成岩特征，更重要的是形成了许多大型矿床。因此，可通过流体包裹体成分、同位素和相平衡物理化学等方法，结合暴露于地表反映地壳深部不同层位岩石组合的研究，注意地质流体和有机无机组分的来源分析，进行地质流体与围岩化学反应动力学研究，揭示地下流体大规模运移的机理，形成新的油气生成和运聚理论与金属矿床成矿理论。

同时，把沉积盆地演化与流体运动学和动力学相结合，探寻在盆—山系统演化的各个阶段中的流体性状及运移控制因素。

2 实验室的由来

沉积盆地与流体动力学开放研究实验室是伴随成都地质矿产研究所近15年来所形成的优势学科——沉积地质学而建立的。成都地矿所沉积学科已取得的学术成果在国内外处于先进和领先水平。70年代末率先引进国外碳酸盐岩、碎屑岩和岩相古地理研究的新理论、新方法；为地矿部、石油部、煤炭部和冶金部举办短训班30多期，达2000多人次；地矿部确定沉积地质和全国岩相古地理编图等为成都地矿所重点发展方向之一；当时对云南兰坪-思茅地区钾盐等的研究，龙门山地区泥盆纪沉积相和峨眉山龙门洞的沉积相的研究，属于我国沉积方面的开创性工作，在国内外都有相当的影响。以后龙门洞剖面成国家自然保护剖面，国际著名。1979年，地矿部"岩相古地理研究及编图工作协作组"及其"岩古办"挂靠成都地矿所。80年代以来，我所不断地向国内引进国外的沉积学理论和研究方法，多次约请外国专家讲课，并合作进行专题研究，同时主办各类沉积学的培训班，有力推进了国内沉积学的发展。同时以科研项目带动学科发展，"中国南方岩相古地理及沉积、层控矿床远景预测"的研究，在造山带沉积学、板块沉积学、大陆边缘层序地层学、露头层序地层学、沉积盆地分析和碳酸盐台地动力分析、沉积盆地模拟、"盆相位"三位一体和"地质统一场"的成矿理论等方面都有所创新，其研究达到世界先进水平。其中对古老造山带、大陆边缘盆地演化、古地理和成矿作用等方面处于国际领先，在中国沉积学界具有里程碑意义，并在国际上引起强烈反响。

随着学科发展，沉积学的研究不仅仅集中在稳定的板块内部，同时也扩展到造山带中，例如在三江造山带中的沉积学研究、秦岭造山带的沉积盆地分析，同时还与德国合作进行喜马拉雅造山带深水盆地分析及阿尔卑斯对比研究、中—法东昆仑造山带沉积盆地研究，创立了造山带沉积学这一新的研究领域。这些研究对国内外沉积学有重大推动作用。

90年代中期，研究思路更加开阔。西藏特提斯沉积学的研究，对整个特提斯的沉积作用特征进行了探索。中国南方古大陆和全球古地理对比，使研究扩展到全球的范围，建立了全球三大陆块群的古地理格局的新模式，在国内外独树一帜，引起了国际同行的兴趣和重视。

研究工作不仅在区域扩展，而且在成岩作用、微生物成矿作用等精细研究中不断深入，如在狗头金、磷块岩的生物成矿方面的发现和创新，都达到世界先进水平。

所以，成都地矿所的沉积学科是具有特色和优势的学科，也是该领域高层次人才培养和科学研究重要基地。在造山带形成演化、沉积盆地及成矿作用、储层沉积及成岩作用模拟、流体包裹体、全球古地理等方面研究，均取得了一系列重大成果，多次获国家自然科学和部门科技奖，在国内外有较高声誉和影响。这为建立该开放研究实验室提供了前提。

由于学科发展的突飞猛进，人类对地球的资源和环境等问题的日益重视，为了更好地发展沉积盆地和流体动力学学科，攀登沉积地质学高峰，改善人类生存环境和探寻矿产资源等前沿理论基础和应用基础，1995年正式成立了沉积盆地与流体动力学实验室。通过两年的自筹资金运动，1997年正式被地矿部审批为地矿部重点开放研究实验室。

3 一九九七年资助的主要范围

沉积盆地与流体动力学开放实验研究工作是沉积地质学和能源地质学研究工作的重点

和核心，也是研究人类赖以生存的环境和资源的有力手段。为发挥学科研究优势、突出学科特色并确保学科研究的核心和重点，开放实验室研究课题应瞄准学科的前沿基础和应用基础，以多学科交叉渗透和地球系统科学为指导。要求课题立题新颖、思路清晰、方法和手段切实可行，具很强的操作性。研究周期通常为两年。利用新的学术思路、先进的测试模拟技术手段，以获得具国际先进水平的科研成果。

资助的主要范围为：

1. 盆地的热状态和喷流关系
2. 造山带沉积盆地分析
3. 盆地形成演化的数值模拟
4. 层序地层学
5. 露头层序划分与盆地分析
6. 盆山转换过程中的地质流体与成矿作用
7. 沉积盆地中古流体地质作用

徐强、牟传龙供稿

OPEN LABORATORY FOR DYNAMICS OF SEDIMENTARY BASINS AND GEOFLUIDS, MGMR: AN INTRODUCTION

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The Open Laboratory for Dynamics of Sedimentary Basins and Geofluids established in the Chengdu Institute of Geology and Mineral Resources is a key laboratory examined and approved in 1997 by the Ministry of Geology and Mineral Resources, the People's Republic of China. It is open to the public internally and externally for the purpose of the better management of the application of research topics at home and abroad, supplement of funds and conditions for laboratory research and stimulation of the subject development and personnel flow.

Aims and contents about the laboratory research

Sedimentary basins may provide numerous information about the formation and evolution of the earth's crust, continent-ocean changes, lithospheric dynamic mechanisms and plate tectonic processes, formation of energy and solid mineral resources, and therefore sedimentary basin analysis may serve as an important pathway and method for the acquirement of these information. Current research focus is directed more to the genetic dynamics of sedimentary basins, basin-range systems and mineralizing fluids, and fluid behaviours

and main controlling factors of fluid migration in the development of sedimentary basins. In a word, the research in the laboratory will focus on sedimentary basin analysis, formation and transformation of basin-range systems, and dynamics of geofluid processes. The main contents of research are generalized as follows.

Sedimentary basin analysis and modelling

A sedimentary basin is a locus for the concentration and preservation of energy, metallic and non-metallic ore-forming matter. The scope of the research encompasses basin formation, sediment filling, tectonic activity, basin closing, mountain building and burial processes with the aid of theory and methodology on sequence stratigraphy, event stratigraphy and seismic stratigraphy in combination with geophysics and geochemistry so as to reconstruct the evolutionary processes of sedimentary basins and relevant dynamic conditions, set up the databases for basin research, and quantitatively simulate in a three-dimensional space the basin evolution and sequence development, deformational mechanisms of basins, the coupling relations between basins and ranges, and provide quantitative modelling parameters on the migration and enrichment of geofluids.

Basin-range systems

There are close connections between sedimentary basins and their peripheral orogenic belts in the crustal evolution. The emphasis in the future laboratory research will be on the studies of the whole basin-range systems rather than separate studies of sedimentary basins and orogenic belts. This approach aims to present the theory and technology for the studies of sedimentary basin models for orogenic belts, regularity of basin-range transformation and associated dynamic mechanisms in the light of unique geological features in China.

Dynamics of geofluids

The geofluids are believed to be the important geological agencies in sedimentary basins. The formation of oil and gas and solid mineral resources is closely bound up with the migration of subsurface fluids. For instance, a number of large-sized and ultralarge-sized ore deposits in the Nujiang-Lancangjiang-Jinshajiang area and on the western margin of the Yangtze platform in southwestern China may owe their origins to the migration and concentration of the ore-forming fluids caused by the Himalayan orogenesis. The recent research abroad shows that the high-salinity subsurface fluids flow on a large scale for serval hundred kilometers across the North American craton, resulting not only in the appearance of the diagenetic features in the sedimentary cover but also in the formation of many large-sized ore deposits. Numerous studies may be conduced on the origins of geofluids and organic and inorganic matter, dynamics of chemical reactions of geofluids and wall rocks, mechanisms of the large-scale migration of subsurface geofluids. Thus new theories on the accumulation and migration of oil and gas and formation of metallogenic ore deposits may be presented on the basis of the physical and chemical studies of fluid inclusion compositions, isotopes and phase equilibrium in conjunction with the studies of the rock associations cropped out on the surface representing different depths. Moreover an attempt is made to reconcile the evolution of sedimentary basins with kinematics and dynamics of geofluids in order to arrive at a better resolution for the interpretation of fluid behaviours and main controlling factors on fluid migration in various stages of transformation of basin-range systems.

The development of the laboratory

The open laboratory for Dynamics of Sedimentary Basins and Geofluids was founded in response to the development of sedimentary geology, a dominant subject in the Chengdu Institute of Geology and Mineral Resources during the last fifteen years. The scientific and technologic results of research achieved by the institute have been at the world's and China's advanced levels. The new theories and methods on the studies of carbonate and clastic rocks, and sedimentary facies and palaeogeography were firstly introduced to the institute in the 1970's. More than 30 short-term training courses with more than 2000 people were conducted for the Ministry of Geology and Mineral Resources, Ministry of Petroleum Industry, Ministry of Coal Industry, and Ministry of Metallurgical Industry. Sedimentary geology and the compilation of country-wide sedimentary facies and palaeogeographic maps were assigned as the key projects to the institute, and the coordination group and office for sedimentary facies and palaeogeographic research and compilation were affiliated to the institute. The pioneering research was conducted on the potash mineral resources in the Lanping-Simao region, Yunnan, and Devonian sedimentary facies in the Longmen Mountain area and sedimentary facies in Longmendong, Emei Mountain, southwestern China. As a consequence, the Longmendong section has been known as a national nature reserve. From the 1980's onwards, the constant introduction of the theories and methods on sedimentology from foreign countries, and academic exchange and cooperation between China and foreign countries, and a variety of sedimentological lectures and training courses provided a great stimulus for the development of sedimentology in China. Notable advances were made on the studies of sedimentary facies and palaeogeography and sedimentary and stratabound ore deposits in southern China, sedimentology of orogenic belts, plate sedimentology, continent-margin sequence stratigraphy, outcrop sequence stratigraphy, sedimentary basin analysis and dynamics of carbonate platforms, sedimentary basin modelling. "sedimentary basin-sedimentary facies-tectonic setting" trinity and geologic unified field theory, of which the results of research on ancient orogenic belts, continent-margin basin evolution, palaeogeography and mineralization have reached world's advanced level, and have an epoch-making significance in China's sedimentological research.

The emphasis of sedimentological research is now being shifted from stable plate interior to orogenic belts, as indicated by the sedimentological studies of the Nujiang-Lancangjiang-Jinshajiang orogenic belt, sedimentary basin analysis in the Qinling orogenic belt, the deep-water basin analysis in the Himalayan orogenic belt and comparative studies with Alps in cooperation with Germany, and Sino-French cooperative study of the sedimentary basins in the East Kunlun orogenic belt, which, in turn, have given an impetus to the development of sedimentology at home and abroad.

Up to the middle 1990's, the sedimentological studies of the Tibetan Tethys gave rise to the approaches to the sedimentary characteristics of the whole Tethyan domain. The studies of ancient land and global palaeogeography led to the construction of the new model for the palaeogeographic framework of three global continental mass groups, which has drawn the interest and attention of the internal and external colleagues.

In addition, recent progress was also made in diagenesis and microbial mineralization including biomineralization of doghead gold and phosphorites.

It can be seen from the above-mentioned results that sedimentology is a distinctive and dominant subject in the institute which has long been an important base for the training of senior scientists and technicians and scientific research in this field. The major results of research comprising the formation and evolution of orogenic belts, sedimentary basin and mineralization, reservoir sediments and diagenesis modelling, fluid inclusions, and global palaeogeography have won the State Natural Science Prize and the Ministrial Scientific and Technological Achievement Award. The achievements cited above have provided essential prerequisites for the foundation of the open laboratory.

At present, the development of the subject sedimentology is going ahead by leaps and bounds. Increasing attention is being drawn to mineral resources and environments. In order to promote specific thematic studies of sedimentary basins and fluid dynamics, and to resolve some theoretical and applied problems confronted in the subject such as of environmental changes affecting the existence of mankind and prospecting and exploration of mineral resources, a laboratory for sedimentary basin analysis and fluid dynamics was founded in 1995, and hereafter examined and approved as an open laboratory in 1997 by the Ministry of Geology and Mineral Resources, the People's Republic of China. It is clear that such endeavors are timely indeed.

1997 assistance

The research work in the open laboratory for dynamics of sedimentary basins and geofluids will be the emphasis and focus of sedimentary geology and energy geology. Current research should focus on interdisciplinary approaches, solutions and integration in the frontier and applied aspects of these subjects. The topics germane to such research activity should be characterized by original theses, clear thoughts and feasible plan so as to acquire the scientific and technological results at world's advanced levels. The duration of one topic generally lasts for two years.

The assistance in 1997 includes:

(1)The relationship between thermal regime and exhalation in sedimentary basins

(2)Sedimentary basin analysis in orogenic belts

(3)Numerical simulation for the formation and evolution of sedimentary basins

(4)Sequence stratigraphy

(5)Classification of outcrop sequence stratigraphy and basin analysis

(6)Geofluids and mineralization during basin-range transformation

(7)Geological processes of palaeofluids in sedimentary basins