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Ministry of Natural Resources

China Geological Survey

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INSTITUTE OF GEOLOGY CHINESE ACADEMY OF GEOLOGICAL SCIENCES

2018 Annual Report Contents

Institute of Geology, Chinese Academy of Geological Sciences (CAGS)

Preface 2018

The Institute of Geology, Chinese Academy of Geological Sciences (IGCAGS), is a national public scientific research institution and is mainly engaged in national fundamental, public, strategic and frontier geological survey and geoscientific research. Entering the new century, and in particular during the past 5 years, the Institute has made notable progress in scientific research, personnel training and international cooperation, with increasing cooperation and exchange activities, expanded fields of cooperation, abundant output of new research results, and an increased number of papers published in "*Nature*", "*Science*" and other high-impact international scientific journals. In the light of this new situation and in order to publicize, in a timely manner, annual progress and achievements of the Institute to enhance its international reputation, an English version of the Institute's Annual Report has been published since 2010.

Similar to most previous reports, the Annual Report 2018 includes the following 8 parts: (1) Introduction; (2) Selected Research Achievements; (3) Talents and Awards; (4) Projects and Funding; (5) International Cooperation and Academic Exchange; (6) Important Academic Activities in 2018; (7) Postgraduate Education; (8) Publications. In order to avoid confusion in the meaning of Chinese names, all Chinese family names in this Report are capitalized.

We express our sincere gratitude to colleagues of related research departments and centers of the Institute for their support and efforts in compiling this Report and providing related material – a written record of the hard work of the Institute's scientific research personnel for the year 2018.

Editorial Board of
The Annual Report (English Version) of the Institute of Geology,
Chinese Academy of Geological Sciences
19 April, 2019

1 2018 Introduction

The Institute of Geology, Chinese Academy of Geological Sciences (IGCAGS), is a national public scientific research institution and is mainly engaged in national fundamental, public, strategic and frontier geological survey and geoscientific research, aiming to provide fundamental geological theory and technological support for national geoscientific research and investigation:

(1) To carry out national fundamental, public, strategic and frontier geoscientific research and fundamental geological survey.

(2) To carry out investigation and innovation research on major basic geological problems in the field of earth resources and environment.

(3) To carry out fundamental disciplinary research on tectonic geology and geotectonics, regional geology and metallogeny, stratigraphy and palaeontology, metamorphic rocks and Precambrian geology, petrology and mineralogy, and Quaternary geology; to conduct research in major areas, such as continental tectonics and dynamics, deep lithosphere exploration and three-dimensional geological survey, isotope geology and chronology, comprehensive geological research and mapping research.

(4) To carry out research on isotopic chronology and geochemical techniques and systems, major key technologies and instruments and equipment; to undertake the construction, management and operation of relevant experimental and observational bases.

(5) To carry out basic geological international cooperation and exchanges.

The Institute has a total of 254 staff members, which includes 151 senior professionals, 7 Academicians of the Chinese Academy of Sciences, 5 “New Century Talents Project” nominees, 1 “National Youth Talents Project” nominee, 4 “National Outstanding Contributions to Young Experts” nominees, 5 professionals supported by the “National Natural Science Foundation of China (NSFC) for Distinguished Young Scholar”, 2 professionals supported by the “NSFC Excellent Young Scientists Fund” and 1 research group supported by the “NSFC Science Fund for Creative Research Groups”. In 2016, the Institute was supported by the “Innovative Talent Training Demonstration Project” of Ministry of Science and Technology (MOST) of China.

IGCAGS has trained a large number of excellent, highly qualified graduate students. It also has designated programs for postdoctoral research. The Institute has a post-graduate education system for Master's and PhD students. IGCAGS has 38 doctor tutors and 42 master tutors. The institute enrolls about 30 PhD and MA students each year, and currently has 43 postdoctoral researchers.

The Institute has 11 research divisions, namely Division of Regional Geology and Mapping, Division of Tectonics, Division of Stratigraphy and Paleontology, Division of Metamorphic Rocks and Precambrian Geology, Division of Igneous Rocks, Laboratory of Continental Dynamics, Laboratory of Isotope Geology, Lithosphere Research Center, Beijing SHRIMP Center, Mineral and Energy Resources Center, and Three-dimensional Geological Survey and Research Center. In addition, Beijing SHRIMP Center is National Fundamental Resources Platform of Science and Technology.

The Institute also has 4 key laboratories of Ministry of Natural Resources of the People’s Republic of China (MNR), namely the Key Laboratory of Deep-Earth Dynamics, the Key Laboratory of Isotope Geology, the Key Laboratory of Stratigraphy and Paleontology and the Key Laboratory of Earthprobe and Geodynamics.

7 academic organizations are affiliated in the institute, namely China Commission of International Continental Scientific Drilling, Commission of Regional Geology and Mineralization of the Geological Society of China (GSC), Commission of Geological Mapping of GSC, Commission of Stratigraphy and Paleontology of GSC, Commission of Petrology of GSC, Commission of Isotope Geology of GSC, Commission of Metamorphism, Mineralogy and Geochemistry of GSC.

In recent years, the Institute has undertaken more than 500 research projects, including the “National Science and Technology Major Project of MOST”, National Scientific Instruments and Equipment, the National Key Research and Development Plan [including the “National Basic Research Program of China (973 Program)”], significant research programs supported by the National Natural Science Foundation, as well as projects of China Geological

Survey (CGS), and so on.

The Institute has produced a great number of innovative results by promoting the growth of talents, fostering innovative ideas, and enhancing the ability to perform scientific research and meet major national needs, and has achieved a large number of innovative achievements in the field of solid Earth science. The Institute attaches great importance to intellectual property rights, having been authorized for about 20 patents. In recent years, 6 research achievements have been awarded to the Institute, including 2 National Natural Science Awards, and 4 Science and Technology Progress Award from MNR.

Fig. 1 Main building of the Institute

Organizational framework

*Administrative Departments

General Office
Party Committee Office
Service and Security Department
Finance Department
Department of Personnel and Education
Department of Science and Technology
Department of Experimental Administration
Department of Discipline Inspection and Supervision

* Technical Support Organizations

National Geological Mapping and Research Center, China Geological Survey
Collaborative Research Center for Stratigraphy and Paleontology, China Geological Survey
Three-dimensional Geological Survey Center, China Geological Survey

* Technology Platform

Beijing SHRIMP Center of the National Science and Technology Resource Sharing Service Platform
Key Laboratory of Deep-Earth Dynamics, Ministry of Natural Resources
Key Laboratory of Isotope Geology, Ministry of Natural Resources
Key Laboratory of Stratigraphy and Paleontology, Ministry of Natural Resources
Key Laboratory of Deep Exploration and Geodynamics, Ministry of Natural Resources

* Affiliated Academic Organizations

China Commission for International Continental Scientific Drilling
Commission for Regional Geology and Mineralization, Geological Society of China

* Publications

Acta Petrologica et Mineralogica

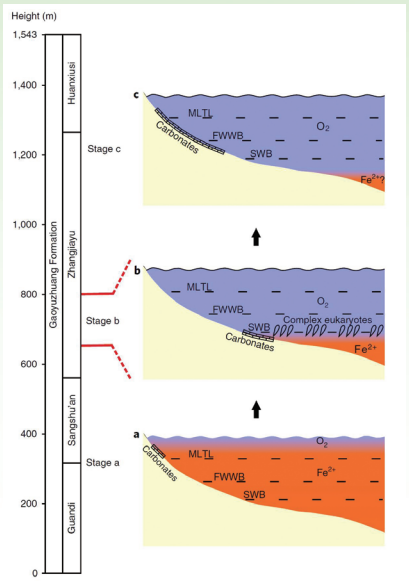
* Research Fields

▲Regional geology, mapping and database construction
▲Regional and global tectonics
▲Origin and evolution of life, paleontology and stratigraphy
▲Sedimentary basins and evolution of paleogeography and paleoenvironments
▲Precambrian geology and early crustal evolution
▲Cenozoic geology and modern geological and ecological environments
▲Ultrahigh pressure metamorphism and metamorphic belts
▲Petrology, mineralogy and mineral deposits
▲Continental dynamics and mantle dynamics
▲Geological setting of mineralization and regional mineralization
▲Three-dimensional geological surveying
▲Deep geophysical probing and lithospheric structures
▲Geological theory, method system and applications of isotopes

2.1 Research Papers

Oxygenation of the Mesoproterozoic ocean and the evolution of complex eukaryotes

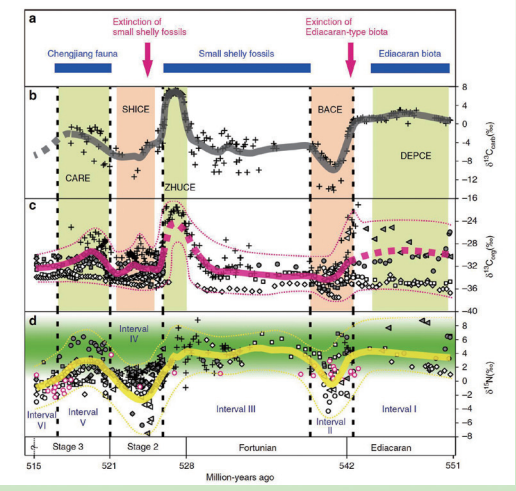
ABSTRACT: The Mesoproterozoic era [1,600–1,000 million years (Ma) ago] has long been considered a period of relative environmental stasis, with persistently low levels of atmospheric oxygen. There remains much uncertainty, however, over the evolution of ocean chemistry during this period, which may have been of profound significance for the early evolution of eukaryotic life. Here we present rare earth element, iron-speciation and inorganic carbon isotope data to investigate the redox evolution of the 1,600–1,550 Ma Yanliao Basin, North China Craton. These data confirm that the ocean at the start of the Mesoproterozoic was dominantly anoxic and ferruginous. Significantly, however, we find evidence for a progressive oxygenation event starting at ~1,570 Ma, immediately prior to the occurrence of complex multicellular eukaryotes in shelf areas of the Yanliao Basin. Our study thus demonstrates that oxygenation of the Mesoproterozoic environment was far more dynamic and intense than previously envisaged, and establishes an important link between rising oxygen and the emerging record of diverse, multicellular eukaryotic life in the early Mesoproterozoic.



ZHANG Kan and ZHU Xiangkun et al., 2018- Nature Geoscience, 11: 345–350

Coupling of ocean redox and animal evolution during the Ediacaran-Cambrian transition

ABSTRACT: The late Ediacaran to early Cambrian interval witnessed extraordinary radiations of metazoan life. The role of the physical environment in this biological revolution, such as changes to oxygen levels and nutrient availability, has been the focus of longstanding debate. Seemingly contradictory data from geochemical redox proxies help to fuel this controversy. As an essential nutrient, nitrogen can help to resolve this impasse by establishing linkages between nutrient supply, ocean redox, and biological changes. Here we present a comprehensive N-isotope dataset from the Yangtze Basin that reveals remarkable coupling between $\delta^{15}N$, $\delta^{13}C$, and evolutionary events from circa 551 to 515 Ma. The results indicate that increased fixed nitrogen supply may have facilitated episodic animal radiations by reinforcing ocean oxygenation, and restricting anoxia to near, or even at the sediment-water interface. Conversely, sporadic ocean anoxic events interrupted ocean oxygenation, and may have led to extinctions of the Ediacaran biota and small shelly animals.

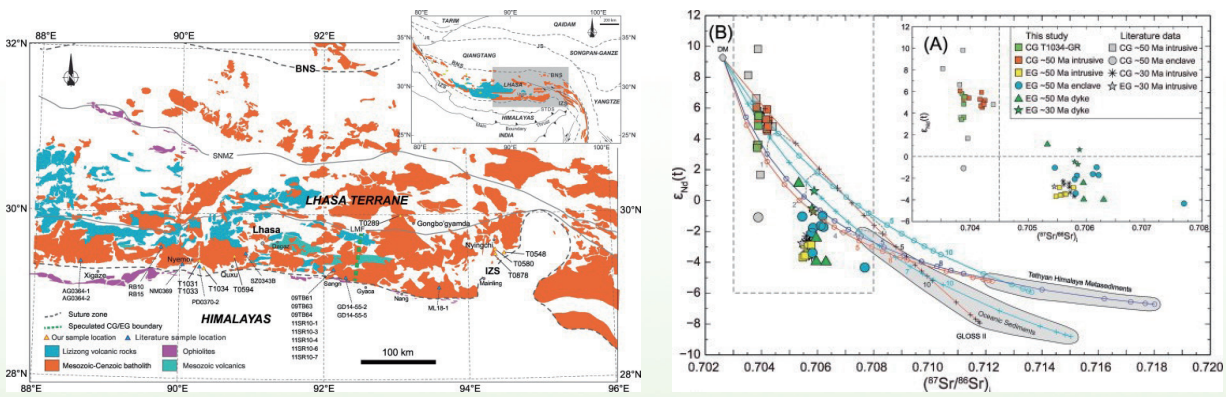


WANG Dan et al., 2018- Nature Communications, 9: 2575

Along-arc variations in isotope and trace element compositions of Paleogene gabbroic rocks in the Gangdese batholith, southern Tibet

ABSTRACT: Gabbroic rocks in continental arcs constrain the composition of sub-arc mantle and the roles played by mafic magmas in the generation and differentiation of continental crust. Here, we report whole-rock elemental and isotope (Sr and Nd) compositions of ~50 Ma and ~30 Ma gabbroic rocks from the central and eastern Gangdese (CG and EG) batholith, southern Tibet. A key observation is the along-arc isotopic and geochemical variations of ~50 Ma gabbros and dykes: EG rock samples show enriched Sr-Nd isotope compositions, with initial $^{87}Sr/^{86}Sr = 0.7053–0.7077$ and $\varepsilon_{Nd}(t) = -4.3$ to $+1.1$ (average -3.0), and have higher abundance of heavy rare-earth elements (HREEs), high field strength elements, and melt-mobile elements compared with CG samples, which yield initial $^{87}Sr/^{86}Sr = 0.7038–0.7043$ and $\varepsilon_{Nd}(t) = +3.4$ to $+6.9$. Geochemical evidence suggests that the Sr-Nd isotope differences reflect those in the mantle sources and are not due to crustal interactions, indicating that the sub-Gangdese batholithic mantle exhibited different degrees of enrichment at least ~50 Ma ago.

These observations, combined with previous data, suggest that the sub-Gangdese batholithic mantle exhibited along-arc segmentation at 92°E–93°E at 50 Ma. This segmentation occurred probably between 90 and 47 Ma and was a result of the different characteristics and variable additions of the enriching agents into the asthenospheric mantle. CG gabbroic rocks were derived from depleted asthenospheric mantle enriched by variable amounts of aqueous fluids from the Neo-Tethyan slab, whereas EG rocks were generated from asthenospheric mantle enriched by hydrous melts from Indian continental crust. This interpretation implies that Indian continental crust was subducted beneath the southern Lhasa subterrane prior to 47 Ma. Compared with ~50 Ma rocks, ~30 Ma EG dykes exhibit higher melt-mobile element abundance and stronger REE fractionations, and were generated from deeper, melt-enriched mantle, signifying that a lithospheric thickening event occurred between 50 and 30 Ma in the EG batholith.

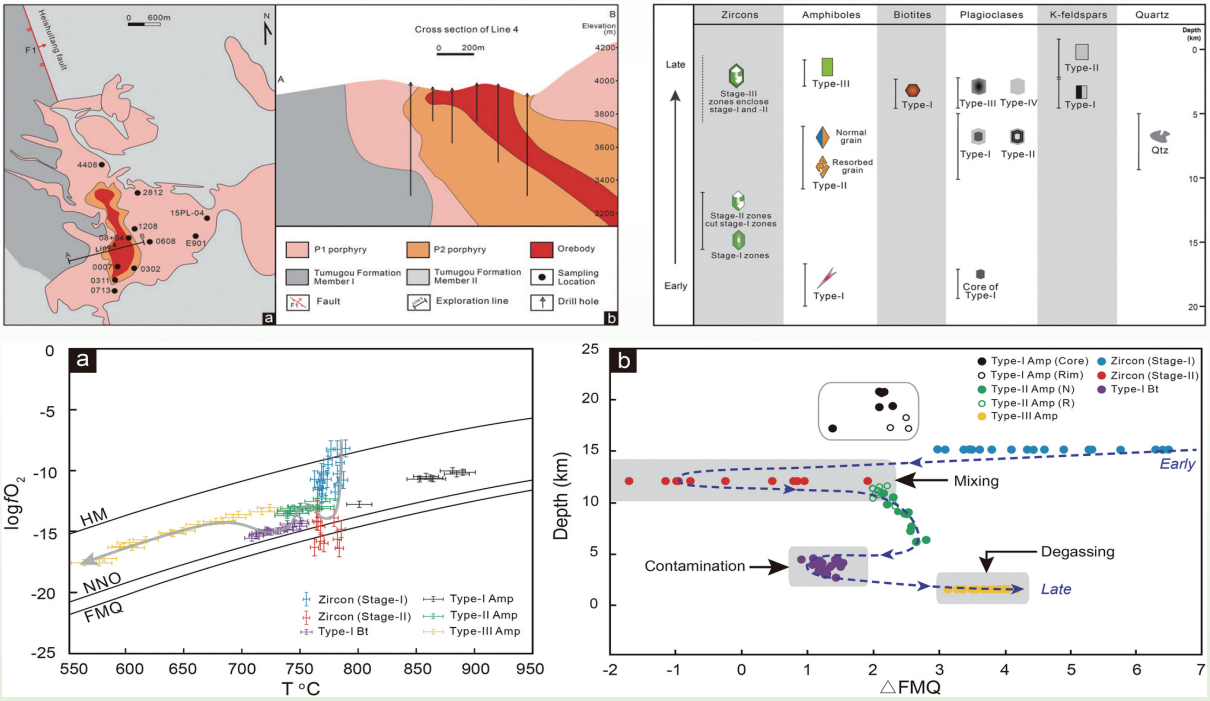


WANG Yafei and ZENG Lingsen et al., 2019- Lithos, 324-325: 877-892

Redox-controlled generation of the giant porphyry Cu-Au deposit at Pulang, southwest China

ABSTRACT: Some porphyry Cu-Au deposits with relatively reduced ore assemblages, characterized by high hydrothermal pyrrhotite contents and a lack of primary hematite and magnetite, are generally considered to be associated with reduced I-type granitoids. However, the role of magmatic oxygen fugacity (fO_2) in controlling Cu-Au mineralization in such reduced porphyry deposits is poorly understood. The giant Late Triassic (ca. 216 Ma) Pulang porphyry Cu-Au deposit of southwest China shows typical reduced ore assemblages. This study reported the systematical variation of upper crustal magmatic fO_2 of Pulang deposit, based on detailed investigations of mineral crystallization sequences and compositional features of the mineralization-related porphyries (early P_1 and late P_2

porphyry). Results indicate that magma of the mineralization-related porphyries experienced complex fO_2 fluctuations during its upper crustal evolution. The early primary magma had very high initial fO_2, with $\Delta FMQ \geq +3.0$ at depths of >12 km [ΔFMQ is the deviation of $\log fO_2$ from the fayalite-magnetite-quartz (FMQ) buffer]. The $fO_2$of evolved parental magma subsequently decreased, with $\Delta FMQ \leq +1.9$, due to injection of relatively reduced dioritic magmas ($\Delta FMQ = +1.4$ to $+2.3$) from a deeper chamber (17–21 km depth) into the primary magma chamber at 10–12 km depth. Magma mixing had largely ceased at 6–10 km depth. The parental magma then ponded within the reduced Tumugou formation at a depth of ~3.7 km where magmatic fO_2 decreased to a moderately oxidized state ($\Delta FMQ = \sim +1.6$), and finally to a moderately reduced state [reflected by $\log(Fe_2O_3/FeO)$ ratios of <-0.5 for P_1 porphyry] due to contamination of parental magma by wall-rock Tumugou Formation. This decrease of fO_2 in the parental magma resulted in separation of magmatic sulfide, and the subsequent exsolution of reduced ore fluids responsible for the generation of Pulang ore assemblages. The fO_2 of the residual parental magma increased after exsolution of the reduced fluids to ΔFMQ values of $+3.2$ to $+4.2$ [also reflected by high $\log(Fe_2O_3/FeO)$ ratios of >-0.5 for P_2 porphyry]. Results of this study of magmatic fO_2indicate that porphyry magmas associated with reduced Pulang ore assemblages were initially generated as highly oxidized magma which was subsequently reduced through magma mixing and contamination by reduced sedimentary rocks of the Tumugou Formation. The sharp fO_2 decrease at very shallow depth prevented the early loss of Cu and Au because the magma remained oxidized until it was emplaced at ~3.7 km depth. Moderately reduced magmas may thus have a genetic association with porphyry Cu-Au mineralization.

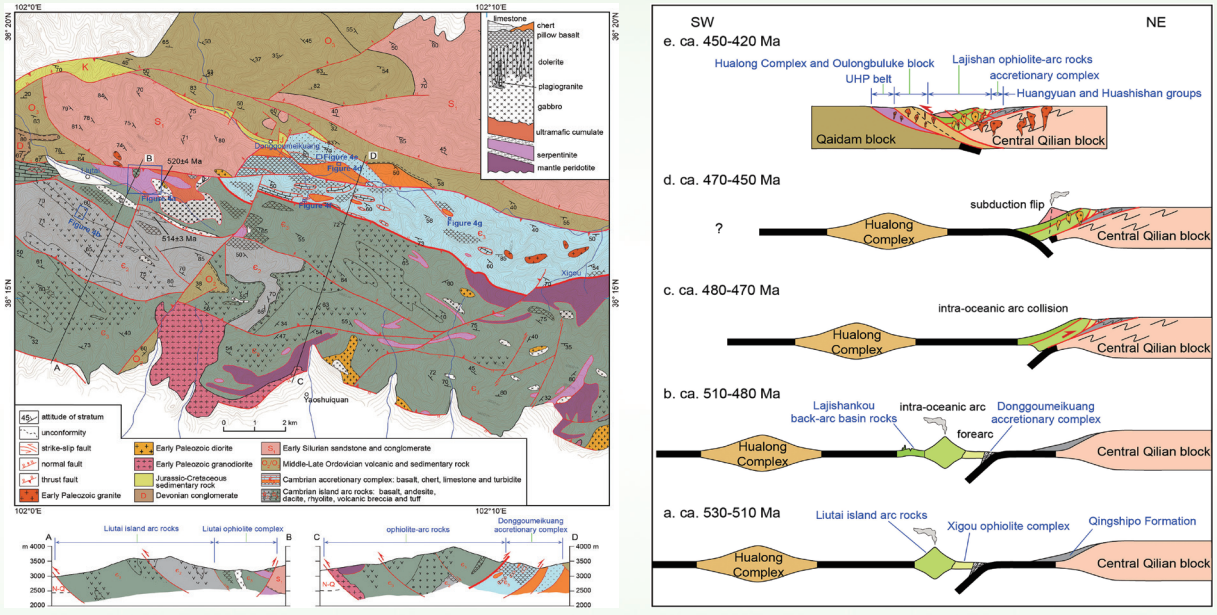


LI Weikai and YANG Zhiming et al., 2019- Contributions to Mineralogy and Petrology, 174: 12. https://doi.org/10.1007/s00410-019-1546-x

Lajishankou ophiolite complex: Implications for Paleozoic multiple accretionary and collisional events in the South Qilian Belt

ABSTRACT: The Lajishan ophiolite complex in the Qilian Orogen is one of several ophiolites situated between the Qaidam and North China blocks that record episodic closure of the Proto-Tethyan Ocean. Detailed field relations and geochemical and geochronological studies are critical to unraveling the tectonic processes responsible for an extensive

period of intraoceanic subduction that produced juvenile ophiolite/island arc terranes, which were obducted onto continental margins during ocean closure. The Lajishankou ophiolite complex crops out along the northern margin of the South Qilian belt and was thrust over a Neoproterozoic-Ordovician passive margin sequence that was deposited upon the Proterozoic Central Qilian block. The mafic rocks in Lajishankou ophiolite complex are the most abundant slices and can be categorized into three distinct groups based on petrological, geochemical, and geochronological characteristics: massive island arc tholeiites, 509 Ma back-arc dolerite dykes, and 491 Ma pillow basaltic and dolerite slices that are of seamount origin in a back-arc basin. These results, together with spatial relationships, indicate that the Cambrian island arc rocks, ophiolite complex, and accretionary complex developed between 530 and 480 Ma as a single, intraoceanic arc-basin system as a result of south directed subduction of the Proto-Tethyan Ocean prior to Early Ordovician obduction of this system onto the Central Qilian block. Final continental amalgamation involved continental collision of the Central Qilian block with the Qaidam block during the Late Ordovician. This model solves the long-lasting discussion on the emplacement of the Lajishan ophiolite and contributes to an improved understanding of multiple accretionary and collisional processes in the Qilian Orogen.

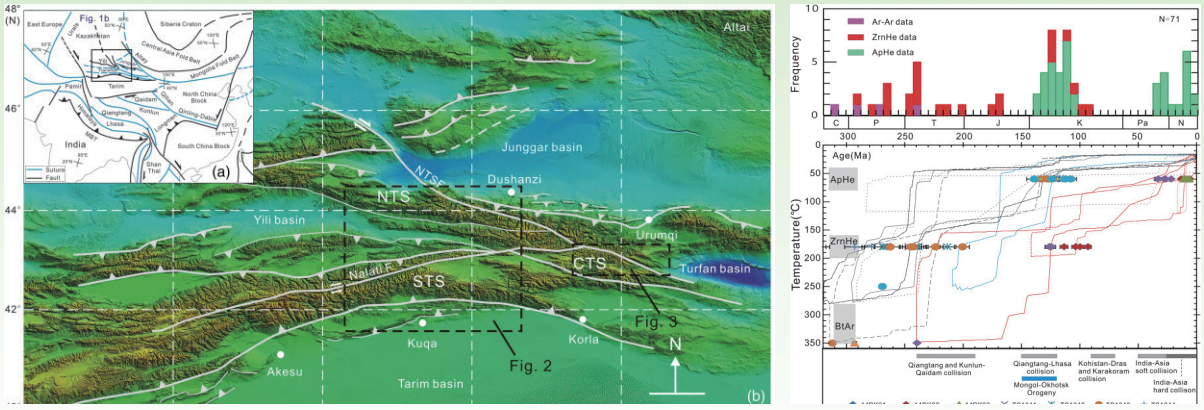


FU Changlei and YAN Zhen et al., 2018- Tectonics, 37(5): 1321-1346

The thermal evolution of Chinese central Tianshan and its implications: Insights from multi-method chronometry

ABSTRACT: The Chinese Tianshan is located in the south of the Central Asian Orogenic Belt and formed during final consumption of the Paleo-Asian Ocean in the late Palaeozoic. In order to further elucidate the tectonic evolution of the Chinese Tianshan, we have established the temperature-time history of granitic rocks from the Chinese Tianshan through a multi-chronological approach that includes U/Pb (zircon), $^{40}Ar/^{39}Ar$ (biotite and K-feldspar), and (U-Th)/He (zircon and apatite) dating. Our data show that the central Tianshan experienced accelerated cooling during the late Carboniferous to early Permian. Multiple sequences of complex multiple accretionary, subduction and collisional events could have induced the cooling in the Tianshan Orogenic Belt. The new $^{40}Ar/^{39}Ar$ and (U-Th)/He data, in combination with thermal history modeling results, reveal that several tectonic reactivation and exhumation episodes affected the Chinese central Tianshan during middle Triassic (245–210 Ma), early Cretaceous (140–100 Ma), late Oligocene-early Miocene (35–20 Ma) and late Miocene (12–9 Ma). The middle Triassic cooling dates was only found in the central Tianshan. Strong uplift and deformation in the Chinese Tianshan has been limited and

localized. It have been concentrated in around major fault zone and the foreland thrust belt since the early Cretaceous. The middle Triassic and early Cretaceous exhumation is interpreted as distal effects of the Cimmerian collisions (i.e. the Qiangtang and Kunlun-Qaidam collision and Lhasa-Qiangtang collision) at the southern Eurasian margin. The Cenozoic reactivation and exhumation is interpreted as a far field response to the India-Eurasia collision and represents the beginning of modern mountain building and denudation in the Chinese Tianshan.

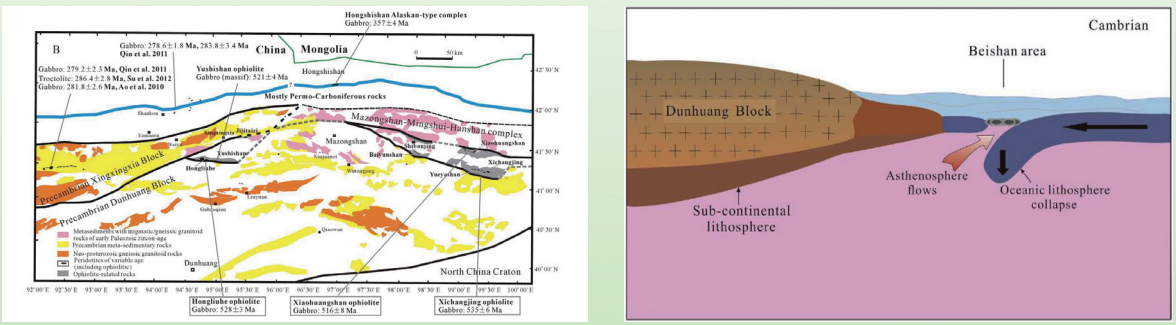


YIN Jiyuan and CHEN Wen et al., 2018- Tectonophysics, 722: 536-549

Cambrian ophiolite complexes in the Beishan area, China, southern margin of the Central Asian Orogenic Belt

ABSTRACT: We present zircon ages and geochemical data for Cambrian ophiolite complexes exposed in the Beishan area at the southern margin of the Central Asian Orogenic Belt (CAOB). The complexes consist of the Xichangjing-Xiaohuangshan and Hongliuhe-Yushishan ophiolites, which both exhibit complete ophiolite stratigraphy: chert, basalt, sheeted dikes, gabbro, mafic and ultramafic cumulates and serpentinized mantle peridotites. Zircon grains of gabbro samples yielded $^{206}Pb/^{238}U$ ages of 516 ± 8, 521 ± 4, 528 ± 3 and 535 ± 6 Ma that reflect the timing of gabbro emplacement.

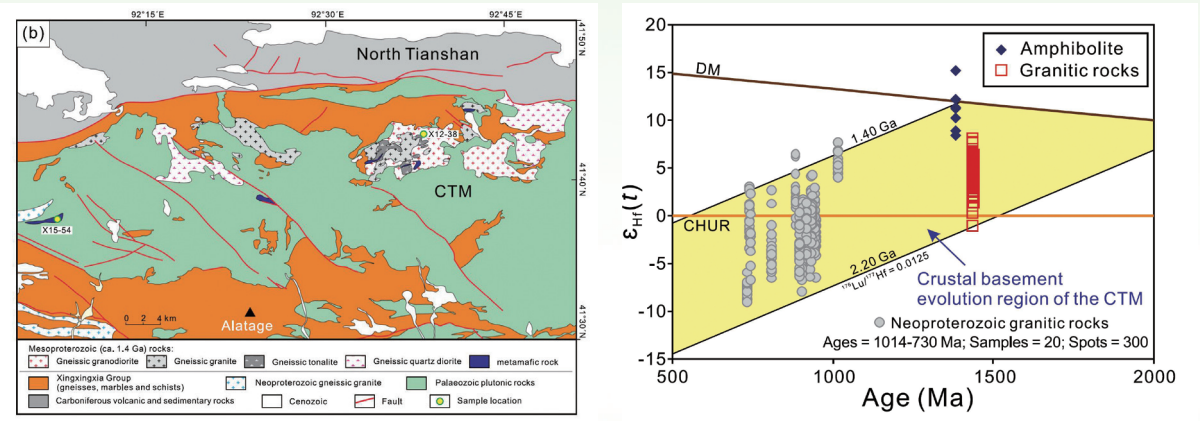
The geochemical data of the basaltic rocks show enrichment in large-ion lithophile elements and depletion in the high field strength elements relative to normal mid-oceanic ridge basalt (NMORB) in response to aqueous fluids or melts expelled from the subducting slab. The gabbro samples have higher whole-rock initial $^{87}Sr/^{86}Sr$ ratios and lower positive $\varepsilon_{Nd}(t)$ values than NMORB. These geochemical signatures resulted from processes or conditions that are unique to subduction zones, and the ophiolites are therefore likely to have formed within a supra-subduction zone (SSZ) environment. We suggest that the Cambrian ophiolite complexes in the Beishan area formed within a SSZ setting, reflecting an early Paleozoic subduction of components of the Paleo-Central Asian Ocean and recording an early Paleozoic southward subduction event in the southern CAOB along the northern margin of the Tarim and North China Cratons.



SHI Yuruo et al., 2018- Journal of Asian Earth Sciences, 153: 193-205

Mesoproterozoic juvenile crust in microcontinents of the Central Asian Orogenic Belt: Evidence from oxygen and hafnium isotopes in zircon

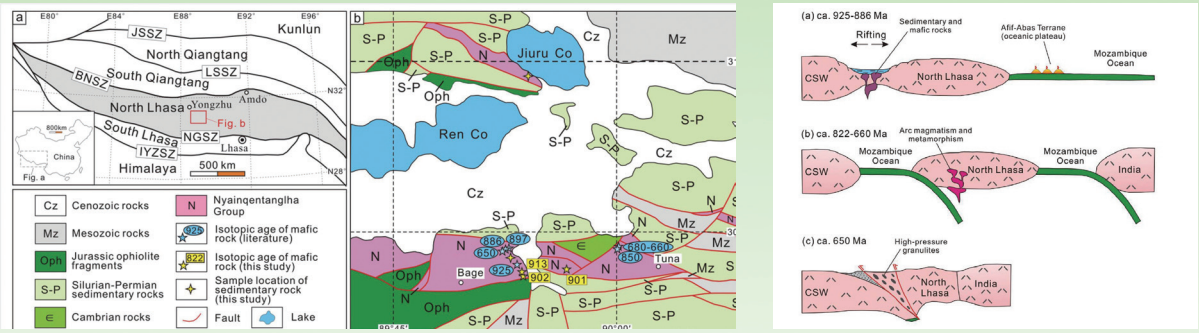
ABSTRACT: We report in situ O and Hf isotope data of zircon grains from coeval Mesoproterozoic (ca. 1.4 Ga) igneous metamafic (amphibolite) and granitic rocks of the Chinese Central Tianshan microcontinent (CTM) in the southern Central Asian Orogenic Belt (CAOB). Zircon grains from amphibolite have mantle-like $\delta^{18}O_{VSMOW}$ values of 4.7–5.6‰ and juvenile Hf isotopic compositions [$\varepsilon_{Hf}(t)$ = 8.4–15.3; T_{DMC} = 1.57–1.22 Ga], whereas those from granitic rocks have $\delta^{18}O_{VSMOW}$ values of 5.6–7.0‰ and evolved Hf isotopic compositions [$\varepsilon_{Hf}(t)$ = −1.0–8.2; T_{DMC} = 2.09–1.62 Ga]. Zircon O-Hf isotopic compositions of the metamafic and granitic rocks provide evidence for Mesoproterozoic (ca. 1.4 Ga) crustal growth and a substantial Palaeoproterozoic supracrustal component in the CTM. These findings and previous studies, reporting ca. 1.4 Ga magmatic rocks from other microcontinents of the CAOB, suggest that a large belt of Mesoproterozoic (ca. 1.4 Ga) juvenile continental crust formed in a continental terrane, fragments of which now occur over a distance of more than a thousand kilometres in the southern CAOB.



HE Zhenyu et al., 2018- Scientific Reports, 8(1): 5054 DOI: 10.1038/s41598-018-23393-4

Early Neoproterozoic (ca. 900 Ma) rift sedimentation and mafic magmatism in the North Lhasa Terrane, Tibet: Paleogeographic and tectonic implications

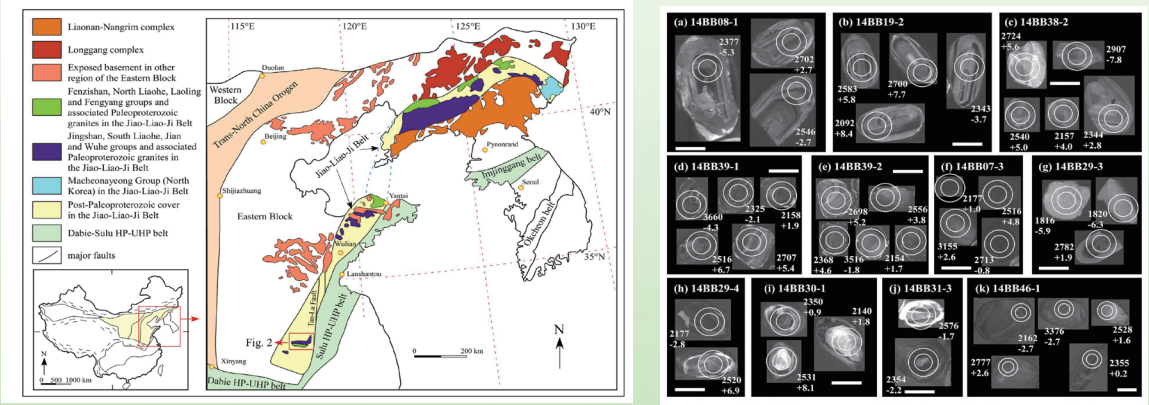
ABSTRACT: The origin and evolution of the Precambrian North Lhasa Terrane in the central Tibetan Plateau remain enigmatic. Here we present U/Pb age and Hf isotopic data for detrital zircons from early Neoproterozoic quartzites in the North Lhasa Terrane, Tibet. An integrated petrological, geochronological, geochemical, and Sr-Nd-Hf isotopic study was also undertaken on amphibolites associated with the quartzites. The depositional age of the quartzites is constrained to be between ca. 931 Ma (youngest detrital igneous zircon core) and 869 Ma (oldest metamorphic zircon rim). The detrital zircons have a main age population from1200 to 1000 Ma, and lack zircons with ages of 1000–900 Ma. Zircons from the amphibolites yield concordant ages of ca. 913–902 Ma, which are comparable to the depositional age of the quartzites. The amphibolites have N-MORB-like compositions and are characterized by high positive zircon $\varepsilon_{Hf}(t)$ (+7.2 to +14.0) and whole-rock $\varepsilon_{Nd}(t)$ (+5.5 to +6.0) values. Their compositions have been modified by crustal contamination. The formation of these quartzites and amphibolites was related to an early Neoproterozoic rift adjacent to the African side of the northern East African Orogen, followed by opening of part of the Mozambique Ocean.



HU Peiyuan and ZHAI Qingguo et al., 2018- Lithos, 320-321: 403-415

The southwestern extension of the Jiao-Liao-Ji belt in the North China Craton: Geochronological and geochemical evidence from the Wuhe Group in the Bengbu area

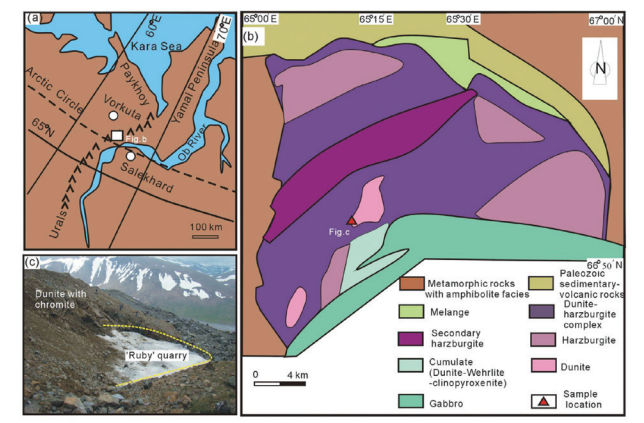
ABSTRACT: The Wuhe complex is located at the southeastern margin of the North China Craton. The complex consists of metamorphosed Paleoproterozoic potassic granitoids and supracrustal rocks, of which the latter include the Fengyang and Wuhe Groups. Meta-mafic rocks from the lower Wuhe Group have igneous zircon U-Pb ages of 2126±37 Ma with $\varepsilon_{Hf}(t)$ values of −6.22 to +8.38, and xenocrystic zircons of 2.39–2.36 Ga, 2.55–2.54 Ga and 2.77–2.69 Ga. Geochemically, the meta-mafic rocks can be classified into two groups. Group 1 island arc tholeiites display flat to slightly right declined REE patterns and moderately negative Nb, Ta, Zr, and Ti anomalies. Group 2 mature arc calc-alkaline basalts display strongly fractionated chondrite-normalized REE patterns and evidently negative Nb, Ta and Ti anomalies. These meta-mafic rocks formed by partial melting of sub-arc depleted mantle wedge which had been modified by slab-derived melts at an active continental margin. Depositional age of the group can be constrained in the period of 2.16–2.10 Ga based on ages of the youngest detrital zircons and latter intrusions. U-Pb ages of detrital zircons yield major age peaks of 2.69 Ga and 2.52 Ga, with minor peaks at 2.88 Ga, 2.78 Ga, 2.35 Ga and 2.17 Ga, most of which are derived from the late Mesoarchean to early Paleoproterozoic granitoids in the Wuhe complex and the Jiaodong Terrane. Metamorphic zircons in the marbles coexisting with garnet amphibolites or granulites occur as either single grains or overgrowth (or recrystallization) rims surrounding magmatic zircon cores and yield ages of 1882±19 Ma to 1844±15 Ma. The comparable ca. 2.1 Ga potassic granites with A-type granite affinity, the ca. 2.1 Ga meta-mafic rocks with arc-like geochemical features, the 2.1–1.9 Ga meta-sedimentary units and the 1.9–1.8 Ga subduction- and collision-related granulite-facies metamorphism suggest that the Wuhe complex and the Jiao-Liao-Ji belt share the same late Paleoproterozoic tectonic evolution process and the former is the southwestern extension of the latter.

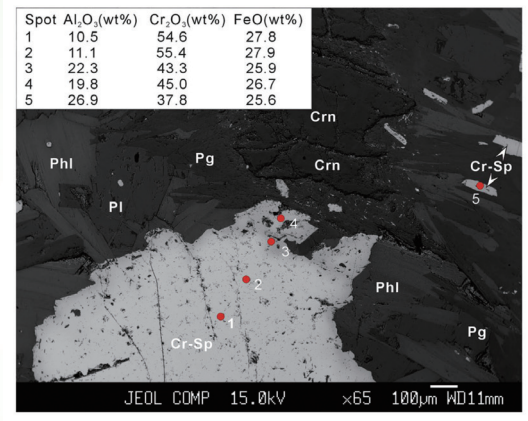


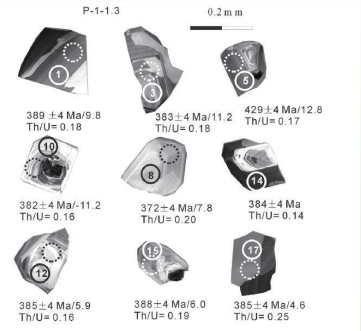
LIU Chaohui et al., 2018- Lithos, 304-307: 258-279

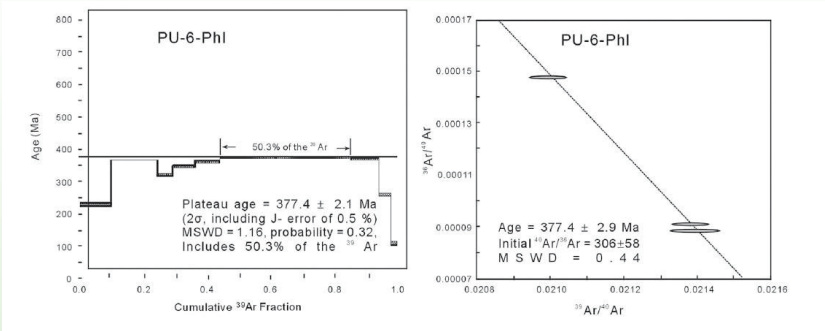
A red-corundum-bearing vein in the Rai–Iz ultramafic rocks, Polar Urals, Russia: The product of fluid activity in a subduction zone

ABSTRACT: The veins in the mantle wedge peridotite can record the activity of slab-derived melt/fluid, which is the reflection of the material circulation between crust and mantle. A red-corundum-bearing vein is present in the Rai–Iz ultramafic rocks in the Polar Urals, Russia. The ultramafic rocks are harzburgite and dunite, and the red corundum-bearing rocks consist of phlogopite, paragonite, oligoclase, red corundum, and chromian spinel. Red corundum occurs as prophyroblasts or fine grains that contain 92–98 wt% Al_2O_3 and 2–7wt% Cr_2O_3. Chromian spinel has $Cr^{\#}$ values [100Cr/ (Cr+Al) atomic ratio] of 46–78. Oligoclase is characterized by An values of 20–30. Phlogopite is Ba-rich (BaO=0.8–2.7 wt%) and paragonite is Sr-rich (SrO=0.8–2.3 wt%). Zircons from the oligoclasite show oscillatory zoning and Th/U values of < 0.2, indicating crystallization from fluid. A zircon weighted-mean $^{206}Pb/^{238}U$ age of 382±2 Ma and a phlogopite $^{40}Ar/^{39}Ar$ plateau age of 377±3 Ma indicate that the red-corundum-bearing vein formed at 380 Ma. The occurrence and formation age of the vein, structure and composition of vein minerals, and zircon ε_{Hf} values (–11 to +13) suggest that the vein was the product of interaction between a subduction-zone-derived fluid and mantle wedge peridotite.









MENG Fancong et al., 2018-Lithos, 320-321: 302-314

2.2 Results of Projects of the National Natural Science Foundation of China (NSFC) Completed in 2018

Comparison of the main metallogenesis of the Himalayan-Zagros collisional orogenic system (chief researcher: HOU Zengqian)

This study shows that the two collisional orogen of Himalaya-Tibet in China and the Zagros in Iran are characterized by different convergent processes and metallogenesis. The Himalayan-Tibetan orogen experienced three stages of evolution, including an early stage of compressional shortening, a middle stage of large scale of transpressional strike-slip movement, and a late stage of extension in the core zone and outward propagation of compressional deformation. Correspondingly, skarn Fe-Cu-Pb-Zn deposits formed in the early stage, porphyry Cu, orogenic Au, MVT Pb-Zn, and carbonatite-related REE deposits occurred in the middle stage, and a late stage of porphyry Cu, MVT Pb-Zn, and leucogranite-related polymetallic deposits. The Zagros orogen experienced the early and middle stages of evolution history, with the formations of porphyry Cu, orogenic Au, and MVT Pb-Zn deposits. The Hf isotope mapping of magmatic rocks in the Lhasa terrene, the Himalayan-Tibetan orogen indicates that porphyry Cu deposits are exclusively located in regions with high ε_{Hf}(>5) juvenile crust, skarn Pb-Zn deposits cluster in the oldest crustal regions or developed along the margin of the old crustal block bounded by lithospheric faults, and skarn Fe-Cu ore deposits are typically localized along a terrane boundary fault, i.e., lithospheric discontinuity. Collision-related porphyry Cu deposits were formed throughout the entire stages of the collisional process. Porphyry magmas, copper, sulfur, and water were generated mainly from the thickened juvenile lower crust but not from mantle wedge. Hydrothermal alteration-mineralization zonation pattern is characterized by strong overprints of different stages of hydrothermal minerals. Collision-related MVT Pb-Zn deposits occur in fold thrust belts and forelands of the continent-continent collisional zones and formed throughout the entire stages of the collisional process. Metals-bearing fluids derived from basinal brines with metal sources possibly being volcanic-sedimentary rocks. Extensional and strike-slip faults control the locality of orebody. Ores occur in evaporite diapir structure, carbonate or evaporite dissolution-collapse structure, porous dolostone, and pre-existing barite-bearing carbonate. Mixing of metals-bearing fluids with reduced fluids led to the precipitation of Pb and Zn sulfides.

Study on the seismic faulting process in the drilling cores of the Wenchuan Earthquake Fault Scientific Drilling (chief researcher: LI Haibing)

This project focused on the core of the 5 boreholes drilled by “Wenchuan Earthquake Fault Scientific Drilling (WFSD)”. On the basis of detailed researches on the microstructure, mineralogy, petrology, geochemistry, magnetics and thermal history of fault rocks, we summarized the main conclusion with 1) determining the deformation behavior of Longmenshan fault zone (LMS) for the first time; 2) obtaining some significant cognitions of Wenchuan earthquake rupture mechanism; 3) obtaining new understandings of LMS uplift. This research provides substantial data for studying fault features and ruptures mechanism and has import meaning for understanding the rupture process of great seismic events, as well as basic research in the fields of earthquake prevention and disaster reduction, structural geology and geodynamics.

Spatial-temporal distribution of deep old and juvenile continental crust and its constraint on metallogenesis of northern Xinjiang and adjacent areas (chief researcher: WANG Tao)

This project carried out Nd-Hf isotopic mapping of felsic rocks in northern Xinjiang and adjacent regions. Based on studies surrounding petrogenesis and sources of plutonic rocks from the eastern South Tiansahn Belt and northeastern Tarim Craton, we assign the Xinger fault as the boundary between the Tarim Craton and SW CAOB. We also carried out statistical analysis (or isotopic mapping) of zircon xenocrysts, and the results suggest that it is

an effective method to trace the nature of the deep continental crust. In addition, this project has compiled the spatial and temporal distributions of granitoid intrusions in northern Xinjiang and adjacent regions. The juvenile crusts beneath the northern Xinjiang occupy an area of ca. 800000 km^2, accounting for more than 50% of total area. The results of this project are expected to shed new light on our understanding of crustal architecture and continental growth. We propose that the regional-scale isotopic mapping of igneous rocks is a reliable tool to reveal compositions, architectures and metallogenic controls of the deep lithosphere. On a larger scale, the ratios of juvenile/ancient areas of the huge orogenic belts have a potential for quantitatively/semi-quantitatively determining/describing their types. Based on the above ideas, a new IGCP project (IGCP-662) was successfully applied.

Tectonics of the Tibetan Plateau (chief researcher: ZHAI Qingguo)

This study focused on the evolution of the Paleo-Tethys Ocean in the Tibetan Plateau through the research on ophiolite and high-pressure metamorphic rocks in the Qiangtang area. After three years work, some new perspective was obtained as follow: 1) Zircon U-Pb dating on gabbros and plagiogranites yielded ages of 437–501 Ma, suggesting that the W. Gangma Co ophiolite was the oldest ophiolite in the Paleo-Tethys suture zone, and the opening timing of the Paleo-Tethys Ocean was at least in the Cambrian. 2) Devonian-Carboniferous arc-affinity granites were discovered in the central Qiangtang area (364–346 Ma), indicating that northward subduction of the Paleo-Tethys Ocean should start in the Late Devonian. 3) Cameca U-Pb dating on zircon and rutile suggested that the age of the peak eclogite facies metamorphism of the Qiangtang eclogite was ca. 237–232 Ma, and the age of exhumation was ca. 217 Ma, thus the Qiangtang high-pressure belts was formed in the Mid-Late Triassic. 4) Zircon U-Pb dating suggested that the Dongqiao ophiolite was formed in 188–181 Ma, the Beila ophiolite in 173–164 Ma, and the Zhongcang ophiolite in 163 Ma, so the Bangong-Nujiang Ocean might have opened in the Early Jurassic and closed in the late Early Cretaceous following collision between the Lhasa and Qiangtang terrane. 5) The Lhasa terrane was derived between Arabian and Indian continents in the Neoproterozoic (930–540 Ma), and it had undergone multi-stages of accretionary orogeny. 6) The Simian ophiolite was formed in the Mesoproterozoic (1066 Ma) in the West Sichuan area, and it recorded the oceanic evolution in the Yangtze terrane during Meso- to Neo-proterozoic. In a summary, this work will play a key role in understanding the detailed evolutionary processes of the Paleo-Tethys Ocean, and provide important information for exploration of mineral resources.

Late Permian organic reefs and palaeo-geographic conditions in the Linxi, Inner Mongolia and the Jiutai, Jilin (chief researcher: TIAN Shugang)

This study focused on Land-marginal reefs of the Late Permian in the Linxi area of Inner Mongolia and the Jiutai area of Jilin Province. Some important achievements and progresses have been got by carrying out the project. Reef-strata have been divided and correlated carefully, and the north-margin of Huabei Platform be proved again as the open-marine conditions in light of first-discovered reefs, ammonites, *Lopingoceras guangdeense* and *Micrhystridium* sp. Three reef-built conditions have been distinguished, i.e. the land-marginal carbonate terrace, the simple volcano-arc system and the compound volcano-arc system. Especially a lot of "volcano-clast baffle-reefs" occurred in volcano-arc conditions, which break through the conception that reefs are carbonate buildings. Palaeo-geographic evolutions in the north-margin of Huabei Platform have been restored, and it is proved that the Xing-Meng Sea-Trough closed and swelled up in the Late Permian, by summing up evidences about reef-growths, reef-built conditions, co-occur sedi-structures and measured data.

Stratigraphic correlation of high precision between South China and Tibet during the major turning period of Permian-Triassic biotic evolution (chief researcher: YAO Jianxin)

Through detailed comprehensive stratigraphic research, the results revealed that the sedimentary characteristics,

correlation relations and distribution of the Triassic marine red beds in eastern Sichuan and Chongqing of South China, the regional correlation of middle Triassic Poduan Formation has been established in Guizhou and Yunnan, the main controlling factors of organic matter accumulation of the Upper Permian Dalong Formation have been revealed in western Hubei. Based on the comprehensive analysis of the data, the characteristics of the Middle-Late Triassic coral fauna, ecological environment and correlation relation in important areas of South China and Tibet were established, the correlation relationship between the international and Chinese chronostratigraphic series and the correlation relationship of lithostratigraphy and biostratigraphy among North China, South China and Qinghai-Tibet Plateau were showed in "Stratigraphic Chart of China (2014)" in Yao J X et al. (2016). The above results have revised and improved the stratigraphic division standards of the Late Permian-Late Triassic in South China and Tibet, and established the correlation between the relevant strata, which provided an important basis to carry out the comparative study on the extinction and recovery in different regions during the Permian-Triassic period.

Petrogenesis and geological significance of early-middle Triassic mafic volcanic rocks from southeast Inner Mongolia (chief researcher: LIU Jianfeng)

This project carried out petrological, geochronological and geochemical studies on the early-middle Triassic mafic volcanic rocks in southeast Inner Mongolia. The rock associations, spatial and temporal distribution, petrogenesis and tectonic settings of the early-middle Triassic volcanic rocks on both north and south sides of the Xar Moron River ophiolite belt were studied based on previous and our new data, and major progresses are listed as following: the early-middle Triassic volcanic rocks (251–230 Ma) on the north margin of the Sino-Korean paleoplate are mainly composed of intermediate basaltic andesite and andesite, which are distributed to the north of Chifeng City. Compared with the Permian volcanic rocks, the early-middle Triassic rocks display stronger light and heavy REE fractionation, which indicates that they were formed by partial melting of thickened lithosphere metamorphosed by subduction-zone fluid. Besides, mid-late Triassic (230.4±2.2 Ma) asthenosphere-derived enclaves were identified in the Jiefangyingzi pluton on the north margin of the North China craton for the first time.

Formation and evolution of the Precambrian crystallization basement of the southeastern Tibet (chief researcher: ZHANG Zeming)

The Precambrian crystalline basements in the southeastern part of Tibetan Plateau are ancient component of orogens, and record the formation and reworking histories of continental crust and orogen. This project conducted a petrological, geochemical and geochronological study for the Precambrian crystalline basements exposed in the southeastern Tibetan Plateau. The obtained results revealed the component, formation time and environment, metamorphic, deformation and magmatic events of the crystalline basements, and multiple reworking during the Neoproterozoic, Paleozoic and Mesozoic orogenesis, reconstructed their origin and tectonic affinity, and established the Mesozoic terrane assembly and tectonic model of the southern Tibetan Plateau. The relevant results provided a new insight into the formation and growth of the Tibetan Plateau.

Magmatism system dynamics in Shujiadian, Tongling (chief researcher: WU Cailai)

The project carried out the field outcrop in Shujiadian area in Tongling, the exploration borehole core of the copper deposit and the 3000-meter scientific drilling core as the research object. This study shows that pyroxene accumulative enclaves in the shoshonitic series are formed at depths of 45–60 km, while a large number of dioritic microgranular enclaves in the high-K calc-alkaline series are formed at depths of 12–15 km, which is the result of magmatic mixing from different sources. Zircon Lu-Hf isotope analysis confirms that the shoshonitic series magma comes from the enriched mantle with a small amount of crustal material, while the high-K calc-alkaline series magma are derived from both enriched mantle and ancient crust. Combined with the characteristics of Mesozoic magmatic activity in

eastern China, it is believed that the deep lithosphere delamination occurred before 147 Ma, and the mantle-derived basic magma rose to the crust-mantle transition zone to form a huge deep magma chamber. The heat of the magma chamber itself and the latent heat of magmatic crystallization cause partial melting of the low-melting point material in the upper crust, forming a shallow acid magma chamber. The shoshonitic rocks are mainly derived from the differential magma in the deep magma chamber, while the high-K calc-alkaline magma comes from the mixture of the different magma in the deep magma chamber and the acid magma in the shallow magma chamber.

Coupling between deformation and fluid flow in the Baiyangping ore-producing hydrothermal system, Sanjiang area (chief researcher: ZHANG Hongrui)

This project chooses the Baiyangping for case study of coupling between deformation and fluid flow. The regional deformation of Baiyangping district had been revealed by geological mapping of the Hexi-Zhongpai cross section. The ore-forming structures had been analyzed during geologic mapping of thirteen underground mines from the Baiyangping, Liangchaqing, Zhatang, Wudichang, and Liziping ore blocks. The composition of the ore-bearing fluids had been determined by C-O-Sr isotopic data of calcite and celestine, and the source of the metal had been traced by S-Pb isotopic data of sulfide. Finally, the coupling model between deformation and ore bearing fluid flow had been proposed. The major achievements include that: (1) demonstrated that the deformation styles of the Cenozoic Lanping basin are mainly N-S trending open folds and high anger reverse faults; (2) the rotation of Lanping basin is important for the extension of fractures and infilling of the ore-bearing fluids. These achievements enriched the contents of orefield structure, and provided important data for understanding the coupling between deformation and ore bearing fluid flow.

Formation mechanism and correlation for Molar Tooth Carbonate – The sedementary record in the Meso-Neoproterozoic (chief researcher: KUANG Hongwei)

Based on microfabric, mineral geochemical test and analysis, this project revealed global characteristics of Molar Tooth Carbonate (MTC) (including microscopic fabric, petrology, geochemistry and controlled factors), perfected the genetic model of MTC, and explored the Precambrian marine nature. A series of good progresses have been made in the following aspects by four years of study: 1) There are some new MTC sections discovered in Neoproterozoic Kangjia Formation of Benxi, Liaoning and Xiangkuang Formation of Penglai Group in Qixia, Shandong, which can be compared with the MT structures developed in the Neoproterozoic in Xuhuai and Jiaoliao Area. 2) We investigated into many Neoproterozoic MTC sections in Shandong, Jiangsu, Anhui, Henan and Yunnan Provinces. At meantime, by carrying out cooperation and exchanging with Professor Linda Kah from University of Tennessee, the comparative study was carried out with Belt supergroup in North America. 3) The results showed that MTC were formed in the early diagenesis and the origin, development and disappearance of MTC were dependent on the marine chemical properties, temperature, redox condition and the microbial dissimilatory iron reduction in the Proterozoic era. 4) Stromatolite, as the biological-sedimentary structure related to the oldest living things on the Earth, have episodic sedimentary characteristics of their prosperity and diminish, which is similar to the development and distribution of MTS on the Earth. 5) As the correlation mark, MTC has a good application effect on studying stratigraphic correlation and reconstruction of paleocontinent in Meso-Neoproterozoic.

Late Neoarchean to early Paleoproterozoic tectono-magmato-thermal events in the Daqingshan area: Geologoly, geochemistry and zircon (chief researcher: DONG Chunyan)

This project carried out field geological, geochemical studies and SHRIMP U-Pb zircon dating on Neoarchean-early Paleoproterozoic rocks in the Daqingshan area, arriving at main understandings as follows: 1) The Sanggan Group is

a set of high-grade metamorphic basic-acid volcanic rocks formed in the late Neoarchean, being the residual Archean basement in the Khondalite Belt. 2) The Lower Ural Mountain Subgroup is a metamorphic basic-acid volcanic sedimentary sequence formed in the early Paleoproterozoic. Compared with the Sanggan Group, the Lower Ural Mountain Subgroup is younger in magmatic zircon ages, generally 2.35–2.45 Ga. 3) Late Neoarchean intrusive rocks, together with the Sanggan Group and the Lower Ural Mountain Group, strongly superimposed tecton-thermal events in the late Neoarchean-early Paleoproterozoic and the late Paleoproterozoic. 4) There are obvious $\delta^{18}O$ differences between metamorphic zircons from different meta-sedimentary rocks, and also, there are obvious $\Delta^{18}O$ differences between detrital and metamorphic zircons, mainly reflecting the differences in O isotopic compositions between rock systems and metamorphic fluids. 5) Same as those in Ural Mountain, "the Daqingshan supracrust rock" in the Daqingshan area, which once considered being early Paleoproterozoic in formation age, was thought to have formed in the late Neoarchean. 6) The Daqingshan area underwent intense tectono-thermal events of the late Paleoproterozoic, resulting in the final assemblage of the North China Craton.

The tectono-thermal events and tectonic setting during the late Neoarchean in western Shandong (chief researcher: XIE Hangqiang)

This study carried out field geological studies, mapping, SHRIMP U-Pb zircon dating, zircon Hf-isotope analysis, whole-rock Nd-isotope analysis, and major and trace elements analysis, arrived at main understandings as follows: (1) The Neoarchean supracrustal rocks in western Shandong can be divided into two periods: the early Neoarchean (2.7–2.75 Ga) and the late Neoarchean (2.5–2.56 Ga). (2) The pillow lava with different deformations was found in early Neoarchean supracrustal rocks and it is the largest known Archean pillow basalt in the North China Craton. It can be divided into N-MORB type and E-MORB type, and this difference come from the mantle source, suggesting that the obvious differentiation in the mantle occurred at western Shandong area even in the 2.7 Ga. (3) Two anatexis events with age of 2.6 Ga and 2.5 Ga were identified in western Shandong, combined with the widespread occurence of inculsions of early TTG and meta-basalt in 2.5 Ga potassium-rich granite, recording the transformation of Neoarchean crust from oceanic crust and immature continental crust to manture continental crust in western Shandong. (4) The superposition of two deformation events in late Neoarchaean was identified in Qixingtai area. (5) We defined that the Shanggang pluton was dominated by the 2.7 Ga tonalite which was suggested to be 2.6 Ga trondhjemite. (6) Well-preserved magmatic mingling at the end of Neoarchean was found in Sihaishan-Dianzi area, southwestern Shandong. It shows zonal character in spatial distribution, recording the zonal extension of 2.51 Ga in western Shandong. (7) Considering various evidences and comparation with Archean geology in south Africa, we pointed out that there are large-scale zonal structures in Western Shandong in Neoarchean and the deformation patterns are similar to those of collisional orogen, suggesting that the plate-like tectonics have begun in western Shandong at around 2.5 Ga.

Formation and evolution of Archean basement in eastern Hebei: Geology, geochemistry and zircon SHRIMP U-Pb dating (chief researcher: WAN Yusheng)

This project carried out detailed studies on Archean rocks from east to west in eastern Hebei, including Archean granitoidic rocks in eastern coastal belt, Archean Jielingkou diorite (the largest Archean diorite body in the North China Craton), Archean rocks in the Huangbaiyu-Yangyashan area, TTG rocks in the Santunying area, and meta-mafic-ultramafic rocks in the Zunhua area. Based on abundant geological, geochemical and SHRIMP U-Pb zircon dating data, some important conclusions and progress have been arrived at: 1) Continental material older than the Mesoarchean are widely distributed in eastern Hebei, with an ancient nucleus probably occurring in the Huangbaiyu-Yangyashan area; 2) late Neoarchean tectono-magmato-thermal events were well developed in eastern Hebei, as a result of mantle underplating. 3) Archean tectono-chronological frame has been established in the region; 4) the meta-mafic-ultramafic rocks in Zunhua do not belong to late Neoarchean ophiolite suite, as thought by some geologists; 5) combined with studies in Anshan-Benxi and western Shandong, it is further supported that a huge double magma belt

occurs in the western margin of the Eastern Ancient Terrane; 6) we summarize the temporal and spatial distribution and composition features of Hadean to Paleoarchean rocks and zircons in the main land of China.

The distribution of the Pan-African orogenic belts in the East Antarctica Craton and geological features of the Prydz belt (chief researcher: REN Liudong)

The Pan-African event is widely distributed in East Antarctica (EA) craton, including both the coastal regions and interior of the EA. From aspects of the shear zones, granites, pegmatites, time of high-grade metamorphism and detrital zircon age peaks of the downflowing sediments from the inland, the Pan-African event in the EA and adjacent areas in the reconstructed Gondwana, like SE Africa, southern India and SW Australia, was described in the paper. The water or fluid available along the shear zones was responsible for retrogression of the earlier, e.g., Grenville age, high-grade outcrops to later Pan-African amphibolites facies metamorphism. In geochemistry, the granites are generally anorogenic, ocassionally with some gabbros or dolerite dykes, showing sign of bimodal feature. Meanwhile, the event has influenced most isotopic systems, including the U-Pb, Sm-Nd, Rb-Sr and Ar-Ar systems, giving Pan-African apparent ages. Spatially, the Pan-African event is demonstrated from possibly local granitic magmatism, to wider medium-high grade metamorphism, and mostly widespread in resetting for some isotope systems, suggesting the prevailing thermal effect of the event. Before Gondwana formation, local depressions in the EA may have been filled with sediments, implying the initial breakup period of the Rodinia. The later Pan-Gondwana counterrotating cogs shaped the interstitial fold belts between continent blocks and formed a set of shear zones. The mafic underplating in the Gondwana may be responsible for the typical features of the Pan-African event.

Tectonic coupling between Kumukuli basin and adjacent orogenic belts: Evidence from paleomagnetism and low-temperature (chief researcher: LU Haijian)

The Kumkol basin, situated between the major Hoh Xil and Qaidam basins, is tectonically controlled by the Altyn Tagh (ATF) and Kunlun faults. The project investigated sedimentology, tectonics, and paleomagnetism of Cenozoic strata in the basin and low-temperature thermochronology of E-W trending bedrocks, north and south of the basin. We have made some achievements in following aspects. First, a new two-stage uplift model of the Tibetan Plateau (TP) was proposed based on sedimentologic, paleomagnetic and low-temperature thermochronological investigations in northern Tibet. Second, we obtained some insights into uplift mechanism of the TP. In addition, there were several major geological events in and around the TP during the late Oligocene–early Miocene. Finally, the provenance of Cenozoic sediments in the northern Qaidam basin was reconstructed based on sedimentological and paleocurrent analyses of the Lulehe Formation and detrital zircon U-Pb dating of Mesozoic strata in the northern Qaidam Basin. The results, in combination with existing paleocurrent and seismic reflection data, collectively indicate that although the source area cannot be specified by matching zircon U-Pb ages in sedimentary rocks with crystalline basement source rocks, other evidence points consistently to a unified proximal northerly source area (the northern Qaidam Basin margin and the southern Qilian Shan).

P-T-t-D path base on quantitative data of porhpyroblast growth: A case study of Qilian Tuolemuchang (chief researcher: CAO Hui)

This project carried out the comparative study on different closed temperature mineral dating age used for constraining deformation and Metamorphism. Monazite and rutile separated from garnet mica schist and mica schist samples, which were collected from Fenzishan Group and Jingshan Group, Jiaobei Massif were analyzed for U-Pb isotopic age in this study. It reveals that Fenzishan Group and Jingshan Group not only experienced the Proterozoic (1869±16 Ma~1864±14 Ma) metamorphism, but also overprinted by Triassic deformation and metamorphism

(215.1±4.2 Ma~217.8±6.3 Ma).

Precise determination of Ti isotope composition in rock samples and geolocial application in mantle process (chief researcher: TANG Suohan)

High-precision Ti isotopic measurement of igneous samples and peridotite samples (high-Fe/Ti and high-Mg/Ti samples) was established in this project. (1) Ti separation was achieved by ion exchange chromatography using Bio-Rad AG® 1-X8 anion exchange and DGA resins. For igneous samples such as andesite, basalt, dolerite, and vanadium titanomagnetite, a two-column procedure was used, while for high-Fe/Ti and high-Mg/Ti samples a three-column procedure was required. (2) Ti isotopic ratios were analysed by MC-ICPMS, and instrumental mass bias was corrected using a ^{47}Ti–^{49}Ti double-spike technique. (3) Eleven reference materials (BCR-2, BHVO-2, GBW07105, AGV-1, AGV-2, W-2, GBW07126, GBW07127, GBW07101, JP-1, and DTS-2b) were analysed. Of which, Ti isotopic compositions of BCR-2, BHVO-2, AGV-1, AGV-2 and W-2 are consistent with published literatures, making sure that the method is reliable. Establishment of high-precision Ti isotopic measurement in domestic laboratory offers Ti isotope research opportunities for geological researcher and accumulates data for lithospheric mantle evolution.

Genesis of comb quartz layers: Case studies from porphyry Cu deposits at Qulong, Tibet and Now Chun, Iran (chief researcher: YANG Zhiming)

To test these hypotheses, as well as to constrain genesis of porphyry Cu systems, comb-layered quartz from Qulong and Now Chun porphyry Cu deposits and Bilihe Au deposit have been selected for case studies. Study results indicate that comb quartz layers from Qulong and Now Chun deposits, containing abundant fluid inclusions, have $\delta^{18}O$ values of 6.2–7.6‰ and were crystallized at temperature of 760–800°C, indicating their origin from magmatic-hydrothermal fluids. In contrast, comb-layered quartz from Bilihe is characterized by the presence of many well-kept melt inclusions but the lack of primary fluid inclusions. Heating experiments using a furnace indicate that these melt inclusions at Bilihe generally formed at temperatures >950°C, demonstrating their magmatic origin. Therefore, the presence of comb quartz layers is not sure to indicate fluid saturation. Our studies also indicate: (1) Au mineralization at Bilihe is magmatic origin. This defines a new type of Au deposit, and thereby opens new potential for Au exploration. (2) The water in the Cu-forming porphyry magmas at Qulong was concentrated during dehydration reactions in the upper parts of the subducting continental plate and/or degassing of mantle-derived H_2O-rich ultrapotassic and (or) alkaline mafic magmas. (3) A slightly early separation of the sulfide phase (relative to H_2O-rich volatiles) from a porphyry magma would facilitate the concentration of metals in smaller volumes of material, from which they could be released later. This seems to be the most important step in the generation of a giant porphyry Cu deposit. Ten papers have been already published in the international journals, including Econ Geology, SEG Spec Pub, Journal of Petrology, and CMP, with the fund of this project.

Isotope thermochronological research on orogenic and ore-forming process in eastern part of the Western Tianshan orogenic belt (chief researcher: CHEN Wen)

The main achievements of this project are as follows: (1) The tectonic-thermal evolution history and metallogenic process of the key sections of the orogenic belt in the eastern part of the Western Tianshan Mountains have been reconstructed. (2) It is considered that the closure time of the Southern Tianshan Ocean should be at least before the early Permian, and the post-collision began at ~266 Ma; (3) The first 1:50000 scale denudation depth map in China has been compiled, and a set of thematic mapping methods for large scale denudation depth has been formed. 4) It is found that there are three stages of hydrocarbon fluid filling in Cretaceous reservoirs in the Krasu thrust belt of Kuqa basin. The reservoir-forming stages are 20–5 Ma, 5–2.5 Ma and 2.5–0 Ma, respectively. (5) The metallogenic epoch and genesis of Wangfeng gold deposit and Niazi Tiekxie gold deposit in Western Tianshan are determined, and the

metallogenic model of orogenic gold deposit on both sides of the fault in the northern margin of Narati in Western Tianshan is put forward. It is found that there are differential uplift and denudation phenomena in the Niazi Tiekxie gold deposit, and it is believed that there are ore bodies in the deep part of the south and north sides of the mining area, and the deep metallogenic potential of the whole mining area is huge.

Crustal evolution of high grade metamorphic block from the Bolingen Islands, Antarctica: Constraints from geochemistry and zircon U-Pb, Hf-O isotopes (chief researcher: WANG Yanbin)

Felsic orthogneiss in the Bolingen Islands, Antarctica, represent important suites of rocks exposures for investigating the development of high-grade metamorphic terrains in East Antarctica. Zircon grains from felsiic gneiss will be analysed for U-Pb ages and Hf isotope isotopes, using in situ SHRIMP and LA-ICPMS techniques, to evaluate the terrane-scale crustal evolution, and for the correlation of terranes. The dating results from Bolingen Islands, Antarctica, indicate 1091±25 Ma, 1031±8 Ma, 523 Ma multiple geological events. The Hf model ages 1.8–2.4 Ga imply rapid crustal generation inresponse to depleted mantle input. The data reveal that crustal generation in part of Gondwana was limited to major period at 1.8–2.4 Ga , and that the zircons crystallized during repeated reworking of crustal formed at 523 Ma and 1.03 Ga. The significance of this orogenic belt affected by the Grenville and Pan-African event will be properly evaluate, such as the degree of crustal recycling or the importantance and timing of juvenile (mantle-derived) contributions to the crust. The study will provide an important temporal framework for the correlation of other parts of a complex mosaic of metamorphic terraness from East Antarctica.

Pleistocene palynological sequence and paleoecology reconstruction of karst caves in Chongzuo, Guangxi (chief researcher: LI Suping)

Based on pollen analysis of samples collected from eight karst caves in Chongzuo, Guangxi in Pleistocene, we reconstructed the paleovegetation and paleoclimate here. According to the MAT (mean annual temperature) and MAP (mean annual precipitation) values, we obtained the changing curves in Pleistocene. The MAT tends to decline from 2.0 Ma to 0.06 Ma, while the MAP shows an increase trend. The climate around 1.0 Ma was warmer than other periods which may be correlated with the intensification of Asian summer monsoon. Compared with the climate of Nanning today, the climate in Pleistocene was much cooler and drier. The MAP of the fossiliferous layers were higher than those from unfossiliferous layer, while MATs shows little differences. This may suggest that precipitation are quite important to the distribution of mammals especially in karst areas.

Study of Late Devonian Famennian brachiopod fauna from western Junggar, Xinjiang (chief researcher: ZONG Pu)

This project is to study and subdivide the Upper Devonian to Lower Carboniferous strata, to systematically study the brachiopods of the Late Devonian to Early Carboniferous (in particular Famennian), in addition, to evaluate the probable effects in western Junggar caused by two Late Devonian mass extinction events (Frasnian-Famennian event and Latest Famennian event). We have made progress in the following aspects. (1) We consider that the Famennian sequence is composed of the Hongguleleng Formation and the Heishantou Formation (the lower part), and the former formation is divided into five lithological members. Based on the combined evidences of conodonts, brachiopods and ammonoids, new proposals about the age of these formations and members are provided. (2) Five brachiopod assemblages are recognized in western Junggar, based on the abundant brachiopod fossils from the Famennian in the Bulongguoer and adjacent sections. (3) The carbon isotope study suggests that the lower Member of the Hongguleleng Formation probably may not contain Frasnian deposits, or even lacks the basal part of the Famennian.

Systematic and biostratigraphic studies on the early Meishucunian small shelly

fossils from the Daibu Member of the Yongshan area in Yunnan Province (chief researcher: YANG Ben)

This study focused on the Xiaotan section in the northeast Yunnan. In this section, we found small shelly fossils at the base of the Daibu Member for the first time, and reported the Cloudina in the basal Cambrian deposits in the Kuanchuanpu region of Shaanxi, the Maidiping region of Sichuan etc. Similar fossils assemblage containing a new cloudinids Rajatubulus was also reported from the Karatau–Naryn Terrain of Kazakhstan. The study confirmed that the Daibu Member of East Yunnan is an early Cambrian deposit correlated with contemporaneous strata of the regions menmetioned above. The study provides new knowledge for the reassessment of the E-C boundary. And some of the tubular fossils such as Rugatotheca, Rajatubulus may have close affinity with some of the Ediacaran (-early Cambrian) fossils including the cloudinids. The study proposed that the mass extinction at the E-C boundary may have not be significant as former suggested. At least some of the metazoans such as cloudinids survived into the Phanerozoic.

Phase equilibrium of the metamorphic PTt paths for granulite from the Namche Barwa (chief researcher: TIAN Zuolin)

This project deeply investigated the metamorphism of the high-pressure metapelitic, metabasic and metagreywacke granulites from the Namche Barwa complex based on the field work, the metamorphic petrology, the mineral major and trace elements, the phase equilibria modeling and the zircon petrochronology. The HP granulites in the Namche Barwa complex are determined to have experienced the clockwise P-T path with the HP granulite-facies metamorphic peak. The core of the Namche Barwa complex is proposed to have a higher metamorphic peak P-T condition. Through the phase equilibria modeling, the partial melting of the HP granulite is predicted to occur dominantly during the prograde heating stage, although the metagreywacke is interpreted to generate a small amount of melt during the early decompression stage. Part of the generated melt has been excluded from the rock, which is likely to form the patches and veins of the leucosome or the leucogranite. The remaining melt is proposed to crystallize during the retrograde decompression and cooling stage. According to the shape, the cathodoluminescence image and the rare earth elements of zircon and the phase equilibria modeling, the metamorphic zircon in the HP granulites is interpreted to grow and/or recrystallize during the retrograde decompression and cooling stage, although minor metamorphic zircon may grow during the prograde stage. Accordingly, the P-T-t paths are constrained for the HP granulites in the Namche Barwa complex, which is applied to develop the tectono-metamorphic evolution of the eastern Himalayan orogen during the ongoing continent-continent collision between Indian and Asian plates.

Origin of platinum group minerals in different types of chromitite from Purang ophiolite, Tibet (chief researcher: XIONG Fahui)

The research content mainly includes the petrological and mineralogical characteristics of mantle peridotite and genesis chromitite, high-pressure minerals such as platinum group minerals and diamonds. After three years of detailed research, some preliminary results of the project have been published. 1) High-Al and high-Cr chromite ore bodies have been found in the Purang peridotite, which were rare in the world. 2) High-Cr chromitite ($Cr^{\#}$ 73–77) and high-Al chromitite also were found in the Dongbo massif in the western section of the Yarlung Zangbo River suture zone in Tibet. 3) Different with the western part of the Yarlung Zangbo suture zone, a large number of ultra-high pressure reducing minerals such as diamond and carbon silica were found in the Dingqing ophiolite in the eastern part of the Bangong Nujiang suture zone and the Boerzin ophiolite in Albania. 4) Proposed chromitite formation of a multi-stage new model, included four stages.

Phase equilibria modeling constraints on the metamorphic-anatectic evolution of metasedimentary rocks within Ji'an and Laoling groups, southern Jilin Province (chief researcher: CAI Jia)

The study results revealed that granulite-facies metamorphism is widespread in Ji'an, Southern Liaohe, Jiaobei, and Bengbu throughout the Jiao-Liao-Ji Belt, moreover, similar clocwise P-T paths and metamorphic ages are obtained for those areas indicating that the granulite facies metamorphism of the rocks within the Jiao-Liao-Ji Belt was a response to Paleoproterozoic continent-continent subduction and collision of the Longgang and Nangrim blocks of the North China Craton in the peak metamorphic stage, followed by post-collisional exhumation in the post-peak decompressional stage.

Tectonic evolution of the Medog shear zone and its constraints on the formation of the Namche Barwa Syntaxis (chief researcher: DONG Hanwen)

This study focused on the Medog shear zone, the eastern boundary of the Namche Barwa Syntaxis (NBS). Based on detailed field mapping, petrographic observation, petrofabric and thermochronological, we found that: (1) the Medog shear zone can be further divided into three sections according to the structure, deformation and metamorphic grade. (2) Two patterns of deformation in the Medog shear zone are observed, which are high-temperature (prism <a> slip, >650°C) and low-temperature deformations (basal <a> slip, 300–400°C), respectively. (3) The dextral shearing along the Medog shear zone was not earlier than the Early Oligocene (29.4 Ma~28.6 Ma), then it experienced three thermo-tectonic events from the Late Oligocene to the Pliocene. (4) The Namche Barwa metamorphic terrane was constrained by the two shear zones, then moved northward and subducted deeply beneath the Lhasa terrane. (5) The main deformation activity time of the two boundary faults of the NBS is 32.7–23.2 Ma, which is consistent with the STDS, MCT and the large strike-slip faults around of the NBS.

Neoproterozoic magmatic events in the Central Tianshan block, NW China (chief researcher: MA Xuxuan)

This study have investigated the 940–930 Ma granites in the Chinese Central Tianshan terrane and the Yili block and collected the data of the reported 1.0–0.9 Ga granites from the Chinese Tianshan area. Study results revealed that the Chinese Central Tianshan terrane (as an integral part of the Tarim block in the Precambrian period) or the proto-Tarim block was situated within the interior of the Rodinia supercontinent, rather than in the outer margin in the Early Neoproterozoic period. Thus, the 1.0–0.9 Ga magmatic rocks cannot be used as the direct evidence for the involvement of the Chinese Central Tianshan or the proto-Tarim block into the Rodinia assemble process. This study provides new insight into the understanding of the evolutionary history of the Chinese Central Tianshan or the proto-Tarim block during the formation of the Rodinia supercontinent.

The geochronology, petrogenesis, and tectonic significance of the Gongpoquan Group volcanic rocks in the Xiaohuangshan-Yueyashan region, Beishan, Inner Mongolia (chief researcher: ZHENG Rongguo)

This study presents zircon U-Pb-Hf isotopic, and bulk-rock major element, trace element, and Sr-Nd isotopic data of samples of the Gongpoquan (GPQ) volcanics from the Xiaohuangshan-Yueyashan area, Central Beishan. Observations of contemporaneous sanukitic and adakitic rocks, together with coeval supra-subduction zone (SSZ)-type ophiolites, and the regional geology of Central Beishan indicate that Paleo-ocean may have still been subducted during Middle Paleozoic. During this process, a spreading ridge was subducted, resulting in the opening of a slab window beneath Central Beishan, which generated the observed 431–382 Ma sanukitoids-adakites. The Beishan Orogenic Collage formed through prolonged multiple accretionary-collisional events in the Paleozoic.

The tectonic significance of the Cambrian volcanic-sedimentary event of the Lhasa terrane, Tibetan Plateau (chief researcher: HU Peiyuan)

This study performed detailed field survey and high-precision analysis to bridge the gap left by previous studies, and discussed the Ediacaran-Cambrian tectonic evolution of the Lhasa terrane in the Tibetan Plateau, through analysis of the Ediacaran-Cambrian magmatic rocks and the Cambrian sedimentary rocks. The detrital zircons of the Cambrian metasedimentary rocks display age peaks at ca. 505, 548, 926, and 1104 Ma, and are interpreted to have Gondwanan source regions. These metasedimentary rocks were probably deposited in a collisional tectonic setting (e.g., foreland basin) related to the Cambrian collisional accretion of microcontinents along the Gondwanan proto-Tethyan margin. Integrating previous studies with the data presented in this contribution, we suggested that the Lhasa terrane was most likely located in the transitional area between the Arabian and Indian-Australian proto-Tethyan margins in the Ediacaran-Cambrian and it originated from the northern segment of the East African orogen.

Himalayan orogenic belt in the Caledonia Time (chief researcher: GAO Li'e)

This study carried out a systematic investigation on the nature of geochronology, petrography and geochemistry of granitic gneisses from the gneiss domes (Xiaru, Mabja, Lhagoi Kangri, and Kangmar within the Tethyan Himalaya and from the High Himalaya (Gyirong, Yadong, and Namche Barwa), which indicates that the Paleozoic granites are peraluminous granite and derived from partial melting of metasedimentary rocks with various degrees of input of mantle-derived materials in the extension setting. Literature data from Sibumasu, Lhasa, and Qiangtang block suggest that Paleozoic granitoids from Cambrian to early Silurian are ubiquitous and share similar geochemical characteristics to Himalayan Paleozoic granites. Therefore, we infer that Himalaya, Lhasa, Qiangtang and Sibumasu block were present along the northern margin of East Gondwana and the Paleozoic granites represented a protracted (~90 Ma) Paleozoic magmatism which possibly could be formed by Andean-type subduction followed by asthenospheric upwelling, passive crustal extension, possibly even a rift event. In additional, the Xiaru granites are enriched in rare metal elements of Nb, Ta, W, Sn, suggesting that the Paleozoic granites in the Himalaya belt could be another new important target for the exploration of race metal deposits.

Genesis of pegmatoid shell: Case studies from the super-large Dahutang tungsten deposit in Jiangxi Province (chief researcher: ZHANG Zhiyu)

The world-class Dahutang tungsten deposit is located within the Jiuling mining district of the central Jiangnan orogenic belt, South China. No.1 ore block of the deposit contains a shell-shaped pegmatoid zone that defines an inner contact zone between the porphyritic-like biotite granite and biotite granodiorite. This study results indicate that the shell-shaped pegmatoid zone formed from primary PGW, with the pegmatoid recording the transition from magmatic to hydrothermal processes during the continuous but multi-stage evolution. The high-temperature, water-rich, high ^{18}O, alkali-metal-rich, low oxygen fugacity, and acidic nature of the fluids that formed the deposit promoted the transportation and further deposition of tungsten.

Tectonic-thermal evolution study of Aqishan-Yamansu Area in Eastern Tianshan, NW China (chief researcher: SUN Jingbo)

This project selected Aqishan-Yamansu island-arc belt and its adjacent regions as the research area. Zircon and apatite (U-Th)/He dating were adopted to reveal the tectonic-thermal evolution and establish the uplift-denudation-time framework. We have made the following achievement: (1) Aqishan-Yamansu area had experienced two rapid uplift-denudation process, which happened during Middle-Late Triassic and Late Cretaceous; (2) The two fault zones on both sides of Aqishan-Yamansu area had experienced two rapid uplift-denudation process, which happened during Middle-Late Triassic and Late Jurassic to Early Cretaceous; (3) The Tuha Basin had experienced rapid uplift during Oligocene. Inside the Tuha Basin, the maximum burial depth of Upper Cretaceous strata, Lower Cretaceous strata and Jurassic strata is less than 2 km, around 2 km and over 2 km, respectively. The maximum burial depth of Jurassic

strata in the edge of the Tuha Basin is less than 2 km. (4) The reason for abnormal old apatite (U-Th)/He ages from some samples in research area is that these apatite grains contain some sub-mineral inclusions that can't dissolve in nitric acid.

The tectonic-thermal evolution and uplift/exhumation of the thrust-fold zones in Kuqa-South Tianshan area: Constraints from low temperature thermochronometry (chief researcher: YU Shun)

The Tianshan orogenic belt thrust towards the Kuqa Depression and a series of Cenozoic thrust-fold zones developed, which contained rich resources of oil and gas. This study conducted the low-temperature thermochronology to constrain the tectonic thermal history and uplift/exhumation history, and the results are summarized as following: (1) The (U-Th)/He ages from 26 FCT zircon standard yielded an algorithmic mean of 28.3±0.3 Ma (S.E.), consistent with the ages of 28.4±1.9 Ma reported by other laboratories. (2) The geochemical compositions and $^{40}Ar/^{39}Ar$ ages from Cretaceous sandstone in Kuqa basin indicated during Cretaceous the high pressure-low temperature rocks had been exhumed at surface and served as the provenance for Kuqa basin. (3) New apatite (U-Th)/He ages and modeling indicated that the Center Tianshan experienced at least late Cretaceous, early Miocene and late Miocene uplift and exhumation events during Mesozoic and Cenozoic. (4) Based on the He ages data from Kuqa basin, the rapid uplift and exhumation events in late Eocene, late Oligocene, early Miocene, and late Miocene-Pliocene were recorded.

Tectonics and geodynamics of the Altai-Junggar intracontinental orogen in the Vendian-Paleozoic (chief researcher: YIN Jiyuan)

This project investigated middle Paleozoic mafic-intermediate dikes and carried out petrology, geochronology, and elemental geochemistry studies to investigate their ages and petrogenesis and thus elucidate the geodynamic processes for the formation of the dikes. We have made the following achievement: (1) Established the minerals association and formation ages of the mafic-intermediate dikes in the Xiemisitai area of West Junggar; (2) Established the geochemical characteristics and petrogenesis mechanism of mafic-intermediate dikes in the Xiemisitai area of West Junggar; (3) Established the rocks association and formation ages for the pluton during the middle Paleozoic in the Xiemisitai area of West Junggar, we propose that a slab roll-back model can account for their petrogenesis and geodynamics process. The above researches have led to the publication of 3 peer-reviewed papers on international scientific journals on the first authorship, such as Geology Review, Journal of Asian Earth Sciences and Tectonophysics.

International IGCP-662 meeting, field geological training and training courses (chief researcher: WANG Tao)

IGCP-662 Project “Orogenic Architecture and Crustal Growth from Accretion to Collision: Examples from the Central Asian Orogenic Belt and Tethyan orogen” is a new initiative funded by the International Geosciences Program (2018-2022) sponsored by the UNESCO and IUGS. The first IGCP-662 workshop, training course and field excursion was successfully held in Gansu and Beijing, China from 15 to 22 September, 2018. More than 90 scholars from 12 countries including Australia, Canada, Britain, France, Israel, Russia, Turkey, South Korea, Mongolia, Pakistan, Germany and China participated the meeting. Oral presentations are presented by 23 scholars, including 19 from foreign countries and the themes of the oral report include ophiolites, constituents, geological history, continental crustal growth and metallogenesis in Central Asian Orogenic Belt, Tethys Orogenic Belt, Jiangnan Orogenic Belt, Lachlan Fold Belt, Appalachia Orogenic Belt and Western Pacific. In addition, 12 poster presentations were presented. On 23 September, post-workshop training courses were held. These courses were taught by Yusheng Wan from Institute of Geology, Chinese Academy of Geological Sciences, Alfred Kröner from University of Mainz, and Suzanne Y. O’ Reilly and Willian Griffin from Macquarie University. The theme of thesecourses is “Using isotopes in zircon and sulfides to understand crust-mantle evolution”. More than 70 experts, young scholars and graduate students took part in the courses.

In December 2018, "Innovation Team on Continental Collision Mineralization" led by Research Professor **YANG Zhiming** was selected as the "Innovation Team in Key Areas" of "Innovative Talents Promotion Program" by the Ministry of Science and Technology.

Team Introduction

The team has eleven people and four research directions, mainly focusing on the issue of whether large deposits can be formed in collisional orogen. Under the guidance of Academician Hou Zengqian, the team selected the Qinghai-Tibet Plateau (the Indo-Asian continental collision started at 65Ma and has lasted until now), the most typical continental collision zone in the world, as their main research area. They have found that not only large but also giant deposits can be formed during continental collision. Furthermore, with the implement of several projects focusing on investigation of the characteristics and genetic mechanism of these large to giant deposits, an innovation team, mainly comprising young and middle-aged scholars, has gradually formed in the Institute.

Fig. 3.1 Innovation Team on Continental Collision Mineralization led by Reaearch Professor YANG Zhiming

In June 2018, the research team on "Metamorphic Geology and Precambrian Geology" led by Research Professor **LIU Fulai** was selected as "Scientific and Technological Innovation Team" in the third batch of "High-level Innovative Scientific and Technological Personnel Training Project (Land Resources, Geological Minerals, and Geological Environment) " of the Ministry of Natural Resources (MNR).

Team Introduction

The scientific research team has made a series of innovative achievements in the field of "Metamorphic Geology and Precambrian Geology", especially in the formation and evolution of the North China craton, the metamorphic evolution and orogenic process of the Paleoproterozoic-Cenozoic composite orogenic belt, high-pressure-ultra-high-pressure metamorphism, land mass dispersion and supercontinent evolution, which has aroused widespread concern and strong repercussions at home and abroad. The academic papers published by the team are among the top ones in the original Ministry of Land and Resources. They are the main force of basic geological research in MNR,

metamorphic-rock mapping of China Geological Survey and research of Metamorphic Geology and Precambrian Geology in the Institute.

Fig. 3.2 The Scientific and Technological Innovation Team of "Metamorphic Geology and Precambrian Geology" led by Research Professor LIU Fulai

Research Professor ZENG Lingsen has been selected as "Scientific and Technological Leading Scientist" in the third batch of "High-level Innovative Scientific and Technological Personnel Training Project (Land resources, Geological Minerals, and Geological Environment)" of the Ministry of Natural Resources.

Research Professor ZENG Lingsen Introduction

The research directions are crustal anatexis and deep process of orogenic belt, lithospheric geochemistry and geotectonic dynamics of the Qinghai-Tibet Plateau, basic magmatism and mantle melting. The research results are mainly published in the important international academic journals (Geology, GCA, EPSL, CMP, etc.). More than 140 papers have been published, including more than 40 papers written as the first author. They have been cited by SCI papers for more than 1,100 times, among which those written as the first author have been cited by SCI for more than 400 times. Among them, EPSL papers have been rated as one of top 25 high-cited papers since 2010. With some of his achievements cited by newly compiled foreign textbooks, he has been invited to make thematic reports at academic conferences or research institutions at home and abroad. In 2014, he was financed by the National Outstanding Youth Fund and selected into the National Special Support Plan for High-level Talents and the Promotion Plan for the first batch of innovative talents. He has won honorary titles such as "Special Allowance of the State Council", "Young and Middle-aged Experts with Outstanding Contributions", "Huang Jiqing Youth Geological Science and Technology Award" and "Qinghai-Tibet Plateau Youth Science and Technology Award".

Fig. 3.3 Scientific and Technological Leading Scientist, Research Professor ZENG Lingsen

The Institute won the second prize in the State Natural Science Award in 2018

Research Professor WAN Yusheng et al. won the second prize in the State Natural Science Award in 2018 for their research work "Age and evolution of the oldest continent in China". They have made important discoveries in many aspects and achieved systematic progress and innovative results. They first discovered various types of 3.8 billion-year rocks in Anshan and a large number of 3.5–3.85 billion-year detrital zircons in eastern Hebei, which laid material foundation and time starting point for the growth and evolution of the early continental crust of China. They identified three complexes with ages ranging from 3.1 to 3.8 billion years in Anshan and revealed in detail the long-term continuous Archean (2.5–3.8 billion years) crustal evolution history of the Anshan-Benxi area. For the first time, they confirmed the existence of multiple Archean tectono-magmatic events in the North China Craton, and put forward a new understanding of the wide distribution of 2.7 billion-year TTG rocks in the North China Craton. They confirmed that the majority of BIF iron deposit in the North China Craton formed in the late Neoarchean, divided the North China Craton into three ancient blocks (>2.6 billion years) and presented important evidence that the plate tectonic system began to work about 2.5 billion years ago.


国家自然科学奖

证 书

为表彰国家自然科学奖获得者，特颁发此证书。

项目名称：中国最古老大陆的时代和演化

奖励等级：二等

获 奖 者：万渝生（中国地质科学院地质研究所）

中华人民共和国国务院

2018 年 12 月 12 日

证书号：2018-Z-104-2-01-R01

Fig. 3.4 WAN Yusheng et al. won the second prize in the State Natural Science Award in 2018

The Institute won two second-class prizes in Land and Resources Science and Technology in 2018

The **research achievement** "the Construction of Metal Stable Isotope Tracer System and Its Application Demonstration in Mineral Deposit Research" achieved by **ZHU Xiangkun's** team won the second prize of Land and Resources Science and Technology, which pioneered the research of non-traditional stable isotopes in China. With China's non-traditional stable isotope geochemistry research in the forefront of the world and China's non-traditional stable isotope research in an international leading position in the field of mineral deposits, it contributes to the development of non-traditional stable isotopes in China.

Both Researcher JIAN Ping and Researcher SHI Yuruo won the second prize in Land and Resources Science and Technology for their research achievements, "Ophiolite Dating and Its Application in the Study of Orogenic Belts". Researchers have carried out long-term, in-depth and systematic study of ophiolites and related rock bodies in the central and southern parts of the Central Asian orogenic belt, breaking through the bottleneck of ophiolites dating, systematically revealing the Paleozoic geological evolution characteristics of the Central Asian orogenic belt, and making important progress and innovative achievements in many fields.


国土资源科学技术奖

获奖证书

获奖成果：蛇绿岩定年及在造山带研究中的应用

获奖等级：二等

获 奖 者：中国地质科学院地质研究所

二〇一八年九月

证书号：KJ2018-2-05-D1


国土资源科学技术奖

获奖证书

获奖成果：金属稳定同位素示踪体系的构筑及在矿床研究中的应用示范

获奖等级：二等

获 奖 者：中国地质科学院地质研究所

二〇一八年九月

证书号：KJ2018-2-06-D1

Fig. 3.5 Two second-class prizes in Land and Resources Science and Technology achieved by the Institute in 2018

4.1 Projects funded by the National Natural Science Foundation of China (NSFC)

National Science Fund for Distinguished Young Scholars

No.	Chief Investigator	Project	Duration	E-mail address
1	YANG Zhiming	Economic geology	2019-2023	zm.yang@hotmail.com
2	ZENG Lingsen	Crustal anatexis and deep orogenic processes	2015-2019	lzeng1970@163.com

Excellent Young Scientists Fund

No.	Chief Investigator	Project	Duration	E-mail address
1	LIU Chaohui	Precambrian geology	2017-2019	denverliu82@gmail.com
2	ZHAI Qingguo	Tectonics of the Tibetan Plateau	2016-2018	zhaiqingguo@126.com

Key Projects

No.	Chief Investigator	Project	Duration	E-mail address
1	WANG Tao	Deep juvenile and old composition, architecture and genesis of the largest juvenile crustal region in the Central Asian Orogenic Belt	2019-2023	taowang@cags.ac.cn
2	LI Haibing	Mechanism of seismic rupture propagation in the Longmen Shan Fault	2019-2023	lihaibing06@163.com
3	JIN Xiaochi	Permo-Triassic paleogeography of eastern Tethys: Paleontological, sedimentological and paleomagnetic evidence from western Yunnan	2017-2021	jinxchi@cags.ac.cn
4	ZHANG Jianxin	Linking metamorphism with orogensis: Insight from early Paleozoic orogenic system in the northeastern Tibet	2017-2021	zjx66@yeah.net
5	LI Haibing	Fault friction over time: Co-seismic weakening and post-seismic in-situ healing	2016-2020	lihaibing06@163.com
6	GAO Rui	The high resolution deep seismic probe and research for the lithospheric structure and deformation in the northeastern Tibetan Plateau	2016-2020	ruigao126@126.com

7	ZHU Xiangkun	A high-resolution study on Cryogenian interglacial oceanography: A record from the Yangtze basin	2015-2019	xiangkun@cags.ac.cn
8	LIU Fulai	The spatial extension, multiple metamorphism and magmatism, and tectonic evolution of the Jiao-Liao-Ji orogenic belt, North China Craton	2015-2019	lfl0225@sina.com
9	GAO Rui	Detailed structure of the lithosphere and deep processes of deformation in the transition from the northeastern Tibetan Plateau to the Alashan, Ordos and Sichuan Craton basins	2015-2019	gaorui@cags.ac.cn
10	HOU Zengqian	Comparison of the main metallogenesis of the Himalayan-Zagros collisional orogenic system	2014-2018	houzengqian@126.com
11	LI Haibing	Fault friction over time: Co-seismic weakening and post-seismic healing within the Wenchuan Fault	2014-2018	lihaibing06@163.com

International (Regional) Cooperation and Exchange Projects

No.	Chief Investigator	Project	Duration	E-mail address
1	YU Changqing	Dense profile probing depth extent of Pengguan Complex and Longmenshan Fault	2018-2020	geoyucq@hotmail.com
2	HE Rizheng	Unraveling the dynamic processes beneath the Northern Tibetan Plateau: Paleozoic collision and convergence and Cenozoic destruction and uplift	2018-2020	herizheng@cags.ac.cn
3	YANG Jingsui	Diamond in oceanic peridotites -chromitites and deep recycled mantle in the global ophiolite record	2018-2022	yangjsui@cags.ac.cn
4	YIN Jiyuan	Tectonics and geodynamics of the Altai-Junggar intracontinental orogen in the Vendian-Paleozoic	2017-2018	yinjiyuan1983@163.com
5	LI Haibing	Fault friction over time: Coseismic weakening and postseismic healing in situ	2016-2020	lihaibing@163.com
6	HOU Zengqian	Comparison of the main metallogenesis of the Himalayan-Zagros collisional orogenic system	2014-2018	houzengqian@126.com

Emergency Management Projects

No.	Chief Investigator	Project	Duration	E-mail address
1	LIU Dunyi	Inverstigation of changes in the flux of impactors throughout the history of the Moon: The technological reserve for the chronology study of the lunar samples of Chang'e project	2019.1-2019.12	liudunyi@bjshrimp.cn
2	SHI Yuruo	The formation age and magmatic evolution history of the Moon: In-situ geochronology and geochemistry analyses on lunar samples	2019.1-2019.12	shiyuruo@bjshrimp.cn

3	WANG Tao	International IGCP-662 meeting, field geological training and training courses	2018.1-2018.12	taowang@cags.ac.cn

Major Research Plan

No.	Chief Investigator	Project	Duration	E-mail address
1	LIU Fulai	Multiple metamorphic events of Paleo-Tethys to Neo-Tethys evolutions: Constraints on the collisional orogeny between ocean (or continent)	2019-2022	lfl0225@sina.com
2	ZHANG Zeming	Metamorphism, anataxis and magmatism of the eastern Gangdese magmatic arc: Implications for the growth and reworking of the continental crust	2019-2022	zzm2111@sina.com
3	SONG Yucai	Mississippi Valley-type (MVT) lead-zinc deposits in fold and thrust belts during continental collision: Comparison between the Tibetan and Zagros orogens	2019-2022	song_yucai@aliyun.com
4	QI Xuexiang	Mesozoic melange belt in the southeastern Gaoligong orogen, west Yunnan, and its relationship with the southern extension of the Banggonghu-Nujiang suture	2018-2020	qxuex2005@163.com
5	ZHAI Qingguo	Tectonomagmatism associated with the opening of the Paleo-Tethys Ocean: Key study on the central Qiangtang northern Tibet	2018-2020	zhaiqingguo@126.com

Projects of Joint Funds

No.	Chief Investigator	Project	Duration	E-mail address
1	WANG Tao	Spatial-temporal distribution of deep, old and juvenile continental crust and constraints on metallogenesis of northern Xinjiang and adjacent areas	2015-2018	taowang@cags.ac.cn

General Projects

No.	Chief Investigator	Project	Duration	E-mail Address
1	WANG Xuri	New discoveries of fossil birds from the Jehol Biota in the Great Khingan Range area of Northeast China and their palaeogeographic	2019-2022	wang198109@163.com
2	LIU Pengju	Microfossils from the early Cambrian in the Yangtze Platform and its biostratigraphic signification	2019-2022	pengju@cags.ac.cn
3	JI Shu'an	Study on the Late Cretaceous protoceratopsid fauna from Alxa region, Inner Mongolia	2019-2022	jishu_an@sina.com
4	HUANG Hao	paleogeographic analysis of Permo- Carboniferous fusulinids in the Changning-Menglian Belt, western Yunnan	2019-2022	geohaohuang@gmail.com

5	ZHANG Zeming	High-grade metamorphism and partial melting of the eastern Himalayan orogen	2019-2022	zzm2111@sina.com
6	SHEN Tingting	Petrology and exhumation mechanism of ultradeep subducted serpentinites and enclosed eclogites from southwestern Tianshan	2019-2022	ttshen@pku.edu.cn
7	TIAN Zuolin	High-pressure metamorphism and collision orogenic processes of the micro-massifs from the central-eastern Bangong-Nujiang Suture Zone	2019-2022	zuolintian@163.com
8	DONG Xin	Metamorphism and partial melting of the metabasic rocks in Yadong region, Himalayan orogen	2019-2022	dongxin5811935@163.com
9	WU Cailai	Petrogenesis of Palaeozoic granites in the southern Altun terrane and their significance in continental dynamics	2019-2022	wucailai@126.com
10	HE Bizhu	The paleogeography evolution from Middle to Late Ordovician in the central and northern parts of the Altun, NW China	2019-2022	hebizhu@cags.ac.cn
11	CAI Jia	Phase equilibria modeling on the metamorphic evolution of the Bengbu high-pressure mafic granulite in the southern margin of the North China Craton and its petrogenesis	2019-2022	caijia91052@126.com
12	XIE Hangqiang	Neoarchean and Paleoproterozoic tectono-thermal events in Eastern Hebei Province and their implications	2019-2022	rock@bjshrimp.cn
13	SHI Yuruo	Geochronology and origin of the Cenozoic volcanic rocks in Tengchong area	2019-2022	shiyuruo@bjshrimp.cn
14	SI Jialiang	The identification of new earthquake fossils and their implications to the seismic fault activity	2019-2022	gongrenbaqin@126.com
15	LIU Dongliang	Paleomagnetic records to decipher the Cenozoic collision process between the Pamir and the Southwestern Tian Shan	2019-2022	pillar131@163.com
16	CAO Hui	microstructure and tectonics- Tectonochronology study of monazite LASS and micro-drilling	2019-2022	caohuicugb@hotmail.com
17	HU Peiyuan	Origin of the Lhasa terrane in Tibet constrained by Neoproterozoic tectono-magmatic event in the Ren Co area	2019-2022	azure_jlu@126.com
18	YAN Zhen	Texture and composition of the Lajishan accretionary wedge and the reconstruction of the ancient oceanic basin	2019-2022	yanzhen@mail.iggcas.ac.cn
19	GAO Li'E	Behavior of radiogenic isotopes during cruatal anatexis in the Himalayan orogenic belt	2019-2022	liegao09@163.com
20	ZHU Xiangkun	The controlling factors for the termination of global-scale Precambrian banded iron formations	2019-2022	xiangkun@cags.ac.cn
21	PAN Xiaofei	Ore-forming fluid of Zhuxi ultra-large W-Cu deposit, Jiangxi Province and its significance on the mineralization	2019-2022	pan_smile0551@sina.com

22	YIN Jiyuan	Uplift and exhumation of West Tianshan since the late Paleozoic: Constraints from multi-thermochronology	2019-2022	yinjiyuan1983@163.com
23	LIU Yan	Contribution of metasomatism in carbonatited mantle and dissolution of fluids from carbonatitic melts to the formation of giant Maoniuping REE deposit in Sichuan, China	2018-2021	ly@cags.ac.cn
24	HE Zhenyu	Xingxingxia area, Eastern Xinjiang, NW China: Petrogenesis and their implications for the composition of theancient crust	2018-2021	ahhzy@163.com
25	ZHANG Hongrui	Cenozoic deformation and related Pb-Zn-Cu mineralization in the Lanping basin	2018-2021	hongrui_1982@126.com
26	JIA Jianliang	Efficiency and mechanism of organic carbon burial in Cretaceous lacustrine fine-grained sediments: Insights from mineral surface protection in an anoxic environment	2018-2021	jiajl0228@163.com
27	SU Dechen	Meso-Neoproterozoic seismic records and multi-stage rifting in the North China Craton	2018-2021	sudechen@163.com
28	DU Lilin	Implication of 2.7 Ga and 2.1-2.0 Ga magmatic events in Fuping Complex, central of the North China Craton	2018-2021	dulilin7310@cags.ac.cn
29	WANG Fang	Multiple metamorphism and geochronology of metamorphic complex in southwestern margin of Yangtze Block	2018-2021	wangfang_mr@163.com
30	WANG Wei	The Neoarchean anatexis of the eastern North China Craton and its geological significance	2018-2021	wuchangyuww@sina.com
31	LIU Jianhui	The nature of the polyphase magmatic events and metamorphic volcanic- sedimentary successions in the Kuandian area: Constraint on the tectonic setting of the Paleoproterzoic Jiao-Liao-Ji Tectonic belt	2018-2021	liujianhui1999@163.com
32	LI Huaqi	Basu metamorphic complex, eastern central Tibet: Implications for early Jurassic arc-continental collision along middle-eastern Bangong-Nujiang suture	2018-2021	muzi_7540@163.com
33	LI Yuan	Study on the deformation-metamorphism sequences of the Xigaze ophiolite in South Tibet, China: Implication for the evolution of the Neo-Tethyan ocean	2018-2021	liyuancags@126.com
34	LI Shan	Petrogenesis of Triassic granitoids in Sumatra, Indonesia constraint on continental crust formation and evolution of the southern Paleo-Tethys	2018-2021	lishan428@163.com
35	WANG Tao	Rock assemblages and accretionary orogenic processes of the Lajishan mélange in the Central Qilian belt	2018-2021	real_wt@126.com
36	SUN Jian	The recycling of marine sediments and rare-earth-element mineralization: A multiple-isotope study	2018-2021	sunjiantc@163.com

37	FENG Guangying	Petrogenesis and geological significance of the early-Mesozoic mafic intrusions in the Lesser Xing'an Range-Zhangguangcai Range	2018-2021	fengguangying198@163.com
38	LIU Yingchao	The metallogenesis of quartz-rich carbonate-hosted Pb-Zn deposits in the thrust-fold belt: A case study of the Malayer-Esfahan Pb-Zn metallogenic belt in Iran	2018-2021	lychappy@126.com
39	SONG Yucai	Giant accumulations of barite and metals in the world-class Mehdiabad Pb-Zn deposit, Iran	2018-2021	song_yucai@aliyun.com
40	CHEN Wen	Study on titanite (U-Th)/He dating technique	2018-2021	chenwenf@vip.sina.com
41	WANG Yanbin	Crustal evolutuion of high grade metamorphic Block from the Bolingen Islands, Antarctica: Constraints from geochemistry and zircon U-Pb, Hf-O isotopes	2018-2018	yanbinw@cags.ac.cn
42	ZHANG Hongshuang	The study on lithospheic geometry and extensional mechanism in southeastern China: Receiver function analysis of dense broadband seismic array	2018-2021	zhs1981@126.com
43	XIONG Xiaosong	The detailed crustal structure of the North Qilian-Southern margin of Alxa block, and the constraints of the Paleozoic framework to the Cenozoic northward- propagation of the Tibet	2018-2021	xsxung@126.com
44	MENG Fancong	Genetic mineralogy of garnet peridotite-eclogite from the Polar Urals, Russia	2017-2020	mengfancong@yeah.net
45	Chevalier Marie-Luce	Tectonic activity along the Xianshuihe fault zone and deformation model constraint of the eastern Tibetan Plateau	2017-2020	mlchevalier@hotmail.com
46	LIU Pinghua	Multiple metamorphic events of the eastern Alxa-Langshan Precambrian metamorphic complex, western Inner Mongolia	2017-2020	lph1213@126.com
47	LIU Yongqing	The Late Jurassic eolian depositional associations in North China, and its implications of palaeoclimate and palaeogeography	2017-2020	liuyongqing@cags.ac.cn
48	LÜ Junchang†	Study of the Ganzhou Dinosaurian Fauna from Ganzhou district, Jiangxi Province	2017-2020	lujc2008@126.com
49	NIU Xiaolu	Origin and geological significance of the Indosinian alkaline rocks on the western part of the northern margin of North China Craton, Inner Mongolia	2017-2020	niuxiaoludx@126.com
50	XU Xiangzhen	Detailed FIB and TEM studies from the different types of mantle peridotite	2017-2020	xuxiangzhensjl@aliyun.com
51	YAN Zhen	Study on tectonic evolution of the early Paleozoic Lajishan trench-arc system	2017-2020	yanzhen@mail.iggcas.ac.cn
52	YI Zhiyu	Record of rapid apparent polar wander in East Asia and its significance	2017-2020	yizhiyu09@gmail.com
53	LIU Pengju	Ediacaran silicified microfossils from the Hunan and Guizhou Provinces and their biostratigraphic correlation	2016-2019	pengju@cags.ac.cn

54	TANG Feng	Macrofossil biotas in the late Ediacaran–Cambrian boundary interval of South China and biostratigraphic correlation	2016-2019	tangfeng@cags.ac.cn
55	ZHANG Cong	Tracing the ancient subcontinental lithospheric mantle: Example from garnet peridotite of the Lüliangshan terrane, North Qaidam UHP metamorphic belt	2016-2019	congzhang@pku.edu.cn
56	MENG En	Petrogenesis of the Paleoproterozoic metamorphic supracrustal sequence and meta-mafic intrusions in Liaoning and Jilin Provinces: Constraints on the regional tectonic evolution	2016-2019	mengen0416@126.com
57	YANG Chonghui	Magmatic activity in the (2.4-2.3 Ga) global magmatic quiescence: A case study of the North China Craton	2016-2019	chhyang@139.com
58	ZHANG Jianxin	Metamorphic and deformational history of fossil subduction channels: Examples from the North Qilian and North Altun	2016-2019	zjx66@yeah.net
59	ZHANG Jin	Study on the kinematics, stages and tectonic backgrounds of the main fault systems in and around the Alxa Block	2016-2019	zhangjinem@sina.com
60	SI Jialiang	Fluid-rock interaction during healing of the Longmenshan fault zone	2016-2019	gongrenbaqin@126.com
61	ZHAO Lei	Nature of the Daheishan mafic- ultramafic complex from the Yiwu area, East Junggar, and comparative study on ophiolites in the East and West Junggar	2016-2019	jleiz@163.com
62	YIN Jiyuan	Thermochronologic constraints on exhumation processes in the West Junggar metallogenic belt	2016-2019	yinjiyuan1983@163.com
63	ZHANG Yan	The study of Ar-Ar dating on ultrafine minerals	2016-2019	yzhang737@sina.com
64	LU Zhanwu	Study of “bright spots” structures in deep seismic reflection profiles in central and western Tibet	2016-2019	luzhanwu78@163.com
65	LI Qiusheng	The deep process and geodynamics of Mesozoic tectonic transition in the intersection area of rhe Nanling Range-Wuyi Mountain, southeastern China: Applying a high dense array of broadband seismic observations	2016-2019	liqiusheng@cags.ac.cn
66	WANG Haiyan	Lithosphere structure and development of the Qinling orogenic belt	2016-2019	hyanwhy@126.com
67	TIAN Shugang	Late Permian organic reefs and palaeogeographic conditions in the Linxi, area, Inner Mongolia - Jiutai, Jilin	2015-2018	sgtian@cags.ac.cn
68	YAO Jianxin	High-precision stratigraphic correlation between South China and Tibet during the major turning period of the Permian-Triassic biotic evolution	2015-2018	yaojianxin@cags.ac.cn
69	LIU Jianfeng	Petrogenesis and geological significance of early-middle Triassic mafic volcanic rocks from southeastern Inner Mongolia	2015-2018	wenjv@aliyun.com

70	ZHANG Zeming	Formation and evolution of the Precambrian crystalline basement of southeastern Tibet	2015-2018	zzm2111@sina.com
71	WU Cailai	Magmatic system dynamics in Shujiadian, Tongling	2015-2018	wucailai@126.com
72	ZHANG Hongrui	Coupling between deformation and fluid flow in the Baiyangping ore-producing hydrothermal system, Sanjiang area	2015-2018	hongrui_1982@126.com
73	KUANG Hongwei	Formation mechanism and correlation of molar tooth carbonate—The sedimentary record in the Meso-Neoproterozoic	2015-2018	kuanghw@126.com
74	DONG Chunyan	Late Neoarchean to early Paleoprotero- zoic tectono-magmatic-thermal events in the Daqingshan area: Geology, geochemistry and zircon geochronology	2015-2018	dongchunyan@sina.com
75	XIE Hangqiang	Tectono-thermal events and tectonic setting during the late Neoarchean in western Shandong	2015-2018	rock@bjshrimp.cn
76	WAN Yusheng	Formation and evolution of the Archean basement in eastern Hebei: Geology, geochemistry and SHRIMP U-Pb zircon dating	2015-2018	wanyusheng@bjshrimp.cn
77	REN Liudong	Distribution of Pan-African orogenic belts in the East Antarctic Craton and geological features of the Prydz belt	2015-2018	ldren@cags.ac.cn
78	LU Haijian	Tectonic coupling between the Kumukuli basin and adjacent orogenic belts: evidence from paleomagnetism and low-temperature thermochronometry	2015-2018	haijianlu2007@126.com
79	CAO Hui	P-T-t-D path based on quantitative data of porphyroblast growth: A case study of Qilian Tuolemuchang	2015-2018	caohuicugb@hotmail.com
80	TANG Suohan	Precise determination of Ti isotope com- position in rock samples and geological application in mantle processes	2015-2018	tangsuohan@163.com
81	YANG Zhiming	Genesis of comb quartz layers: Case studies from porphyry Cu deposits at Qulong, Tibet and Now Chun, Iran	2015-2018	zm.yang@hotmail.com
82	CHEN Wen	Isotope thermochronological research on orogenic and ore-forming processes in the eastern part of the western Tianshan orogenic belt	2015-2018	chenwenf@vip.sina.com

Yong Scientists Fund

No.	Chief Investigator	Project	Duration	E-mail address
1	ZHAO Shuo	Late Paleozoic volcanic-sedimentary formations and their provenance in the northwestern Lesser Xing'an Range: Constraints on closure timing of the Heihe-Nenjiang suture zone	2019-2021	zhaoshuo@cags.ac.cn

2	JI Lei	P-T-t-D evolution of Barrovian sequence in the south segment of Ailao Shan complex belt	2019-2021	jileicags@126.com
3	ZHANG Jianjun	Nd-Hf isotopic decoupling in granitoids from the Kungeyite pluton of Qinghe region, southeast of Chinese Altai: Causes and implications for their source interpretation	2019-2021	jianjunzhang@live.cn
4	ZHANG Huichao	Study of gold mineralization in Huilvshan-Mandongshan gold district (Xinjiang): Insights from phase equilibrium calculation and micro-zone analysis of sulfides	2019-2021	zhanghch2012@126.com
5	ZHANG Lei	Formation depth of pseudotachylyte in the Longmen Shan thrust belt constrained by rock magnetism	2019-2021	zhanglei881102@126.com
6	ZHU Junbin	Triassic sedimentary sequences in Linxi area of Inner Mongolia and their tectonic implications	2019-2021	zhujunbin0819@163.com
7	ZHU Zhiyong	The genesis of Makeng iron deposit in Fujian Province and its relationship with the high silica granite—Evidence from Fe isotope	2019-2021	zhiyong_zhu@cags.ac.cn
8	GAO Zhaofu	Spatial evolution of Fe-S-Pb isotopes in the Dongshengmiao deposit and its constraints on the mineralizing process	2019-2021	gaozhaofu@163.com
9	BAO Zemin	Methodology of rare earth element TOF-SIMS In-situ analysis in zircon	2019-2021	baozm@bjshrimp.cn
10	CHE Xiaochao	Combined U-Series and U-Pb dating of speleothem calcite: A case study of Panxian Dadong paleolithic site	2019-2021	cxc@bjshrimp.cn
11	LANG Chao	Study on frequency-domain full waveform imaging method based on big-shot data of deep seismic reflection profiling	2019-2021	langchao@lsec.cc.ac.cn
12	ZHONG Ning	Palaeoearthquake investigation of late Quaternary lacustrine sediments at Shawan in the upper reaches of the Min River	2019-2021	zhongning19860304@126.com
13	BO Jingfang	Research on Middle Triassic scleractinian coral fauna from the Poduan Formation in southwestern Guizhou	2018-2020	jingfangbo@foxmail.com
14	WEI Yi	Palaeoelevation evolution of Tibetan Plateau hinterland during the Eocene- Oligocene : Evidences from ostracods and isotope	2018-2020	ostracods@126.com
15	SHEN Weibin	The study on the geochemical characteristics of pyrite in Nantuo Formation in the Nanhua period, Yangtze Block, South China	2018-2020	swb560316@126.com
16	QU Huanchun	The discovery of sulfide inclusions in the quartz of the UST in Qulong porphyry Cu deposit, Tibet: Constraints on the genesis of ore deposits	2018-2020	quhuanchun@126.com
17	QIU Tian	The characteristics of ore-forming fluid and constraints on genesis of listwaenite-related gold deposit in Sartohay, Xinjiang	2018-2020	qiutian2010@126.com

18	CHENG Ting	High precision U-Pb isochron dating of carbonate minerals	2018-2020	chengting1005@hotmail.com
19	CHAI Peng	Tracking oxygen fugacity of multiphase magmatic processes and study on petrogenesis of Ermi reduced porphyry copper deposit	2017-2019	cx001chaipeng@163.com
20	LONG Tao	High spatial resolution simultaneous dating and determination of trace elements in xenotimes by SHRIMP	2017-2019	longtao@bjshrimp.cn
21	SHE Yuwei	Investigation of iron and chromium isotopes of podiform chromite iron and chromium isotopes of podiform chromite deposits in the Yarlung-Zangbo ophiolite belt, Tibet	2017-2019	sheyuwei@cags.ac.cn
22	WANG Dan	The study of sedimentary N-isotopic compositions in the Nanhua basin during the Cryogenian interglacial period	2017-2019	njuwangdan@163.com
23	WANG Huan	Microstructural, mineralogical and geochemical characteristics of the Wenchuan earthquake fault zone and their deformation mechanisms	2017-2019	wanghuan4585@126.com
24	ZHANG Wen	Age, provenance and tectonic setting of Ji'an and Laoling groups, southern Jilin Province within Jiao-Liao-Ji orogenic /mobile belt	2017-2019	wzhan7@126.com
25	ZHANG Xinyan	Joint traveltime inversion of deep seismic sounding and deep seismic reflection to image the crustal structure and the application	2017-2019	zhangxinyana@163.com
26	ZHENG Yong	Timing of brittle deformation within the Longmen Shan fault zone: New insights from $^{40}Ar/^{39}Ar$ ages of fault-gouges from WFSD-1 drilling core and surface ruptures	2017-2019	zygeology@163.com
27	WANG Yafei	Research on ancient crustal materials in Anshan and eastern Hebei	2017-2019	pengfei4783@163.com
28	GUO Wenfeng	Silicic magma petrogenesis and evolution and the plumbing system of Wangtian'e volcano: Constraint from petrogeochemical evidence and thermodynamic modeling	2017-2019	guowenfeng@cags.ac.cn
29	YANG Shaohua	Overring plate properties constraint subduction evolution: The example of the Lhasa Terrane	2017-2019	yangshaohua09@sina.com
30	ZONG Pu	Study of Late Devonian Famennian brachiopod fauna from western Junggar, Xinjiang	2016-2018	zongpu0501@gmail.com
31	LI Ya	The studies of carpological remains of the aquatic angiosperms from the Miocene of northern Hebei Province, China	2016-2018	liya207@mails.gucas.ac.cn
32	YANG Ben	Systematic and biostratigraphic studies on the early Meishucunian small shelly fossils from the Daibu Member of the Yongshan area in Yunnan Province	2016-2018	benyang@cags.ac.cn
33	TIAN Zuolin	Phase equilibrium of the metamorphic PTt paths for granulites from Namche Barwa	2016-2018	zuolintian@163.com

34	XIONG Fahui	Origin of platinum group minerals in different types of chromitite from the Purang ophiolite, Tibet	2016-2018	xiongfahui@126.com
35	DONG Hanwen	Tectonic evolution of the Medog shear zone and its constrains on the formation of the Namche Barwa Syntaxis	2016-2018	donghanwen123@126.com
36	MA Xuxuan	Neoproterozoic magmatic events in the Central Tianshan block, NW China	2016-2018	xuxuan.ma@hotmail.com
37	ZHENG Rongguo	The geochronology, petrogenesis, and tectonic significance of the Gongpoquan group volcanic rocks in the Xiaohuangshan-Yueyashan region, Beishan, Inner Mongolia	2016-2018	rgzheng@163.com
38	HU Peiyuan	The tectonic significance of Cambrian volcano-sedimentary event of the Lhasa terrane, Tibetan plateau	2016-2018	azure_jlu@126.com
39	GAO Li'e	Himalayan orogenic belt in Caledonian times	2016-2018	liegao09@163.com
40	ZHANG Zhiyu	Genesis of pegmatoid shell: Case studies from the super-large Dahutang tungsten deposit in Jiangxi Province	2016-2018	zhangzhiyu@cags.ac.cn
41	SUN Jingbo	Tectono-thermal evolution study of the Aqishan-Yamansu area in the eastern Tianshan, NW China	2016-2018	jingbo95003@126.com
42	YU Shun	The tectono-thermal evolution and uplift/exhumation of thrust-fold zones in the Kuqa-South Tianshan area: Constraints from low temperature thermochronometry	2016-2018	yushun0722@163.com

† deceased October 2018

4.2 Projects funded by the Ministry of Science and Technology

项目编号：2016YFC0600300　　密　级：公开

国家重点研发计划
项目任务书

项目名称：青藏高原碰撞造山成矿系统深部结构与成矿过程
所属专项：深地资源勘查开采
指南方向：青藏高原碰撞造山成矿系统的深部结构与成矿过程
推荐单位：国土资源部
专业机构：中国21世纪议程管理中心
项目牵头承担单位：中国地质科学院地质研究所（公章）
项目负责人：侯增谦
执行期限：2016年07月 至 2020年12月

中华人民共和国科学技术部

项目编号：2017YFC0601300　　密　级：公开

国家重点研发计划
项目任务书

项目名称：北方东部复合造山成矿系统深部结构与成矿过程
所属专项：深地资源勘查开采
指南方向：北方造山成矿系统的深部结构与成矿过程
推荐单位：国土资源部
专业机构：中国21世纪议程管理中心
项目牵头承担单位：中国地质科学院地质研究所（公章）
项目负责人：秦克章
执行期限：2017年07月 至 2021年06月

中华人民共和国科学技术部
2017年07月11日

Fig. 4.2.1 Two on-going projects belong to the special project named as "Deep Resources Exploration and Mining" in the Framework of National Key Research and Development Program of China

No.	Chief Investigator	Project	Duration	E-mail address
1	QIN Kezhang	Deep structure and ore-forming process of the composite orogenic-metallogenic systems in NE China	2017-2020	kzq@mail.iggcas.ac.cn
2	ZHANG Jin	3D lithosphere framework of compound orogenic belt of North China and its metallogenic backgroun d	2017-2020	zhangjinem@sina.com
3	HOU Zengqian	Deep structure and ore-forming process of main mineralization systems in the Tibetan Orogen	2016-2020	houzengqian@126.com
4	LU Zhanwu	Fine structure of the lithosphere and deep processes in the main collision zone of the Tibetan Plateau	2016-2020	luzhanwu78@163.com
5	LI Qiusheng	Fine lithospheric structure and deep processes of the side colliding belt of Tibetan plateau	2016-2020	lqs1958@163.com
6	YANG Zhiming	Deep structure and ore-forming process of the main porphyry Cu-Mo-Au systems in the Tibetan Orogen	2016-2020	zm.yang@hotmail.com
7	ZHANG Zeming	Deep Earth processes and ore-forming events in the Tibetan Orogen	2016-2020	zzm2111@sina.com
8	KUANG Hongwei	Meso- to Neoproterozoic stratigraphic frame and depositional event correlation in China	2016-2020	kuanghw@126.com
9	TONG Ying	Integration of the tectonic-magmatism-mineralization studies in metallogenic systems	2018-2021	yingtong@cags.ac.cn
10	LIU Yanxue	Prototype restoration and structural reconstruction of typical Uranium-bearing basins and its constrain ts on deep mineralization	2018-2021	lyxue@sohu.com
11	YANG Tiannan	Tethyan tectonomagmatic evolution and the dynamic process of the lithosphere	2018-2021	yangtn@cags.ac.cn
12	DING Xiaozhong	The compilation of the lunar digital geological map	2015-2020	xiaozhongding@sina.com
13	YAO Jianxin	Establishment of the stratigraphic standard of China—Perfection of the stratigraphic chart of China	2015-2019	Yaojianxin53@163.com

4.3 Projects funded by the China Geological Survey

No.	Chief Investigator	Project	Duration	E-mail address
1	GUAN Ye	Application and demonstration of 3D geoscience survey of southeastern areas in Inner Mongolia	2016-2018	guanye@cags.ac.cn
2	ZHANG Jianxin	Geological survey project for Tethys-Tibet Plateau and tectonic setting of major metallogenic belts	2016-2018	zjx66@yeah.net
3	LI Suping	Database construction of index fossils in paleontology	2016-2018	lisuping@cags.ac.cn

4	LIU Fulai	Key geological issues of the North China Craton and its margin and metamorphic and pilot mapping	2016-2018	lfl0225@sina.com
6	REN Jishun ZHAO Lei	Tectonic research and related map compilation for land and sea of China and adjacent area	2016-2018	renjishun@cags.ac.cn jleiz@163.com
7	JI Shu'an	The standards of regional strata and biota evolution in key areas and sedimentary rock geological pilot mapping	2016-2018	jishu_an@sina.com
8	SONG Yucai	Geological survey of the Gangdise-Sanjiang giant metallogenic belt and comparison of ore-forming processes with the Middle Tethyan metallogenic belt	2016-2018	32236471@qq.com
9	DING Xiaozhong	Geological tectonic division and comprehensive integration of regional geological survey of China	2016-2018	xiaozhongding@sina.com
10	WANG Jun	Integrated mapping and comparison of the cross-border metallogenic belt in central East Asia	2016-2018	wj257@126.com
11	ZHANG Zeming	Key tectonic survey and pilot mapping of orogenic belts	2016-2018	zzm2111@sina.com
12	XUE Huaimin	Study on major Phanerozoic magmatism evens in China and tentative mapping of igneous rocks	2016-2018	huaiminx@sina.com.cn
13	YANG Jingsui	A comprehensive survey of chromite in the Yarlung-Zangbo and Bagong-Nujiang suture zones, Tibet	2016-2018	yangjsui@163.com; yangjsui@cags.ac.cn
14	YU Changqing	Basic geological survey of oil and gas in the southwest and southeast depressions of the Tarim Basin	2017-2018	geoyucq@qq.com
15	YANG Tiannan	Three typial deposits mapping with 1: 25000 scale of the Tibetan Plateau	2017-2018	yangtn@cags.ac.cn
16	YANG Tiannan	Deep three-dimensional geological structure exploration in Xiongan New Area	2018-2020	yangtn@cags.ac.cn
17	WANG Tao	Investigation and pilot mapping of key structures in orogenic belt	2018-2020	taowang@cags.ac.cn

5.1 Attendance at International Conferences

YANG Jingsui and colleagues attended the 4th IGCP-649 "Diamonds and Recycled Mantle" Workshop and Field Trip (Brisbane, Australia; New Caledonia)

The 4th IGCP-649 "Diamonds and Recycled Mantle" Workshop and Field Trip, which was co-organized by the University of Queensland, the University of New Caledonia, and Academician YANG Jingsui's team of the Institute of Geology, was held in Brisbane, Australia and New Caledonia respectively from 5-14 July, 2018. Drs. YANG Jingsui, ZHU Xiangkun, ZHANG Jianxin, QI Xuexiang, MENG Fancong, YAN Zhen and 15 other young geologists attended the workshop of IGCP-649 and field trip.

Fig. 5.1.1 The 4th workshop of IGCP-649

Fig. 5.1.2 Academician YANG Jingsui, first leader of the Project, makes a speech and hosts the workshop

Fig. 5.1.3 Prof. Jonathan Aitchison, Head of School of Earth and Environmental Sciences, the University of Queensland, organizer of the workshop, makes a speech

Fig. 5.1.4 Group photo of the field trip

LI Tingdong and colleagues attended the 16th workshop on the Cooperative Project "Deep Processes and Metallogeny of North-Central-Eastern Asia" (Jeju Island, Korea)

The Project of "Deep Processes and Metallogeny of North-Central-Eastern Asia" is an international cooperative project collaborated by members from the five countries of China, Russia, Mongolia, Kazakhstan, and Republic of Korea for more than 15 years. They take turns to hold the annual workshop. The 16th workshop, organized by the Korea Institute of Geoscience and Mineral Resources, was held in Jeju, Jeju Island of Korea on 9-14 July, 2018. Headed by Prof. WANG Tao, Deputy Director-General of the Institute, a delegation of 11 members, with Academician LI Tingdong and Dr. REN Liudong (the leader of the project) included, attended the workshop and a post-Workshop field excursion.

Fig. 5.1.5 WANG Tao (second from left) on behalf of the Chinese team signing the documents

Fig. 5.1.6 Group photo of the field excursion

ZHAO Lei and XU Qinqin attended the CGMW meetings (Paris, France)

Invited by Dr. Philippe ROSSI, President of CGMW, and Dr. Manuel PUBELLIER, Secretary General of CGMW, Drs. ZHAO Lei and XU Qinqin attended the Bureau meeting scheduled on 21 February, 2018 at the headquarters of CGMW and the General Assembly convened on 22-23 February, 2018 at UNESCO Headquarters. At the Assembly, Dr. ZHAO Lei was appointed to be Deputy Secretary General of CGMW Subcommission for South and East Asia.

Fig. 5.1.7 XU Qinqin makes a speech

YANG Zhiming attended the Society of Economic Geologists (SEG) business meetings and the 2018 PDAC International Convention (Toronto, Canada)

Invited by Dr. Richard J. GOLDFARB, Past-President of SEG, Dr. YANG Zhiming, as one of the SEG Councilors, participated in the Society business meetings and as a representative of the Society at the prestigious 2018 PDAC International Convention in Toronto Canada during the time frame of 28 February to 9 March, 2018.

LIU Fulai and colleagues attended the 15th Annual Meeting of the Asia Oceania Geosciences Society (AOGS2018) (Hawaii, USA)

The 15th Annual Meeting of the Asia Oceania Geosciences Society (AOGS2018) took place at the Hawaii Convention Center in Honolulu, Hawaii from 3 to 8 June, 2018. Drs. LIU Fulai, LIU Jianhui, TIAN Zhonghua, ZHANG Wen, CAI Jia, YIN Jiyuan, HUANG He and QIN Qie attended the meeting. They delivered oral and poster presentations.

Fig. 5.1.8 TIAN Zhonghua makes a speech

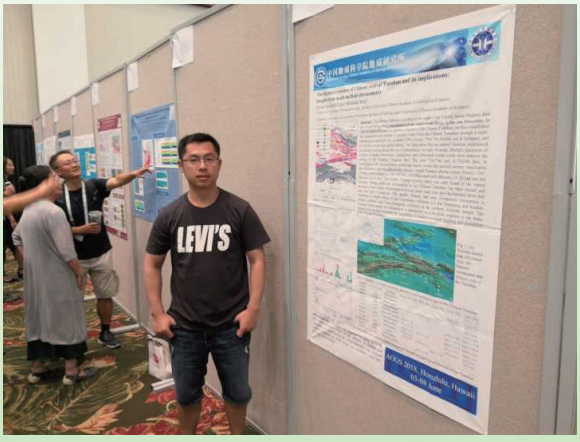
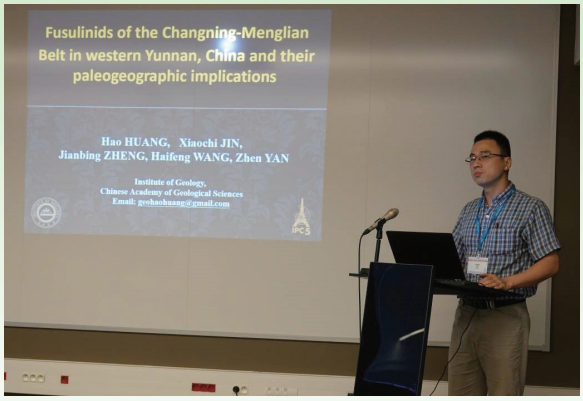


Fig. 5.1.9 YIN Jiyuan at his poster

JIN Xiaochi and HUANG Hao attended the 5th International Palaeontological Congress (IPC5) (Paris, France)



Invited by the Organizing Committee of the 5th International Palaeontological Congress (IPC5), Drs. JIN Xiaochi and HUANG Hao presented their research during the Congress and participated in the field trip in Paris, France, from 8 to 19 July of 2018.

Fig. 5.1.10 HUANG Hao gives an oral presentation

KUANG Hongwei and colleagues attended the 20th International Sedimentological Congress (ISC 2018) (Québec, Canada)

Invited by Dr. Pierre BOLDUC of the ISC 2018 Secretariat, Drs. KUANG Hongwei, LIU Yongqing and PENG Nan attended and actively participated at the 20th International Sedimentological Congress (ISC 2018), held in Québec City, Québec, Canada, from 13 to 17 August, 2018. They delivered oral and poster presentations at the Congress.

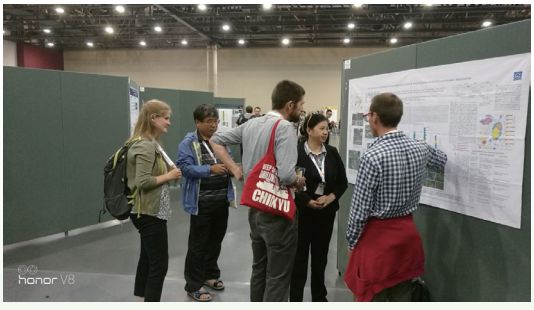


Fig. 5.1.11 KUANG Hongwei (second from right) and LIU Yongqing (second from left) at the poster presentations

Fig. 5.1.12 PENG Nan gives an oral presentation

LI Suping attended the 10th European Paleobotany & Palynology conference (Dublin, Ireland)

Invited by the 10th European Paleobotany & Palynology conference committee, Dr. LI Suping attended the above congress held at the University College Dublin from 12 to 17 August, 2018, and a post-conference tour from 18 to 20 August, 2018.

Fig. 5.1.13 LI Suping (first from right) and other attendees of the same research field at the conference

LIU Yan attended the XXII Meeting of the International Mineralogical Association (IMA2018) (Melbourne, Australia)

During his visit to the School of Physical (Earth) Sciences, University of Tasmania, Dr. LIU Yan attended the XXII Meeting of the International Mineralogical Association (IMA2018), held from 13-17 August, 2018 in Melbourne, Australia. He gave an oral presentation at the Meeting.

Fig. 5.1.14 LIU Yan makes an oral presentation

CHEN Wen attended the 16th International Conference Meeting on Thermochronology (Thermo 2018) (Quedlinburg, Germany)

During his visit to the School of Physical (Earth) Sciences, University of Tasmania, Dr. LIU Yan attended the XXII Meeting of the International Mineralogical Association (IMA2018), held from 13-17 August, 2018 in Melbourne, Australia. He gave an oral presentation at the Meeting.

Fig. 5.1.15 Thermo 2018

LI Haibing and colleagues attended the 2018 Fall Meeting of the American Geophysical Union (AGU) in Washington, D.C., USA

The 2018 Fall Meeting of the American Geophysical Union (AGU) was held on 10-14 December in Washington, D.C., USA. Drs. LI Haibing, LIU Dongliang, PAN Jiawei, WANG Huan, ZHENG Yong, ZHANG Lei, and QU Chen attended the meeting. They delivered oral and poster presentations.

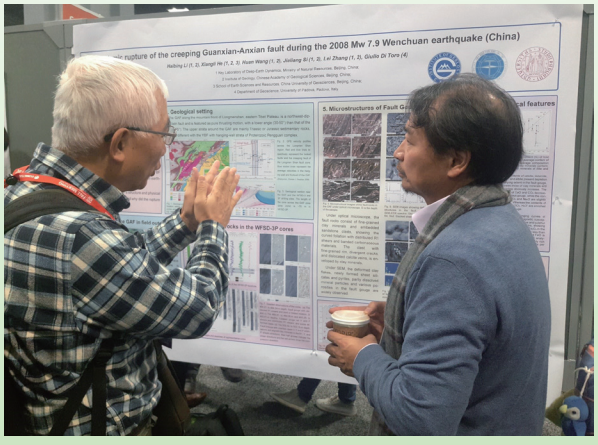


Fig. 5.1.16 LI Haibing makes a poster presentation

Fig. 5.1.17 ZHENG Yong makes an oral presentation

5.2 Foreign visits by members of the Institute

WAN Yusheng and colleagues visited the Cuban Geological Society (Havana, Cuba)

Invited by Dr. Kenya E. Núñez CAMBRA, President of the Cuban Geological Society (SCG), Drs. WAN Yusheng, LIU Dunyi, and 4 other young geologists from the Beijing SHRIMP Center of the Institute of Geology visited SCG to carry their planned research collaboration and a joint field trip in Western Cuba, from 20 April to 1 May.

During their visit, WAN et al. also met Dr. Dora Elisa Garcia DELGADO, a member of SCG and emeritus researcher of the institute of Geology and Paleontology of Havana, and discussed the details of establishing a long-term Sino-Cuban partnership on geological research. The Chinese delegation was also invited to give a series of talks to the Cuban geologists. After the meeting, Dr. Dora Elisa Garcia DELGADO and Dr. Yamirka ROJAS-AGRAMONTE, a member of SCG and the visiting scholar of the Beijing SHRIMP center, guided the group to conduct a 5-day field excursion at 30 geological sites in Western Cuba.

Fig. 5.2.1 The SHRIMP team meets the President of SCG

Fig. 5.2.2 Prof. LIU Dunyi makes a speech

Fig. 5.2.3 Prof. WAN Yusheng makes a speech

Fig. 5.2.4 The field trip at Manacas in Western Cuba

ZHU Xiangkun, LIU Pengju and colleagues joined two scientific field trips in Oman and USA (Sultanate, Oman; Nevada, USA)

The Ediacaran Subcommission of the International Commission on Stratigraphy organized two scientific field trips to investigate the Ediacaran Stratigraphy of Oman during 13-21 January, 2018 and the Ediacaran stratigraphy of

Southwest USA and examine outcrops in Mountain Dunfee and Montgomery Hills in Nevada during 24 April to 4 May, 2018. Drs. ZHU Xiangkun, LIU Pengju and their team members joined the two field trips.

Fig. 5.2.5 At the field trip in Kufai Dome of Oman

Fig. 5.2.6 At the field trip in Pahrump of the Death Valley, Nevada

ZHANG Lei carried out mini-AMS measurements of fault rock samples in the laboratory at Southern Illinois University (Carbondale, USA)

Invited by Prof. Eric C. Ferré of the Department of Geology, Southern Illinois University, Dr. ZHANG Lei visited his laboratory at Southern Illinois University to carry out mini-AMS measurements of fault rock samples, from 14 May to 13 June, 2018.

GAO Rui and colleagues participated in the field trip across the western United States (Los Angeles, USA)

Invited by Prof. An YIN of the University of California, Los Angeles (UCLA), Academician GAO Rui and Drs. GUO Lei, ZHANG Hongshuang and LI Wenhui participated in the Second International Field Conference entitled "Comparative studies of Phanerozoic intra-continental mountain building and volcanism between eastern Asia and western North America", organized by UCLA and held from 4 to 16 August, 2018. The field trip covered visits to a series of classic sites across the western United States.

Fig. 5.2.7 Discussion at UCLA

Fig. 5.2.8 At the field trip

ZHU Xiaosan visited the Institute of Geological Minerals and Metallurgy of Peru (INGEMMET) (Lima, Peru)

Invited by the President of the Institute of Geological Minerals and Metallurgy of Peru (INGEMMET), Dr. ZHU Xiaosan, together with five other members from the Nanjing Center of China Geological Survey, visited INGEMMET to review the map in Chiclayo area, investigate Palma deposit, and visited Geological Survey in Huarochiri (Lima) from 24 July to 12 August, 2018.

Fig. 5.2.9 ZHU Xiaosan (first from right) at the Palma deposit

LU Zhanwu and colleagues visited the Geophysics Program at the Department of Earth Sciences, Uppsala University (Uppsala, Sweden)

Invited by Prof. Christopher Juhlin of Uppsala University, Drs. LU Zhanwu, LI Qiusheng and GUAN Ye visited the Geophysics Program at the Department of Earth Sciences of this University during 21-31 August, 2018, to discuss seismic surveys and possible project collaboration opportunities.

Fig.5.2.10 LU Zhanwu makes a presentation

Fig.5.2.11 Presentation (GUAN Ye, second from left) and discussion

SHI Yuruo and SUN Huiyi participated in a joint field trip in Central and Southeast Iran (Semnan, Iran)

In order to serve the Belt and Road strategy of the Country, promote the cooperation with Iran, invited by Prof. Habibollah Ghasemi of Institute of Geosciences, Shahrood University of Technology, Iran, Dr. SHI Yuruo and SUN Huiyi visited Iran from 18 September to 6 October, 2018 to carry out a joint field trip organized by this University. They investigated the major ultramafic-mafic complexes, metamorphic complexes, Cenozoic granitoids and volcanic rocks in Central and Southeast Iran. More than 30 ophiolite samples and 40 volcanic rock samples were collected for dating and geochemical analysis. The in-depth exchanges and discussions on comparison of Sino-Iran ophiolites and

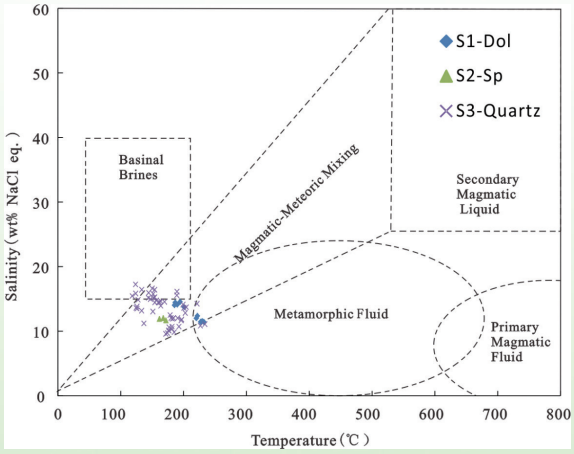
environment of tectonic evolution were conducted with Prof. Ghasemi and Prof. Mahmoud Sadeghian. The SHRIMP Remote Operation System (SROS) developed by the Beijing SHRIMP Center also has been installed successfully in Shahrood University of Technology. Iranian geologists may remotely control the SHRIMP facility located in Beijing through this system.

XIANG Zhongjin carried out collaborative research at the University of Otago (Dunedin, New Zealand)

Invited by Prof. James White of the Geology Department, University of Otago, New Zealand, Dr. XIANG Zhongjin visited this University to carry out collaborative research as a visiting scholar from 21 November to 20 December, 2018. The studies also involved field observations at Kakanui, together with petrographic observations of both Kakanui and Qinling rocks.

Fig.5.2.12 Areas of the field trip (the red star shows the key outcrops)

LIU Yingchao visited the Colorado School of Mines (Illinois, USA)



Invited by Prof. David LEACH of the Colorado School of Mines (CSM), USA, Dr. LIU Yingchao visited the Department of Geology and Geological Engineering at CSM to conduct collaborative research as a visiting scientist from 26 June to 23 November, 2018. She worked jointly with Prof. LEACH on carbonate-hosted Pb-Zn deposits in the Zagros and Himalayan orogenic belts.

Fig. 5.2.13 The ore-forming fluid physical characteristics of the Irankuh Pb-Zn deposit in the East Tethys indicate the genesis of the deposit

5.3 Academic Visitors to the Institute

Visit of Prof. ZHAO Jianxin from the University of Queensland, Australia

From December of 2017 to January of 2018, the overseas senior visiting scholar of the Beijing SHRIMP Center of

the Institute of Geology-- Prof. ZHAO Jianxin from the University of Queensland, Australia, visited the Center for a one-month cooperative research work, and held a series of lectures entitled “Development and application of U-Pb MC-ICP-MS dating method for non-zircon minerals” in the center.

Fig. 5.3.1 Prof. ZHAO Jianxin gives a presentation

Visit of Prof. Alexander NEMCHIN from Curtin University, Australia

According to the agreement signed by both parties, Prof. Alexander NEMCHIN of Curtin University, an overseas senior visiting scholar officially employed by the Beijing SHRIMP Center of the Institute of Geology, visited the Center and stayed for two and a half months, carrying out cooperative research work in January and October of 2018, respectively. The main contents of the cooperative research are as follows: (1) The magmatic evolution history of the moon; (2) building of Impactor’s flux evolution model in the Solar System over time. For this purpose, Prof. NEMCHIN will provide us with over 250 samples of lunar glass beads from all Apollo spacecraft sampling sites as well as some lunar meteorite samples.

In January of 2018, Prof. NEMCHIN analyzed a group of glass beads on the SHRIMP instrument of the center by using the newly developed technique of directly dating the lunar basaltic glass beads developed by his team, and obtained ideal experimental data. Relevant papers have been written and submitted. In October of 2018, Prof. NEMCHIN came to Beijing with a batch of glass beads from Apollo 14 lunar samples, 2 samples of lunar meteorites, 5 samples of Martian meteorites and 2 samples of Allende meteorites (carbonaceous chondrite) to carry out cooperative research with LONG Tao and CHE Xiaochao of the center.

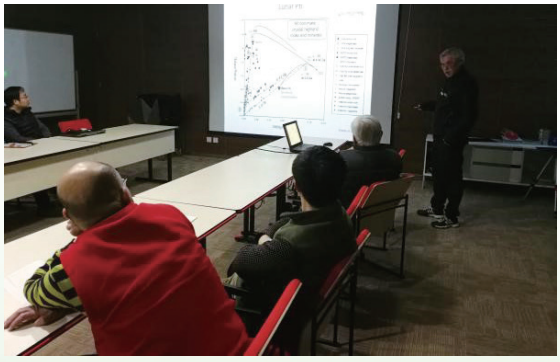


Fig. 5.3.2 Exchanges and discussions of the two sides

The achievements of the above cooperative work will lay a solid technical and methodological foundation for the research of lunar samples taken by China’s Chang’e Program.

Visit of David LEACH from the Colorado School of Mines, USA

Invited by Prof. David LEACH of the Colorado School of Mines (CSM), USA, Dr. LIU Yingchao visited the Department of Geology and Geological Engineering at CSM to conduct collaborative research as a visiting scientist from 26 June to 23 November, 2018. She worked jointly with Prof. LEACH on carbonate-hosted Pb-Zn deposits in the Zagros and Himalayan orogenic belts.

Fig. 5.3.3 Prof. LEACH instructs the students to observe rock sample

Visit of Prof. Alfred KRÖNER from the University of Mainz, Germany

World famous geologist and Honorary Professor of the Beijing SHRIMP Center, Prof. Alfred KRÖNER, visited the Centre for collaborative research in March to April and September to October of 2018, respectively. During his visit, Prof. KRÖNER had in-depth discussions and exchanges with the Center's researchers such as LIU Dunyi, WANG Tao, WAN Yusheng, SHI Yuruo, and LIU Shoujie, et al. on various topics of the Center's ongoing research work.

Visit of Dr. Peter CLIFTON from CAMECA, French

In the morning of 30 March, 2018, Dr. Peter CLIFTON, global product manager of CAMECA, visited the Beijing SHRIMP Center and conducted a discussion on Atom Probe Tomography (APT) with the researchers and technicians of the Center. Dr. CLIFTON introduced APT systematically, involving the principle of APT technology, APT sample preparation technology and the application of APT in geosciences.

Fig. 5.3.4 Discussion on APT

Visit of Prof. Simon WILDE from Curtin University, Australia

According to the agreement signed by both parties, Prof. Simon WILDE of Curtin University, an overseas senior visiting scholar officially employed by the Beijing SHRIMP Center, visited the Center for one-and-a-half months' cooperative research work. During his visit, Prof. WILDE had in-depth discussions and exchanges with the Center's researchers such as LIU Dunyi, WANG Tao, WAN Yusheng, SHI Yuruo, et al. on various topics of the ongoing research work of the Center.

Visit of Prof. Herman VAN ROERMUND from Utrecht University, the Netherlands

Invited by Dr. ZHANG Cong, Prof. Herman VAN ROERMUND from Utrecht University, the Netherlands visited the Institute for two-week's cooperative research. On 24 May, Prof. VAN ROERMUND gave an oral presentation entitled "A re-interpretation of the relict majoritic garnet microstructures found in orogenic garnet peridotites in northern UHP domain of the Western Gneiss Region (SW Norway).

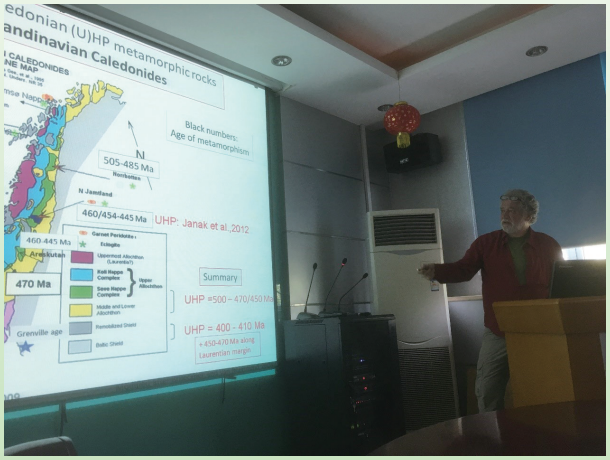


Fig. 5.3.5 Prof. VAN ROERMUND gives a presentation.

Visit of Dr. Steve CLEMENT from Ion Optical Consulting, Canada

Dr. Steve CLEMENT, internationally well-known Canadian specialist on Mass Spectrometry and ion optical design, visited the Beijing SHRIMP Center twice in June and September of 2018, respectively. The main purpose of his visits was to carry out cooperative work of the Specially-Funded Programme on National Key Scientific Instruments and Equipment Development– "New models of TOF-SIMS for Isotope Geology" with the Center's researchers, as well as took part in the optimization of technical specifications for the TOF-SIMS instrument.

Visit of Dr. Marian JANÁK from Slovak Academy of Sciences, Slovakia

Invited by Dr. ZHANG Jianxin, Dr. Marian JANÁK from the Institute of Earth Sciences, Slovak Academy of Sciences, Slovakia, visited the Institute of Geology during 28 May to 10 June of 2018, for academic exchanges. During his stay, he participated in a joint field trip to the areas of Qingdao-Weihai, Shandong Province.

Visit of Prof. Daniel Le Heron from the University of Vienna, Austria and Dr. Thomas Vandyk from Royal Holloway, University of London, the UK

Invited by Dr. LIU Yongqing, Prof. Daniel Le Heron from the University of Vienna, Austria, and Dr. Thomas Vandyk from Royal Holloway, University of London, the UK, visited the Institute of Geology during 1 June to 2 July of 2018, for academic exchanges. During their stay, they participated in the fieldwork in related areas of Shennongjia and western Henan Province, China.

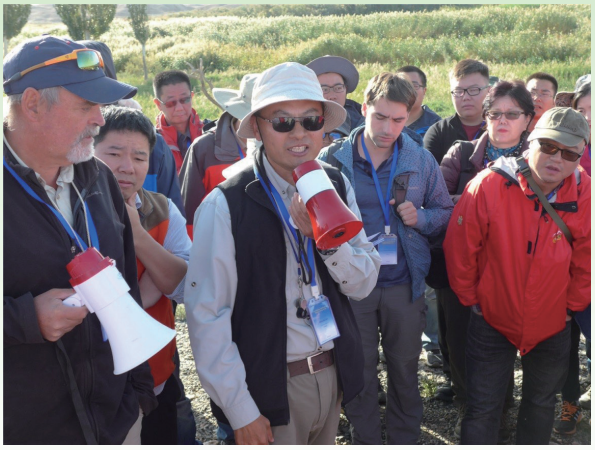
Fig. 5.3.6 Group photo at the field trip

Visit of Prof. Reiner KLEMD from the University of Erlangen-Nürnberg, Germany

Invited by Dr. LIU Yongqing, Prof. Daniel Le Heron from the University of Vienna, Austria, and Dr. Thomas Vandyk from Royal Holloway, University of London, the UK, visited the Institute of Geology during 1 June to 2 July of 2018, for academic exchanges. During their stay, they participated in the fieldwork in related areas of Shennongjia and western Henan Province, China.

Fig. 5.3.7 Discussion during the field work

Visit of Profs. Cees Roelof VAN STAAL and Jean BÉDARD from the Geological Survey of Canada; Prof. LIN Shoufa and Christopher John Anthony Yakymchuk from the University of Waterloo, Canada



Invited by Dr. HE Zhenyu, Profs. Cees Roelof VAN STAAL and Jean BÉDARD of the Geological Survey of Canada, Prof. LIN Shoufa and Associate Professor Christopher John Anthony Yakymchuk from University of Waterloo, Canada, together with two PhD candidates, visited the Institute of Geology for collaborative research and participated in the fieldwork in related areas of Gansu Province, China, during 4 August to 25 September, 2018.

Fig. 5.3.8 Prof. VAN STAAL (first from left) and Prof. LIN Shoufa (in the middle) instructing the field trip

Visit of Prof. Linda C. KAH from the University of Tennessee, USA

Invited by Prof. KUANG Hongwei, Prof. Linda C. KAH from the University of Tennessee, USA, together with Agustin Kriscautzky, her PhD candidate, visited the Institute of Geology for collaborative research from 7-19 October, 2018. During their stay, they participated in the fieldwork in related areas of Shandong, Northern Jiangsu, and Anhui Province, China.

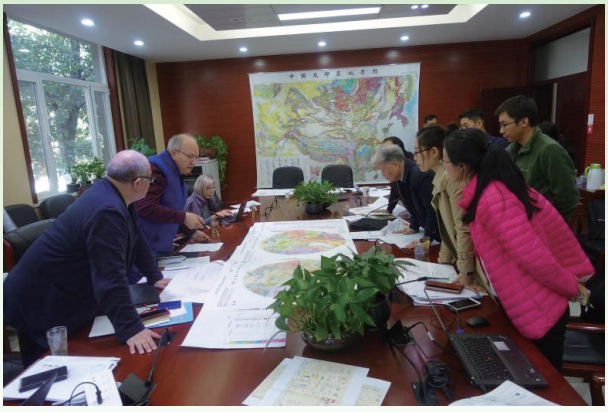
Fig. 5.3.9 Academic exchanges during the field trip

Fig. 5.3.10 Prof. KAH gives a presentation

Visit of Prof. Peter CAWOOD from the Monash University, Australia

Invited by the Director of the Beijing SHRIMP Center, Prof. WAN Yusheng, the core members of IPRCC, Prof. Peter CAWOOD from Monash University, Australia visited the Center from 12-19 October, 2018 and participated in the IPRCC Short Course 2018- Global Geodynamics, as well as the International Field Excursion in Qinling area, Shaanxi Province of China.

Visit of Academician KHANCHUK Alexander from the Far East Institute of Geology, Russian Academy of Sciences, and Dr. POSPELOV Igor et. al from A.P. Karpinsky Russian Geological Research Institute (VSEGEI), Russia



Invited by Academician REN Jishun, Academician KHANCHUK Alexander from the Far East Institute of Geology, Russian Academy of Sciences, and Dr. POSPELOV Igor et al. from A.P. Karpinsky Russian Geological Research Institute (VSEGEI) visited the Institute of Geology for collaborative research on ITMA 5000 (1:5M International Tectonic Map of Asia) from 20 October to 4 November, 2018.

Fig. 5.3.11 Discussion between the two sides

Visit of Dr. John N. ALEINIKOFF from USGS, USA

Dr. John N. ALEINIKOFF from USGS visited the New Laboratory of the Beijing SHRIMP Center on 1 November, 2018 and gave a talk entitled "New interpretations for the which of Mesoproterozoic plutonism in the Adirondacks, NY: Complex CL and BSE terrace, and SHRIMP U-Pb data of zircon and monazite".

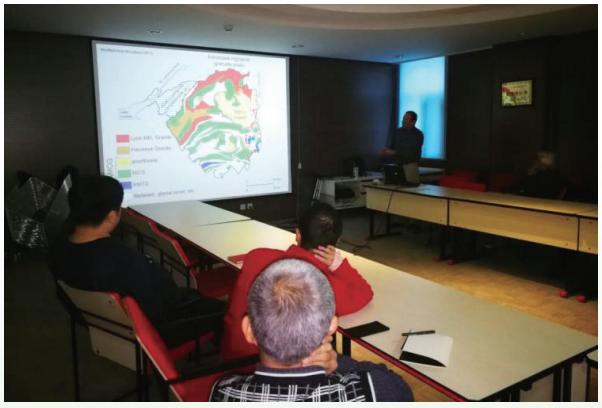


Fig. 5.3.12 Dr. ALEINIKOFF gives a presentation

The trainees of "Training Course (in English) on Geological Survey Information Technology for Developing Countries" visited the Beijing SHRIMP Center

The China Geological Survey organizing 40 government officials and technicians from 16 developing countries such as Ethiopia, Libya, Mozambique, Sri Lanka, Dominica and Papua New Guinea who participated in the "Training Course (in English) on Geological Survey Information Technology for Developing Countries" visited the Beijing SHRIMP Center New Lab Building on 31 October, 2018.

The staff of the Center introduced the achievements of the Center in the field of scientific research and laboratory construction in recent years, and guided the foreign guests to visit the SHRIMP Lab and its affiliated facilities in the Center.

Fig. 5.3.13 The trainees visited the laboratory of the Center

Fig. 5.3.14 Group photo of the trainees at the gate of the Center

The delegation of "Training Course (in French) for the Republic of Guinea on Technology of Mineral Resources Exploration" visited the Beijing SHRIMP Center

The China Geological Survey organizing more than 30 government officials and technicians from the Republic of Guinea who participated in the "Training Course (in French) for the Republic of Guinea on Technology of Mineral Resources Exploration" visited the Beijing SHRIMP Center New Lab Building on 7 November, 2018.

The staff of the Center introduced the achievements of the Center in the field of scientific research and laboratory construction in recent years, and guided the foreign guests to visit the SHRIMP Lab and its affiliated facilities in the Center.

Fig. 5.3.15 The Guinean trainees visited the laboratory of the Center

Fig. 5.3.16 Group photo of the trainees and some of the staff at the SHRIMP Lab building

6.1 International conferences and field excursions organized and/or held by the Institute

The IPRCC Spring Training Course of 2018 "Fluids in high-grade rocks"

The IPRCC Spring Training Course 2018, entitled "Fluids in High-grade Rocks", was held successfully in Beijing on 14-15 April. Lectures were given by two experts on geological fluids, namely Dr. Daniel E HARLOV, senior researcher of GeoForschungsZentrum Potsdam, Germany and Prof. Jacques TOURET, emeritus full professor of Free University of Amsterdam, the Netherlands. The two lecturers gave profound lessons on the fluids in high-grade rocks, including basic research methods, experimental study, interaction between fluids and minerals (specifically those minerals for age dating) and so on.

More than 80 students and geologists from all over China participated in the course and had lively discussions on LIPs, paleomagnetism-paleogeography, supercontinention reconstruction, and global geodynamics and so on. These IPRCC Training Courses have been organized annually since 2010 in order to help young Chinese geologists to have a better understanding of the most important and cutting-edge progress in recent geological research and to promote international cooperation between Chinese and foreign geologists. These series of courses have already become very popular among university students and young geologists. Presentations of the courses in 2018 and from previous years are available on the homepage of the Beijing SHRIMP Center.

Fig. 6.1.1 IPRCC Spring Training course of 2018

The IPRCC Autumn Training Course of 2018 "Global Geodynamics"

The IPRCC Training Course 2018, entitled "Global Geodynamics", was held successfully in Beijing on 12-13 October. Lectures were given by two world-famous scholars, namely Prof. Richard ERNST of Carleton University, Canada and Prof. David EVANS of Yale University, USA. Prof. ERNST's lecture series on LIPs provided a complete overview of the field, from continental and oceanic LIPs and their plumbing systems (including Archaean and planetary analogues), and their links with rifting/supercontinent breakup, resource exploration (ore deposits and oil/gas), environmental changes including mass extinction events, and related silicic magmatism, carbonatites and kimberlites. Prof. EVANS's course provided detailed insights into how palaeogeographic reconstructions are made. It presented the complementary constraints gleaned from regional tectonostratigraphies, large igneous province geometries, and geodynamical considerations. Methods to define paleolongitude were discussed, as well as true polar wander and the long-term behaviour of Earth's magnetic field; and also the possible locations and roles of the Chinese cratons within supercontinents Rodinia and Nuna. In addition, IPRCC core members including Prof. Alfred KRÖNER, Prof. Simon WILDE, Prof. Peter CAWOOD, Dr. Yusheng WAN, Prof. Shihong ZHANG and Dr. Rongfeng GE, et al., also joined the course. More than 100 students and geologists from all over China participated in the course and had lively discussions on LIPs, paleomagnetism-paleogeography, supercontinention reconstruction

and global geodynamics.

These IPRCC Training Courses have been organized annually since 2010 in order to help young Chinese geologists to have a better understanding of the most important and cutting-edge progress in recent geological research and to promote international cooperation between Chinese and foreign geologists. These series of courses have already become very popular among university students and young geologists. Presentations of the courses in 2018 and from previous years are available on the homepage of the Beijing SHRIMP Center.

Fig. 6.1.2 IPRCC Autumn Training Course of 2018 (Prof. David EVANS gives the lecture)

Fig. 6.1.3 Prof. Richard ERNST gives the lecture

The IPRCC Field Excursion in Qinling area

The IPRCC 2018 Field Excursion was undertaken in Shaanxi Province from 14-18 October. This field excursion was organized by the core member of IPRCC, Prof. Yunpeng DONG of Northwest University, China. More than 10 geologists participated in the excursion including those from Australia, USA and China. The field excursion involved the examination into stratigraphies, magmatic bodies and structures of the northern and southern Qinling Orogenic Belt, Shangdan suture and the southern marginal zones of the North China Craton. The field guide was edited by Prof. Yunpeng DONG. It introduced the main content of the field excursion and the updated development in related researches. The participants had a lively discussion on the geological evolution of the Qinling Orogenic Belt and the southern margin of the North China Craton.

Fig. 6.1.4 The IPRCC Field Excursion in Qinling area

The First Workshop of Project IGCP-662 “Orogenic Achitecture and Crustal Growth from Accretion to Collision”

The First Workshop of Project IGCP-662 “Orogenic Achitecture and Crustal Growth from Accretion to Collision” was held in Beijing, China on 21-22 October, 2018. A 5-day pre-workshop field excursion and training course “Field observations and mapping of an accretionary orogen: example from Liuyuan, Beishan, southwestern CAOB, NW

China" was held in Liuyuan area of Gansu Province.

More than 90 experts and scholars from over 12 countries such as Canada, Australia, the UK, France, Germany, Russia, Mongolia, Korea, Turkey, Pakistan, Israel, and China etc. attended the workshop and participated in the field excursion. 23 of the attendees delivered oral presentations, 19 of whom were foreign geologists, and 12 made poster presentations. A training course and discussion meeting, with the theme of "Using isotopes in zircon and sulfides to understand crust-mantle evolution" and four renowned professors as the main lecturers, namely Prof. WAN Yusheng from the Institute of Geology, CAGS, Prof. Alfred Kröner from the University of Mainz, Germany, Profs. Suzanne Y. O'Reilly and William Griffin from Macquarie University, Australia, was held following the workshop. The whole event served as a great platform on which experts from home and abroad exchanged their ideas and cultivated potential cooperation in a much wider and deeper way.

Fig. 6.1.5 Group photos of the Workshop, the field excursion, and the training course

Fig. 6.1.6 Addresses given by LI Jinfa, Deputy Director-General of China Geological Survey (a), HOU Zengqian, Director-General of the Institute of Geology, CAGS (b), Project introduction made by WANG Tao, first leader of Project IGCP-662 (c), address given by and CHENG Qiuming, President of the International Union of Geological Sciences (IUGS) (d).

6.2 Other Academic Activities

The 2018 Academic Workshop of the Institute of Geology was held on 15-16 January, 2019

In order to exchange and discuss the scientific and technological results obtained in 2018, the Institute of Geology held the 2018 Academic Workshop on 15-16 January, 2019. About 200 researchers and postgraduate students, including leaders of the Institute, attended the workshop.

The Workshop fell into two parts: in the first part, Academicians XU Zhiqin, YANG Wencai and HOU Zengqian, Senior research fellows LIU Dunyi, LIU Fulai, LIU Yongqing, XUE Huaimin and LI Haibing, and achievers of various titles of talents and scientific achievement awards, WANG Tao, WAN Yusheng, ZENG Lingsen, ZHU Xiangkun, YAN Zhen, ZHANG Jin and YANG Zhiming made invited speeches, presenting their research achievements; and in the second part, 14 young talents of the institute were invited to deliver special reports concerning different research focuses.

The Workshop was a great success and facilitated exchange and discussion of ideas and promoted the research capabilities of the Institute. The annual academic workshop has become a brand activity of the institute, which is not only involved with the older generation of geologists' devotion to China's geology, but also provides a platform for academic exchanges among the young geologists.

Fig. 6.2.1 Researchers and students attending the Workshop.

Fig. 6.2.2 HOU Zengqian gave a presentation.

Fig. 6.2.3 WAN Yusheng give a presentation

Fig. 6.2.4 ZHANG Jin give a presentation

The 48th Earth Day: Activities to popularize scientific geological knowledge

Assistant Researcher CHE Xiaochao gave a lecture entitled "The chronology study of Imbrium events on the moon" in Beijing SHRIMP Center (Life Science Park). He introduced the recent research results concerning the origin of the moon, the source of the impact materials, and the late heavy bombardment to the undergraduates from China University of Geosciences (Beijing) and Peking University. After the lecture, students visited the two core instruments, Sensitive High Resolution Ion Microprobe (SHRIMP) and time-of-flight secondary ion mass spectrometry (TOF-SIMS) independent research and development platform, and then visited the small showroom with a large collection of rare samples.


Fig. 6.2.5 Activities in Beijing SHRIMP Center on the 48th Earth Day

In the home institute, exhibition boards of geological subjects were displayed. The dull and highly professional magma, magmatism and magmatic materials were linked with our daily life, which aroused great interest of teachers and students. Later, researcher JI Shu'an gave a popular science lecture entitled "How to Restore Dinosaur's Living Habits". Researcher GUAN Ye showed how to reveal the mystery of the earth in three-dimensional method. Professor KUANG Hongwei and associate researcher DONG Hanwen told them the stories of typical rocks in Jixian section and rocks from the upper mantle displayed in the Institute.





Fig. 6.2.6 Activities in the home institute on the 48th Earth Day

Twenty-nine graduate students were awarded diplomas at the 2018 Graduation Ceremony

Fifteen doctoral and fourteen postgraduate students completed their studies and obtained their degrees in 2018. ZHANG Kan won the Excellent Graduates of Beijing General Colleges and Universities; WANG Yaying, SHANG Xiaodong and WANG Chaoyang won the CHENG Yuqi Excellent Graduate Award; ZHANG Kan, LIU Mingqi and PENG Yinbiao received the CHENG Yuqi Excellent Thesis Award; LU Zenglong was awarded the academic "Outstanding Graduate" honor of the Chinese Academy of Geological Sciences (CAGS), and sixteen additional graduate students received the academic "Excellent Student" honorary title of CAGS. MENG Yuanku and SHI Fuqiang were awarded "excellent graduate students" by the Beijing Education Department.

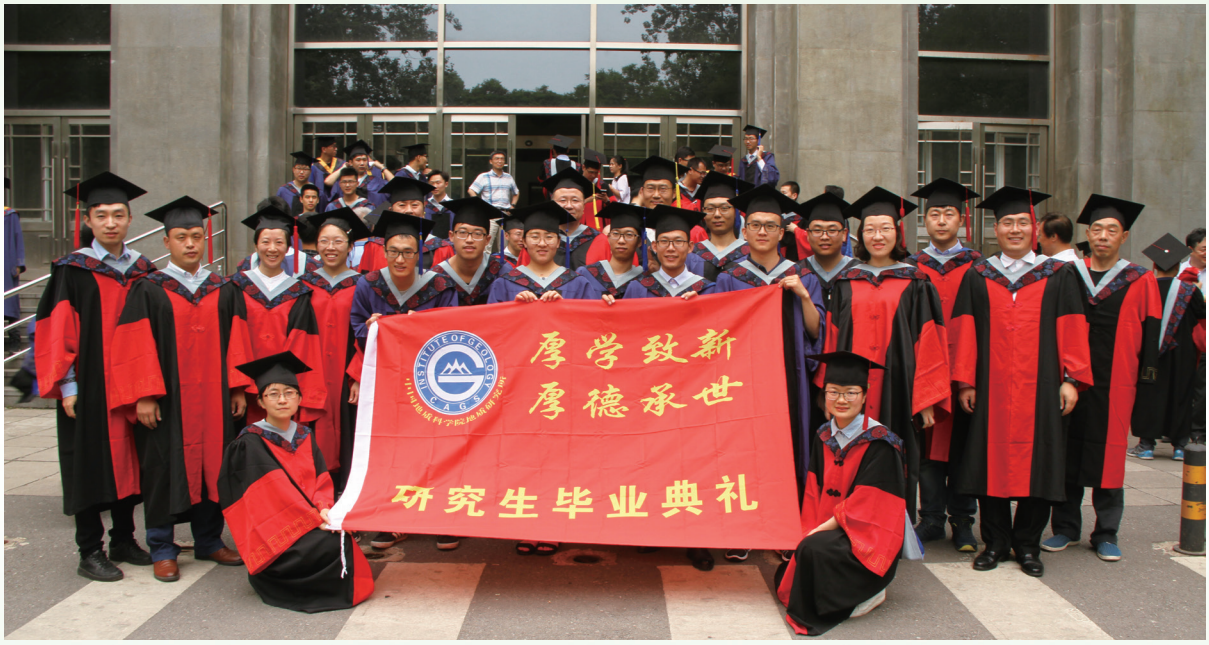


Fig. 7.1 Group photo of the 2018 postgraduate students of the Institute

The first geological summer camp for university students was held by the Institute

From July 20 to 28, 18 excellent university students majored in geology from 11 universities in China gathered at the Institute of Geology and participated in the first 10-day geological summer camp in Qilian Mountains. In the field, the invited geological experts explained the typical geological phenomena of Qilian Mountains in detail, and instructed the campers to practice basic skills such as strike-dip survey of geological structure and sample collection. In addition, the campers visited two key laboratories of the Ministry of Natural Resources, namely, Isotope Geology and Deep-Earth Dynamics, and Beijing SHRIMP Center, to understand the use of various instruments and related important scientific research results.

Fig. 7.2 Field trip in Qilian Mountains

Fig. 7.3 Visiting the Lab of Isotope Geology

The Institute successfully passed the expert evaluation of the Authorization Center for geological degree

On November 9, 2018, the Institute of Geology conducted an evaluation report on the first-level discipline of geological degree. As the leading unit of the authorization center for geological degree, the Institute collected and collated the data and information of 14 training units, summarized and collated the main research directions and characteristics of five secondary disciplines, displayed the representative research results in the past five years, successfully completed all the work of the degree evaluation report, and was highly praised by Graduate School and peer experts.

Fig. 7.4 The Institute conducted an evaluation report on the first-level discipline of geological degree

Postgraduates ZHANG Kan and WANG Chaoyang were awarded the Ninth LI Siguang Excellent Student Award

On November 17, 2018, the Ninth LI Siguang Excellent Student Award Ceremony was held at the University of Chinese Academy of Sciences. Ph. D. student ZHANG Kan (tutored by ZHU Xiangkun) from our institute enrolled in 2014 and master student WANG Chaoyang (tutored by MENG En) enrolled in 2015 won the prize.

Fig. 7.5 Group photo of the Ninth Li Siguang Excellent Student Award winners in the Institute and their advisors

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Hu Peiyuan, Zhai Qingguo, Ren Guangming, Wang Jun, Tang Yue. 2018. Late Ordovician high-Mg adakitic andesite in the western South China block: evidence of oceanic subduction. International Geology Review, 60(9):1140-1154.

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