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ANNUAL REPORT OF SCIENCE AND TECHNOLOGY 2020

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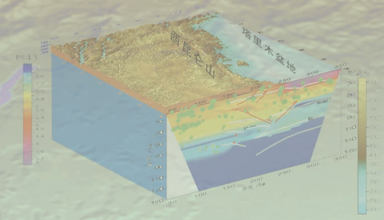

Beijing · China

May 2021

中国地质科学院地质研究所
INSTITUTE OF GEOLOGY CHINESE ACADEMY OF GEOLOGICAL SCIENCES

2020 Annual Report Contents

Preface 2020

The Institute of Geology, Chinese Academy of Geological Sciences (IGCAGS), is a national scientific research institution engaged mainly in fundamental national, strategic, and frontier geological surveys and geoscientific research. Entering the new century, particularly during the past five 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 increasing number of papers published in *Nature, Science*, and other high-impact international scientific journals. In the light of this and to publicize annual progress and achievements of the Institute to enhance its international reputation, an English version of the Institute's Annual Report of Science and Technology has been published since 2010.

The Annual Report 2020 includes the following sections: (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 2020; (7) Postgraduate education; and (8) Publications. 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 in providing related material—a written record of the hard work of the Institute's scientific research personnel for the year 2020.

Editorial Board of
the Annual Report (English Version) of Science and Technology of the Institute of Geology,
Chinese Academy of Geological Sciences
27 May, 2021

1 2020 Introduction

The Institute of Geology, Chinese Academy of Geological Sciences (IGCAGS), is a national scientific research institution engaged mainly in fundamental national, strategic, and frontier geological surveys and geoscientific research with the aim of providing geological theory and technological support for national geoscientific research and investigation through undertaking:

(1) Fundamental national, strategic, and frontier geoscientific research and geological surveys;

(2) Investigations and innovative research on major geological problems pertaining to Earth resources and environment;

(3) Multidisciplinary research on tectonic geology and geotectonics, regional geology and metallogeny, stratigraphy and palaeontology, metamorphic rocks and Precambrian geology, petrology and mineralogy, and Quaternary geology; with research in major areas such as continental tectonics and dynamics, deep lithosphere exploration and three-dimensional geological surveys, isotope geology and chronology, and comprehensive geological research and mapping research.

(4) Research on isotopic chronology, geochemical techniques and systems, major key technologies, and instrumentation, including construction, management, and operation of relevant experimental and observational bases.

(5) International geological cooperation and exchange.

The Institute's 258 staff-members include 154 senior professionals, 6 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 Scholars", 4 professionals supported by the "NSFC Excellent Young Scholars Fund", 2 professionals supported by the "National High-level Personnel of Special Support Program", and 1 research group supported by the "NSFC Science Fund for Creative Research Groups". The Institute is supported by the "Innovative Talent Training Demonstration Project" and "National Talent and Intelligence Introduction Demonstration Base" of Ministry of Science and Technology (MOST) of China.The Institute was newly named "Geoscience Polularization Research Base"by the Geological Society of China (GSC).

IGCAGS has trained a large number of highly qualified graduate students, and has designated programs for postdoctoral research, with a postgraduate education system for Masters and PhD students. IGCAGS has 38 doctoral tutors and 58 masters tutors. The institute enrolls ~25 PhD and MA students each year, and currently has 35 postdoctoral researchers.

The Institute has 13 research divisions: Division of Regional Geology and Mapping, Division of Tectonics, Division of Stratigraphy and Paleontology, Division of Igneous Rocks, Division of Metamorphic Rocks and Precambrian Geology, Division of Continental Dynamics, Division of Isotope Geology, Lithosphere Research Center, Beijing SHRIMP Center, Mineral and Energy Resources Center, Earth System Science Center, Informatization Office and Journal and Reference Room.

The Institute also hosts three key laboratories of the Ministry of Natural Resources (MNR) of the People's Republic of China, namely the Key Laboratory of Isotope Geology, Key Laboratory of Stratigraphy and Paleontology, and Key Laboratory of Deep-Earth Dynamics.

Seven academic organizations are affiliated with the Institute: the China Commission of International Continental Scientific Drilling, Commission of Regional Geology and Mineralization of the 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, and Mineralogy and Geochemistry of GSC.

In recent years, the Institute has undertaken more than 700 research projects including the "National Science and Technology Major Project of MOST", National Scientific Instruments and Equipment, and the National Key Research and Development Plan (including the "National Basic Research Program of China (973 Program)"). Significant

research programs are supported by the National Natural Science Foundation and projects of China Geological Survey (CGS).

The Institute has produced a great number of innovative outcomes by promoting the growth of talent, fostering innovative ideas, and enhancing the ability to perform scientific research and meet major national needs, with many innovative achievements in the field of solid-Earth science. The Institute attaches great importance to intellectual property rights, having been authorized for about 25 patents. In the past five years, ten research achievements have been awarded to the Institute, including two National Natural Science Awards, and eight Science and Technology Progress Award from MNR.

Fig 1.1. Mainbuilding of the Institute of Geology, Chinese Academy of Geological Sciences

Organizational Framework

* Administrative Departments

General Office
Department of Science and Technology
Financial Department
Department of Equipment and Infrastructure
Department of Personnel and Education
Party Committee Office
Department of Discipline Inspection and Audit

* Technical Support Organizations

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

* Technology Platforms

Beijing SHRIMP Center
Key Laboratory of Deep-Earth Dynamics, MNR
Key Laboratory of Isotope Geology, MNR
Key Laboratory of Stratigraphy and Paleontology, MNR
National Observation and Research Station of Crustal Activity in Deep Holes of the Continental Scientific Drilling

* National Bases

Innovative Talent Training Demonstration Base
National Demonstration Base for Talent and Intelligence Introduction

*Publications

Acta Petrologica et Mineralogica

* Research Fields

▲Regional geology and mapping
▲Orogenic tectonics
▲Coevolution of continental multisphere
▲Tethyan evolution and deep geodynamics
▲High–ultrahigh-pressure metamorphism and metamorphic belts
▲Precambrian geology and early crustal evolution
▲Magmatism, crustal growth, and mantle–crust evolution
▲Origin and evolution of life, paleontology, and stratigraphy
▲Sedimentary basins and coevolution of paleogeography and paleoenvironments
▲Active tectonics and ecological environment transition
▲Metallogenic background and theory of critical mineral resources
▲Deep Earth probe and 3D lithospheric stucture
▲Geological method system and applications of isotopes
▲Planetary science, polar science, and island–ocean comparison
▲Geological big data and database construction

2.1 Research Papers

Rejuvenation of ancient micro-continents during accretionary orogenesis: Insights from the Yili Block and adjacent regions of the SW Central Asian Orogenic Belt

ABSTRCAT: In the Central Asian Orogenic Belt (CAOB), whether substantial juvenile additions associated with accretionary orogenesis are preserved is still a pending issue. The Yili Block (YB) is a micro-continent in the Western Tianshan, SW CAOB. Voluminous felsic rocks constitute two major belts stretching in the southern and northern margins of the YB. We synthetically compile up-to-date zircon U-Pb geochronological, elemental, and Nd-Hf isotopic data for felsic rocks from the YB and adjacent tectonic domains. Spatially, Hf-Nd isotopic mapping unveils an inboard-younging trend in Hf model age of the YB, which indicates relative ancient basement rocks in its northern and southern edges and the most juvenile crust beneath its centre. Temporally, the compiled zircon Hf isotopic dataset suggests alternating continental reworking and growth in the YB and adjacent regions during Paleozoic times. In combination with other evidence, we speculate that the Paleozoic continental evolution in the Yili Block and adjacent regions were associated with episodic advancing and retreating subduction of branches of the Paleo-Asian Ocean (*i.e.,* North Tianshan Ocean in the north and South Tianshan Ocean in the south) and the following orogenic collage. Continental arc-type felsic rocks yield two major populations of ~460 to ~395 Ma and ~375 to ~310 Ma, respectively, implying two epochs of subduction events punctuated by a magmatic lull. In the first-stage subduction, tectonic switch from advancing to retreating subduction took place around ~450 Ma in the northern YB and ~420 Ma in the southern YB. The second-stage subduction was characterized by a period of trench advance (~ 375 to ~350 Ma in the northern YB and ~370 to ~350 Ma in the southern YB) at the initiation and the following Early Carboniferous trench retreat (~350 to ~310 Ma in the northern YB, and ~350 to ~322 Ma in the southern YB) associated with the development of back-arc basins. The final assembly of the Western Tianshan orogenic collage plausibly occurred during the Late Carboniferous. In the south, a “hard” collision followed the closure of the South Tianshan Ocean. On the contrary, the northern margin of the YB was likely collided “softly” with an immature/nascent island arc. The current study highlights a crucial link between supra-subduction extension triggered by trench retreat (slab rollback) and the continental growth of the Yili Block and adjacent regions. On a larger scale, such a longterm “rejuvenation” process, which was characterized by the gradual replacement of old basement by juvenile crust and associated with subduction zone retreat (rollback), has been documented in some other micro-continents of the CAOB. The preservation of juvenile/mixed crust requires some continental margins that did not collide with any ancient micro-continent or craton (*i.e.*, non-collisional or soft-collisional margins) even until the termination of accretionary orogenesis. The development of a series of oroclines is likely the principal mechanism resulting in survival (preservation) of juvenile/mixed crust within the huge fossil orogen.

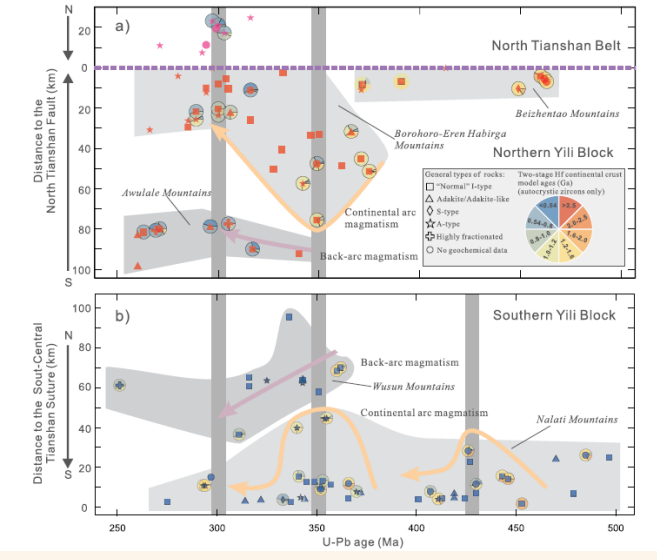

Fig 2.1.1 HUANG He and WANG Tao *et al.,* 2020-*Earth Science Reviews,* 208:103255

Mesozoic juvenile crustal formation in the easternmost Tethys: Zircon Hf isotopic evidence from Sumatran granitoids, Indonesia

ABSTRCAT: Prior to the collision of India with Asia, the evolution of island arcs and resultant crustal formation in the now-disrupted easternmost Tethys are poorly constrained. Here, we report for the first time zircon U-Pb and Hf isotopic data from Mesozoic granitoids in Sumatra, Indonesia. Our analyses identified three magmatic episodes at 214–201 Ma, 148–143 Ma, and 102–84 Ma, respectively, with a drastic change in magmatic zircon $\varepsilon_{Hf}(t)$ values from −13.1 to +17.7 in the Late Triassic granitoids, which reveals a fundamental restructuring of the arc system in Sumatra. Subsequently, all Jurassic to Late Cretaceous granitoids have exclusively positive zircon $\varepsilon_{Hf}(t)$ values (+17.7 to +10.2), consistent with juvenile arc development owing to subduction of the easternmost Tethyan lithosphere beneath Sumatra. Such highly positive zircon $\varepsilon_{Hf}(t)$ values of the Sumatran granitoids, in general accordance with those of the Gangdese arc system in South Asia, are markedly higher than those (+13.7 to −14.7) of broadly contemporaneous Cordilleran arcs in Americas and Zealandia. Our findings from the easternmost Tethys provide new insights into not only the tectono-magmatic evolution of eastern Tethys, but also its crucial role in global juvenile crustal growth.

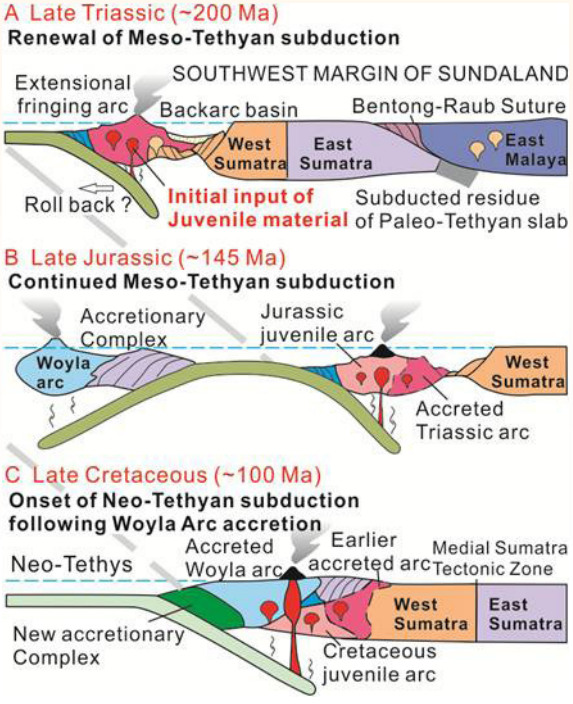

Fig 2.1.2. LI Shan *et al.*, 2020-*Geology*, 48: 1002-1005

Detrital zircon records of late Paleoproterozoic to early Neoproterozoic northern North China Craton drainage reorganization: Implications for supercontinent cycles

Statherian through Tonian strata of the Langshan–Zha'ertai–Bayan Obo–Huade rift zone (LZBH) at the northern margin of the North China Craton provide an excellent record of changes in sediment provenance related to the supercontinent dispersal and amalgamation. During the late Paleoproterozoic to early Neoproterozoic, the LZBH developed over the Yinshan Block and was flanked by the Khondalite Belt to the south, the Trans–North China Orogen and Yanliao rift zone to the east, ultimately preserving a >7000-m-sequence of fluvial, marginal marine, and offshore marine sediments. In order to decipher the influence of these tectonic features on sediment delivery to the area, we evaluated 4955 U-Pb and 1616 Lu-Hf analyses from 66 samples across the entire LZBH, of which 1002 U-Pb and 271 Lu-Hf analyses from 12 samples are newly reported herein. The detrital zircon results indicate three stratigraphic intervals with internally consistent age peaks: (1) Changcheng to lower Jixian system (Statherian–lower Calymmian), (2) upper Jixian system (upper Calymmian), and (3) Qingbaikou system (Tonian). Statistical analysis of the detrital zircon results reveals two distinct changes in sediment provenance. The first transition, between the lower and upper Calymmian, reflects a provenance change from the basement of the Yinshan Block and the Khondalite Belt to a mixed signature, indicating derivation from both basement and Statherian rift-related magmatic products. Such a transition implies establishment of east–west drainage systems traversing the Paleoproterozoic Trans–North China

Orogen caused by continued rifting since Statherian and premagmatic uplift during breakup of the North China Craton from the Columbia supercontinent. The second transition is indicated by the presence of Mesoproterozoic detrital zircons with juvenile Hf isotopic features since Tonian time and the up-section and northward increase of Mesoproterozoic detrital zircons. Their provenance is interpreted to be the Fennoscandian shield by a pancontinental drainage system related to aggregation of the Rodinia supercontinent. Thus, the detrital zircon spectra in the LZBH document the transition from initial unroofing of local uplifted basement of the Yinshan Block and Khondalite Belt to the distant Yanliao rift zone, then to the more distant Fennoscandian shield.

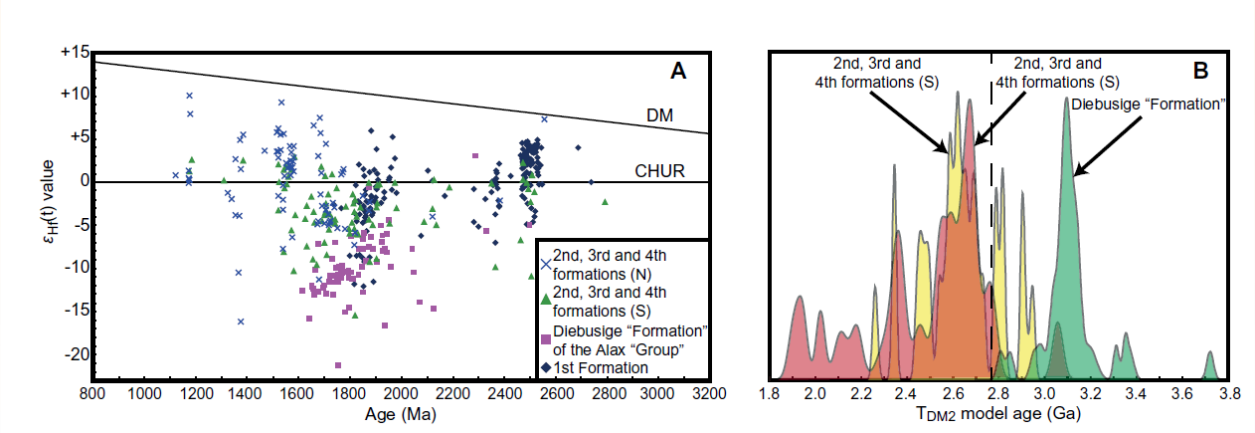

Fig 2.1.3. LIU Chaohui *et al.*, 2020-*GSAB*,132 (9-10): 2135–2153

Early Eocene high-flux magmatism and concurrent high-temperature metamorphism in the Gangdese belt, southern Tibet

ABSTRCAT: The Himalayan-Tibetan orogen represents one of the major Cenozoic tectonic features on Earth, and yet considerable debate continues over the timing and sequence of collisional events leading to its formation. In this contribution, we present new field relations, petrology, geochemistry, geochronology, and phase equilibria modeling in the Gangdese belt of southern Tibet in an effort to address Indo-Asian collisional events in the region. These investigations reveal that the dominantly dioritic Nymo intrusive complex was formed at *ca.* 50–47 Ma. We establish that the Jurassic-aged Bima volcano-sedimentary sequence underwent early Eocene (50–47 Ma) high-temperature (HT) amphibolite-facies metamorphism. Petrology and phase equilibria modeling of garnet-biotite schists in the Bima rocks reveals mineral assemblages of melt + plagioclase + garnet + biotite + magnetite + ilmenite + sillimanite formed under conditions of 5.3–7.5 kbar and 700–800 °C. We contend that the early Eocene Nymo intrusive complex represents part of the *ca.*

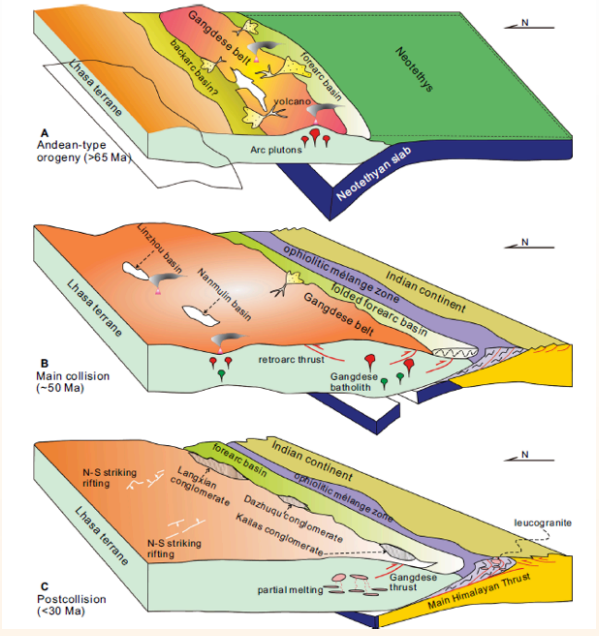

Fig 2.1.4.MA Xuxuan *et al.*, 2020- *GSA Bulletin* (2021) ,133 (5-6): 1194–1216

50 Ma high-flux magmatic "flare-up" that triggered the HT amphibolite-facies metamorphism within the overlying plate during Indo-Asian collision. The synchroneity of high-flux magmatism and HT metamorphism in the Gangdese belt roughly coincided with the continuing Indo-Asian collisional process, implying the early Eocene closure of the Neotethys Ocean along the southern mar¬gin of the Lhasa terrane.

Petrogenesis of Early Cambrian granitoids in the western Kunlun orogenic belt, Northwest Tibet: Insight into early stage subduction of the Proto-Tethys Ocean

ABSTRCAT: The west Kunlun orogenic belt, located on the northwest margin of the Tibetan Plateau, represents a crucial tectonic junction between the central Asia and Tethys domains. Its evolution was closely related to the Paleozoic subduction and closure of the Proto-Tethys Ocean, which was formed by the breakup of the Rodinia supercontinent following the Neoproterozoic. However, the early evolution of Proto-Tethys oceanic subduction (e.g., subduction initiation timing, polarity, and pro-cess) remains controversial. The source of the Early Cambrian granitoids is also unclear. To explore these questions, four Cambrian plutons (*i.e.*, two Tianshuihai monzogranites and south Kunlun diorite and monzogranite) were chosen for geochronological and geochemical studies. Zircon U-Pb dating reveals that these plutons formed at *ca*. 533–513 Ma and thus represent the oldest arc-related magmatism in the west Kunlun orogenic belt. The Tianshuihai monzogranites have positive $\varepsilon_{Nd}(t)$ values (+0.76 to +1.34) and zircon $\varepsilon_{Nd}(t)$ values of +0.25 to +6.42, with low δ_{18}Ozrn values of +5.11‰ to +7.38‰, suggesting that their source includes juvenile material. These rocks are weakly peraluminous and have relatively old Hf model ages of 1.09–1.48 Ga. Mass balance calculations show that the Tianshuihai monzogranites were derived from partial melting of Mesoproterozoic meta-igneous rocks with the addition of 22% of juvenile material. The south Kunlun monzogranites in this study are weakly peraluminous, and their lowest $\varepsilon_{Nd}(t)$ values are –9.24 to –9.27 and zircon $\varepsilon_{Hf}(t)$ values are –7.80 to –11.2. The oldest Hf model ages are 1.97–2.18 Ga, and the highest zircon δ_{18}Ozrn values are +8.11 to +9.73‰. Their isotopic compositions are different from those of the magmas derived from partial melting of just Paleoproterozoic and Mesoproterozoic basement rocks but can be produced by a mixing source of 32% meta-igneous rock and 68% meta-sedimentary rock. The south Kunlun diorites are characterized by high Sr contents and relatively high Sr/Y (52–63) ratios but low Y, Yb, Cr, and Ni contents, like those of the thickened continental crust-derived adakites. Their Sr-Nd–Hf-O isotopic compositions indicate that their parental magma was derived from a Mesoproterozoic metaigneous basement in the garnet stability field. Based on the newly identified, oldest island arc magmatic records in the west Kunlun orogenic belt, the subduction initiation of the Proto-Tethys oceanic slab must have occurred prior to the Early Cambrian (>533 Ma). Our results, with previously published data, show that the west Kunlun orogenic belt was in an extensional setting during the Early Cambrian and that the magmatism migrated northeastward along the axis of the south Kunlun terrane between 533 Ma and 513 Ma. Therefore, considering the spatial and temporal distribution and petrogenesis of the Early–Middle Cambrian plutons in the west Kunlun orogenic belt, we propose that the Early Cambrian magmatism was most plausibly triggered by asthenospheric upwelling in response to the rollback of southward-subducted Proto-Tethys oceanic slab.

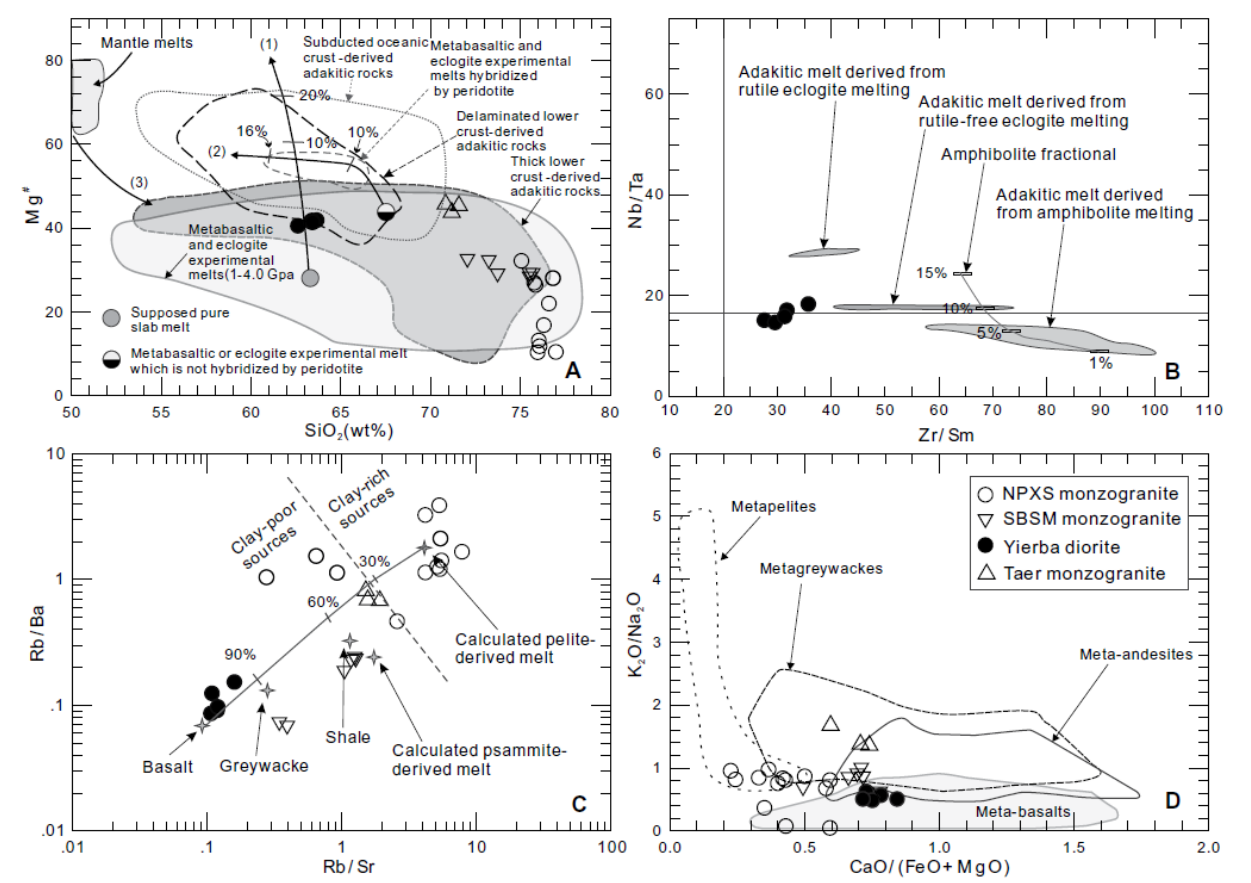

Fig 2.1.5. YIN Jiyuan *et al.*, 2020- *GSA Bulletin*, 132 (9-10): 2221–2240

Algal affinity and possible life cycle of the Early Cambrian Acritarch Yurtusia uniformis from South China

ABSTRCAT: Abundant, well-preserved specimens of spheroidal organic-walled microfossil Yurtusia uniformis are reported from the basal Cambrian Yanjiahe Formation in the Changyang area of Hubei Province, South China. Thin and hollow processes extend between the double walls of the vesicle. The single to multiple internal bodies within the vesicle cavity are observed in the genus for the first time, representing reproductive structures (dividing daughter cells). A small circular perforation may occur on the vesicle wall to release the internal bodies. Morphological analyses of specimens preserved at various life stages reveal that processes gradually became longer as the vesicle grew in size. The internal bodies (daughter cells) underwent several successive divisions within the vesicle, which was accompanied by the simultaneous growth of both vesicle and processes. The regular growth of cells, formation and release of daughter cells, and the remarkable morphological similarity between extant algae and the studied microfossils suggest that Yurtusia uniformis is probably a green microalga that may be closely related to the Trebouxiophyceae or even Chlorellales (Chlorophyta). The growth and reproductive mode of individuals indicates that Y. uniformis is an actively growing vegetative cell of microalgae, rather than a metabolically inert cyst or resting spore. A life cycle involving vegetative growth and asexual reproduction is proposed for Y. uniformis on the basis of the life histories of modern chlorophytes. The multiple internal cells may represent autospores produced by a mature autosporangium during asexual reproduction, which subsequently developed into separate young vegetative cells after their release from the opened autosporangium.

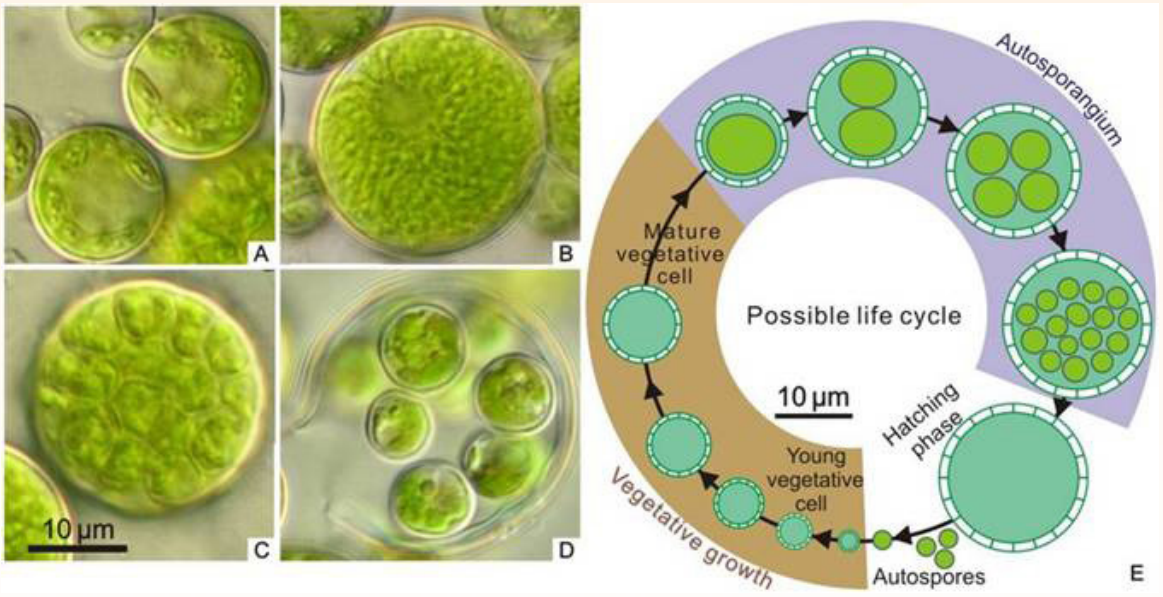

Fig 2.1.6. SHANG Xiaodong and LIU Pengju *et al.*, 2020- *Palaeontology*, 63: 903-917

New Mapping of the World-Class Jinding Zn-Pb Deposit, Lanping Basin, Southwest China: Genesis of Ore Host Rocks and Records of Hydrocarbon-Rock Interaction

ABSTRCAT: Jinding is the third-largest known Mississippi Valley-type (MVT) Zn-Pb deposit. It is hosted by a dome containing a suite of complex breccias and sandstones with abundant gypsum and anhydrite. This study presents the results of new geologic mapping of the Jinding open pit and discusses the geology of the deposit in detail. Our new data support a previously proposed model where the deposit is hosted in an evaporite dome created by the diapiric migration of Late Triassic evaporites during Paleocene thrust loading. Nearly all of the mineralization in the deposit is hosted by evaporite diapir-related rocks, including diapiric breccias and laterally extruded material mixed with fluvial sandy sediments (limestone clast-bearing sandstones) and overlying gypsum- sand diapiric units (mainly clast-free sandstones). The new mapping determined that the currently light gray colored sandstones within the Jinding dome were originally red, with the bleaching being a response to calcite and pyrite alteration as a result of pre-ore interaction with hydrocarbons. The bleached sandstones host sphalerite and galena that replaced calcite, and Zn-Pb sulfides also occur in limestone breccias and gypsum-rich rocks as a result of replacement and open space-filling mineralizing processes. The Jinding deposit demonstrates that MVT Zn-Pb mineralization can be hosted by a variety of evaporite diapir-related rocks and indicates that dome structures and the presence of pre-ore hydrocarbons are both important for the formation of Zn-Pb mineralization.

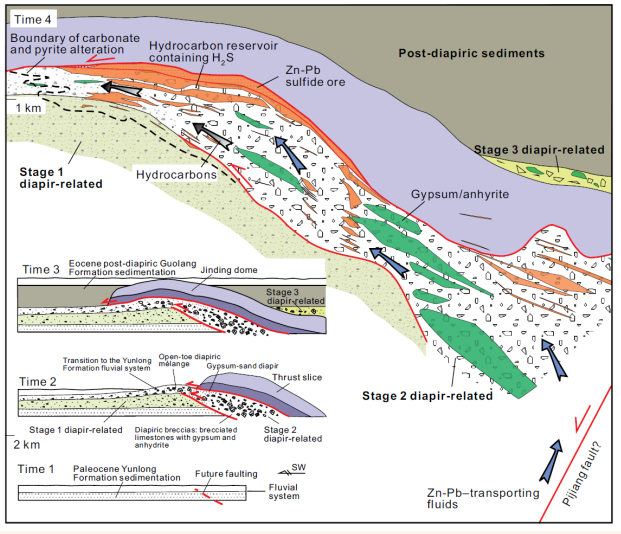

Fig 2.1.7. SONG Yucai and HOU Zengqian *et al.*, 2020- *Economic Geology*, 115(5): 981-1002

Detailed structure of mantle transition zone beneath southeastern China and its implications for thinning of the continental lithosphere

ABSTRCAT: This paper presents a new study on 3-D structure, temperature and water content estimation of the mantle transition zone (MTZ) by P-wave receiver functions common conversion point (CCP) method on broadband array with 267 temporary stations and 203 permanent stations in southeastern China. The results show different structural characteristics of the MTZ to the north and south of the 29°N line. In the northern part, the 660-km discontinuity is generally deeper than globe models, and there are two independent local depressions with characteristics of high velocity, low temperature, and water shortage. We interpret them as two previous subducting plates stagnated in MTZ, possibly related to two separate subduction events at different times. While in the southern part, the 410-km discontinuity is locally depressed, resulting in thinning of the MTZ. Particularly, in the Cathaysian Block south of the 29°N line, based on the MTZ structure and the estimation of temperature and water content, we conside dehydration of the MTZ as one of the important mechanisms of lithospheric thinning through interaction with the asthenosphere. We then propose a dynamic model that combines paleo-Pacific flatslab subduction and upper mantle convection to explain the lithospheric extension and thinning, magmatic rock distribution, weak seismic activity and basin-and-range geomorphology. This model differs from that north of the 29°N line in the North China Block.

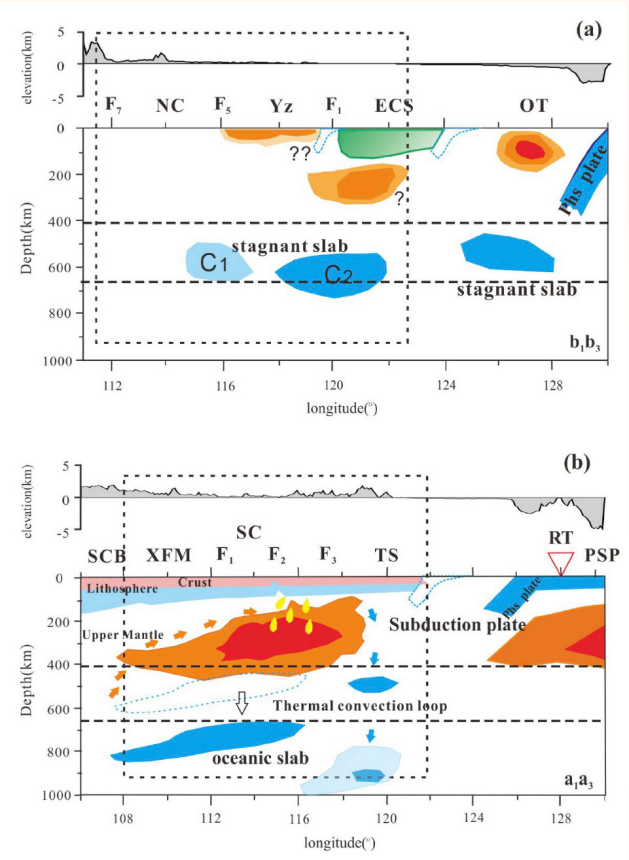

Fig 2.1.8. HAN Rubing and LI Qiusheng *et al.*, 2020-*Tectonophysics*, 789: 228480

Changes in the cell parameters of antigorite close to its dehydration reaction at subduction zone conditions

ABSTRCAT: The unit-cell parameter a of antigorite (usually expressed as the polysome m value) has been determined as a function of temperature (T) and pressure (P) in the range of 600–650 °C, 25–45 kbar in weeklong piston-cylinder experiments. A well-characterized natural antigorite (with m = 16 and less abundant m = 15) was used as a starting material that coexisted with olivine, chlorite, Ti-humite, and aqueous fluid at run conditions. Transmission electron microscope (TEM) measurements on selected focused ion beam (FIB) wafers showed that antigorite m values after the experiments varied between 14 and 22. More than 40 punctual analyses for each run condition were acquired to determine the range and the primary m value. The most frequent antigorite m-value decreased systematically from 17–19 at 600 °C to 15–16 at 650 °C. The spacing of the m-isolines is getting narrower as the antigorite break¬down reaction is approached. The topology of the m-isolines is similar to that previously

characterized for the simple MgO-SiO_2-H_2O (MSH) system. However, the isolines are shifted to about 50–100 °C higher temperatures due to the incorporation of Al into antigorite. Powder samples and FIB wafers of natural antigorite from the Tianshan UHP belt (China) with peak metamorphic conditions of ~35 kbar, ~520 °C were also investigated with TEM. Low Al-antigorite formed at peak metamorphic conditions displays a peak m value of 20–21, whereas high-Al antigorite formed during isothermal decompression displays a lower m value of 19. Combination of our results with the published data of m values from metamorphic antigorite that experienced various conditions allowed construction of a P-T-m diagram that can be used in future studies to better constrain formation conditions of serpentinites. The decrease of m values and the increase of Al in antigorite with increasing temperature result in small, continuous dehydration whereby the H_2O content of antigorite changes from 12.4 to 12.1 wt%. Therefore, it is expected that a pore fluid is present during the prograde deformation of serpentinites. TEM observations showed that antigorite adjusted its Al content by segregation of chlorite at the nanoscale. Together with the observation that multiple m values are always present in a single sample, this result indicates that full equilibration of antigorite at the micrometer-scale is rare, with important implications for the interpretation of geochemical signatures obtained by in situ techniques.

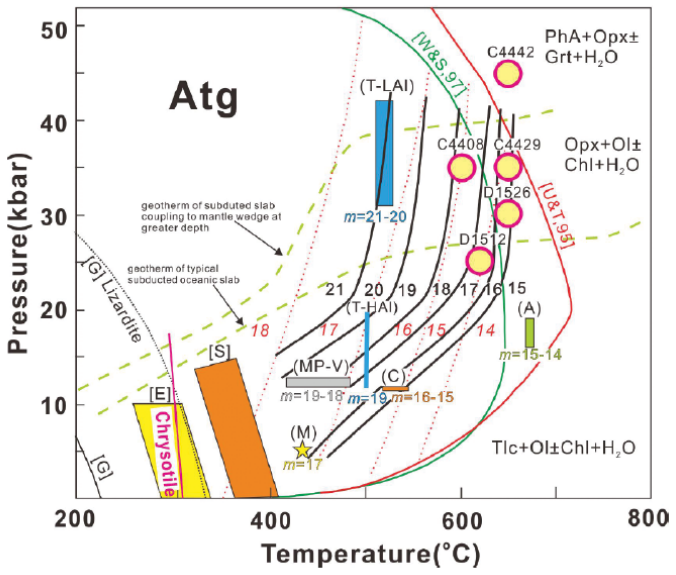

Fig 2.1.9. SHEN Tingting and ZHANG Cong *et al.*, 2020-*American Mineralogist,* 105: 569-582

2.2 Results of the National Natural Science Foundation of China (NSFC) Projects Completed in 2020

Fault Friction over Time: Coseismic Weakening and Postseismic Healing in situ (chief researcher: LI Haibing)

This project is based on long-term monitoring of multiple parameters (temperature, permeability, stress) in Wenchuan Earthquake Fault Scientific Drilling (WFSD) boreholes, together with microstructural, petrological, mineralogical, and physicochemical analyses of drill-cores, to investigate fault slip behavior, fault strength, coseismic weakening, and earthquake rupture and healing mechanisms. There have been a number of innovative achievements, with 29 papers published, as follows. (1) The Yingxiu–Beichuan fault is a large stick–slip zone with long-term strong earthquake activity, and is a typical listric reverse fault. The Guanxian–Anxian fault is a relatively small-scale fault with low angle, characterized by long-term creep structures. (2) Pristine pseudotachylytes were first reported in WFSD drill-cores, generated in fluid-rich fault gouge during the Wenchuan earthquake, considered as principal slip zones. Multiple weakening mechanisms operated during the earthquake. (3) Based on long-term borehole monitoring, two healing mechanisms have been proposed: a short-period reversible effect of loose fillings in the fractures; and long-term irreversible healing with precipitation and crystallization of calcium carbonate and a fault healing cycle of 20–25 years. (4) Fault gouge graphitization provides direct evidence of past seismic slip, with metallic iron formed by melting being a newly discovered cause of the magnetic anomaly of pseudotachylyte. (5) Multiple generations of fault

rock records in the Yingxiu–Beichuan fault zone indicate that strong earthquakes occur there repeatedly; imbricated thrust sheets revealed by WFSD-2 cores have accommodated strong crustal shortening. These outcomes indicate that accumulated crustal shortening caused by imbricated thrusting and long-term seismic activity in the Yingxiu–Beichuan zone is responsible for rapid uplift of the Longmen Shan. These achievements have laid a solid theoretical foundation for the understanding of earthquake faulting mechanisms, rupture processes, post-earthquake healing processes, strong-earthquake reoccurrence, and provided a scientific basis for the study of earthquake dynamics, which is of great significance in the assessment and prediction of regional earthquake disasters.

Tectonomagmation associated with the formation of the Paleo-Tethys Ocean: Evidence from the central Qiangtang, northern Tibet (chief researcher: ZHAI Qingguo)

Our research focuses mainly on early Paleozoic ophiolites and associated tectonmagmatism in the central Qiangtang area, northern Tibetan Plateau. We performed detailed studies of the early Paleozoic ophiolites and associated magmatic rocks including field investigations and petrological, mineralogical, geochemical, isotopic, and geochronological analyses. These studies have elucidated the timing of opening, temporospatial distribution, and tectonic evolution of the Paleo-Tethys Ocean. The study also involved work on ophiolites from the Bangong–Nujiang suture zone on the southern margin of the Paleo-Tethys orogenic belt. Results are as follows. (1) Based on studies of the ophiolites, high-pressure metamorphic belt, and magmatic arc, a tentative model has been proposed for the evolution of the Paleo-Tethys Ocean. (2) Ophiolite sequences in the Lancangjiang belt in the Sanjiang area of the eastern extension of the Qiangtang Paleo-Tethyan orogenic belt have been documented. These ophiolites indicate that the Lancangjiang belt likely represents a back-arc basin of the Sanjiang Paleo-Tethys Ocean. We conclude that an arc–back-arc system developed in the Sanjiang Paleo-Tethyan orogenic belt during the Late Carboniferous. (3) We have identified a mid-ocean ridge (MOR)-type ophiolite in the Ren Co area, the middle part of the Bangong–Nujiang Meso-Tethys suture zone, and tentatively reconstructed the evolution of the Meso-Tethys Ocean. These new data will play a key role in elucidating the evolution of the Paleo-Tethys Ocean and provide important geological information relevant to resource exploration and survey.

Mesozoic mélange belt in the southeastern Gaoligong orogen, west Yunnan, and its relationship with the southern extension of the Banggonghu–Nujiang suture (chief researcher: QI Xuexiang)

The mélange zone in the southeastern Gaoligong orogen of the Longling-Ruiling area is 3–5 km wide and 130 km long. It comprises a turbidite matrix and blocks including serpentinized peridotite, basalt, gabbro/diabase, chert, and carbonate rock with fault contact of both matrix and blocks. The turbidite comprises green greywacke, interbedded with grey–green mudstone of thin–medium layers, siliceous mudstone, and radiolarian-bearing chert, indicating that it formed in a stable abyssal sea environment of outer-fan subfacies on a deep-water turbidite fan. The youngest detrital zircon $^{206}Pb/^{235}U$ age of the greywacke is 212 Ma, representing the oldest turbidite. The age of the youngest turbidite age is older than Early Cretaceous, but there are no Early Cretaceous detrital zircons in the greywacke. Therefore, we suggest that the depositional age of the turbidite is Late Triassic–Jurassic. Blocks of serpentinized peridotite include serpentinized harzburgite with pyroxenite dykes and serpentinized dunite; they are dismembered and randomly distributed in the turbidite matrix. $Cr^{\#}$ and $Mg^{\#}$ values of the chromium spinels in peridotite are 69–88 and 12–39, respectively, and Fo and Fa values of the olives are 90–92 and 8–11, respectively. These results are indicative of a supra-subduction zone. The zircon U–Pb age of the pyroxenite is 188 Ma, representing the timing of intrusion of the pyroxenite dykes. Basalt and gabbro are characteristized by high TiO_2 contents and $Mg^{\#}$ values, with rare-earth-element patterns and spider diagrams indicating ocean-island basalt (OIB)-type trace-element ratios. In (Nb/Y)–(Zr/Ti) and (Nb/Y)–($Zr/P_2O_5 \times 10000$) diagrams, samples plot in the alkaline basalt field, with the basalt being of the Ti-rich alkaline OIB type. The mélange zone in southeastern Gaoligong is a subduction–accretionary complex zone, related to subduction of the Nujiang oceanic crust beneath the Tengchong Block.

Study of Ganzhou Dinosaurian Fauna from Ganzhou district, Jiangxi Province (chief researcher: LYU Junchang and WANG Xuri)

This project focused mainly on the newly discovered dinosaur skeleton and egg fossils in Ganzhou, Jiangxi Province. Through systematic investigation of the dinosaur skeleton fossils found in Ganzhou, the dinosaur fauna of Ganzhou has been confirmed as including mainly small theropods (oviraptorosaurs) with a small number of large sauropods (Somphospondyli) and theropods (tyrannosaurid). Through the study of fossils from Ganzhou and other known oviraptorosaurs, we have clarified the phylogenetic relationships of oviraptorosaurs and propose that the diversity of skull form and function was likely key to the diversification and evolutionary success of oviraptorosaurs. Through the study of dinosaur egg fossils from Ganzhou, we determined the incubation behaviours of oviraptorosuars. Our results indicate that the smallest oviraptorosuars probably sat directly on the eggs but with increasing body size, more weight was likely carried by the central opening, reducing or eliminating the load on the eggs while still allowing contact during incubation by giant species. Through a comprehensive investigation of fossil localities in Ganzhou, the distribution and paleoenvironment of dinosaur skeleton and egg fossils have been clarified. Through study of the newly discovered fossils in other important dinosaur fauna, a number of new genera and species have been established, providing important evidence for the understanding of the evolution and distribution of Mesozoic dinosaurs, pterosaurs, and birds.

Late Jurassic aeolian depositional associations in North China and their implications for palaeoclimate and palaeogeography (chief researcher: LIU Yongqing)

Based on sedimentary records of Mesozoic aeolian deposits, the global or regional atmospheric circulation environment in deep time can be inverted, as core content of habitable-Earth research. Focusing on Early Jurassic aeolian sedimentary rocks in North China, this project considered the sequence of wind–water sedimentary cycles, climate-sensitive minerals, rock and sedimentary structures, and multiple geochemical indicators to reveal the dry–wet paleoclimate succession during the Late Jurassic. Through analysis of the source–sink system of the aeolian sedimentary assemblage, together with consideration of the paleocurrent, wind direction, debris components, and multivariate analysis of isotopic chronology source-area tracing, we were able to discuss the basin–mountain paleogeography and extensional–compressional paleotectonic settings of North China during the Late Jurassic. We also broadened our study to Triassic and Lower Cretaceous aeolian sedimentary rocks and the paleoclimate of North China with the following main findings. (1) Desertification or aeolian sediment/aeolian sand deposition caused by extreme drought were globally widespread in terrestrial environments during the Mesozoic. (2) The succession of humid and dry–hot paleoclimate and paleomagnetic data from the Early to Late Jurassic in North China indicate that there was a change in East Asia from a warm and humid coal-forming climate zone at high latitudes, to a dry, hot, and eolian climate zone at low latitudes (equatorial). (3) The widespread distribution of Late Jurassic aeolian sand deposits in North China is consistent with, and proves the conclusion of, the “Great Jurassic East Asian Aridification” (GJEAA), which may have affected the evolution of late Mesozoic terrestrial biota. (4) During the J/K transitional period, regional continental red-beds, aeolian sandstone successions, terrestrial flora and fauna, and large-scale basic dykes or dyke swarms developed in the northern margin of North China, indicating crustal extension. (5) Thick Cretaceous aeolian deposits are widely developed in North China, possibly representing the sedimentary response to continuous evolution of the GJEAA. However, whether the driving mechanism was ‘true polar wander’ or a change in general atmospheric circulation requires further study.

Late Cenozoic tectonic deformation and the geodynamic background of the Qiangtang Block (chief researcher: PAN Jiawei)

Present tectonics of the Qiangtang Block (QB) of the central Tibetan Plateau are characterized by a series of N–S-trending grabens and NE–NW trending conjugate strike-slip faults. These active grabens/faults are considered to

accommodate coeval N–S shortening and E–W extension of the Tibetan Plateau, affecting the distribution of mineral and energy resources and controlling the nucleation of large regional earthquakes. The study of these active faults is vital to our understanding of late Cenozoic tectonic deformation processes in the QB. However, due to the high altitude and difficult working conditions, the tectonics of the QB are poorly constrained. In this NSFC project, we studied the geometry, kinematics, initiation time, slip rate, paleoseismicity, and tectonic mechanism of these active grabens/faults through detailed field investigations and chronological experiments. Four years of study yielded the following results, which have been published in 13 papers. (1) Geometric and kinematic characteristics of the N–S-trending normal faults and NE-trending sinistral/NW-trending dextral conjugate strike–slip faults in the QB have been identified. (2) Late Quaternary slip rates of the Shuanghu normal fault, Riganpei Co sinistral strike-slip fault, and the Yadong–Gulu normal fault were constrained to 0.2–0.3, 0.2–0.3, and 1–2 mm yr−1, respectively. Contrasting fault slip rates north and south of the Bangong Lake–Nujiang suture zone reflect different dynamic mechanisms.

Genetic mineralogy of garnet peridotite–eclogite from the Polar Urals, Russia (chief researcher: MENG Fancong)

This project involved field investigation and research on genetic mineralogy, petrology, geochemistry, and geochronology of garnet–peridotite–eclogite from the Mica Mountains in southern Marun-Keu Complex, Polar Urals, Russia. Results indicate that metamorphic minerals include garnet, omphacite, enstatite, phengite, kyanite, pargasite, magnesiohasting, zoisite, and quartz. Residual igneous minerals are olivine (Fo = 82–86), enstatite (En = 79–84), diopside, and augite. $\varepsilon_{Nd}(t)$ values vary from −3 to +2 for the eclogites. Protoliths of the garnet–peridotite–eclogite were cumulates (peridotite–pyroxenite–troctolite–gabbro) that intruded the continental margin of East Europe with formation ages of 520–500 Ma, metamorphic ages of 370–360 Ma, and peak metamorphic P–T conditions of 18–21 kbar and 740°C–866°C. The garnet–peridotite–eclogite occurs in situ in the gneisses and represents a fragment of subducted continental crust rather than oceanic crust (ophiolite). This work is important for reconstruction of the tectonic evolution of the Polar Urals. The preserved 'magmatic texture' of the rocks is significant for protolith reconstruction and understanding of the transformation of minerals phases in subduction zones and evolution of orogenic belts.

Multiple metamorphic events in the eastern Alxa–Langshan Precambrian metamorphic complex, western Inner Mongolia (chief researcher: LIU Pinghua)

Precambrian metamorphic rocks are among the most important components of the Alxa Block, recording multiphase metamorphic and deformation events. Their study aids the reconstruction of Paleoproterozoic–Paleozoic crustal evolution of the block, with new metamorphic and petrological constraints aiding exploration of genetic relationships between the Alxa Block and the North China and Tarim cratons. This project focuses on Precambrian metamorphic rocks of the eastern Alxa Block, and involves an integrated study including detailed field investigations, petrographic observations, metamorphic facies analysis and geochronological analysis. Early Neoarchean (*ca*. 2.7 Ga) TTG gneisses have been identified in the Diebusige Complex, providing a new record for the exploration of early Neoarchean crustal evolution of the Alxa Block. Garnet-bearing mafic granulites and corundum-bearing pelitic granulites also occur in the Diebusige Complex, with clockwise P–T paths suggesting that their formation was related to crustal thickening and rapid hot exhumation during the convergence and orogeny of the Paleoproterozoic Columbia supercontinent. Kyanite-, staurolite- and garnet-bearing politic schists have been found in the Alxa Group in the Alatengaobo area, with a metamorphic timing of the early Paleozoic (420–380 Ma). The temperature and pressure conditions of the metamorphic peak stage were P = 0.77–0.85 GPa and T = 670°C–690°C, typical of metamorphism in a medium-pressure phase. This indicates that there may have been a crustal thickening process related to arc–continent collision in the Alxa Block at the end of early Paleozoic. *A ca*. 270 Ma metamorphic and deformation event has been identified in the Alxa Group in the Boluositanmiao area. Garnets in garnet-bearing amphibole–biotite–plagioclase gneiss and garnet amphibolites have typical progressive metamorphic growth zones and near-isothermal

decompression structures, respectively. The metamorphic peak temperature and pressure conditions of plagioclase gneiss containing garnet–black amphibole were T = 710°C–735°C and P = 0.93–0.96 GPa, with a clockwise metamorphic P–T path involving near-isothermal decompression. The geothermal gradient is 22°C km−1, indicative of a typical medium-pressure metamorphic facies series. These new data indicate that there was another collisional orogenic event in the Alxa Block during the late Paleozoic, possibly related to the final closure of the Paleo-Asian Ocean.

Tectonic evolution of the early Paleozoic Lajishan trench–arc system (chief researcher: YAN Zhen)

The texture and evolution of trench–arc systems aid reconstruction of plate tectonics and the formation of orogens. The Lajishan Cambrian–Ordovician ophiolitic mélange and island arc were tectonically sandwiched between the Central and South Qilian blocks, but tectonic evolution of the Lajishan area and its regional geology remain debated because of the lack of systemic studies of the texture, rock assemblages, and temporospatial relationships of both units. Rock/block assemblages, deformation patterns, and spatial variations of the Lajishan trench–arc system have been studied through field surveys, mapping, and multidisciplinary analysis methods. The tectonic setting and evolution of the Lajishan ophiolite complex and island arc are being systemically studied on the basis of new and regional data. Our new data indicate that Proto-Tethyan subduction–accretion, with associated multidirectional arc–continental collision, occurred during the Cambrian–Ordovician. Subduction began prior to 535 Ma, with closure of the ocean basin at *ca*. 450 Ma. These results provide evidence of the texture and tectonic evolution of the Lajishan Cambrian–Ordovician trench–arc system, aiding elucidation of the relationship between Paleozoic oceanic basin evolution in the Lajishan area and the North Qilian belt. In particular, our results provide more details of the temporospatial structure and evolution of the Lajishan Cambrian–Ordovician trench–arc system, and provide evidence of the relationship between the tectonic evolution of the South Qilian belt and the Proto-Tethyan Ocean.

On November 2020, Research Professor LIU Yan was awarded the "Hou Defeng Young Scientist Award of Minerology Petrology and Geochemistry" by the Chinese Society for Mineralogy Petrology and Geochemistry.

Fig 3.1 Research Professor LIU Yan

TSince graduating with a Doctoral Degree of Science from the China University of Geosciences, Beijing, in 2010, LIU Yan has engaged in research on the origin of carbonatite and its complex-type REE deposits and has published 18 papers as first or corresponding author in Economic Geology, Mineralium Deposita, Lithos, and Ore Geology Reviews. These papers describe the formation of carbonatite and its REE deposits, and reveal that the formation of carbonatite and its REE deposits involved two large-scale super-normal concentration processes.

On December 2020, Research Professor Marie-Luce CHEVALIER was awarded the "Huang Jiqing (Huang T. K.) Science and Technology Prize to Young Geological Workers" by the Geological Society of China.

Fig.3.2 Research Professor Marie-Luce CHEVALIER

Engaged in the study of the active tectonics, tectonic geomorphology, and paleoclimate of the Tibetan Plateau for almost 20 years, Marie-Luce CHEVALIER uses mainly remote sensing and cosmogenic dating approaches to constrain slip rates of major active faults on the Tibetan Plateau, to promote understanding of how deformation due to the India–Asia collision is absorbed. There have been important achievements regarding plateau deformation and paleoclimate reconstruction, notably: (1) precise determination of late Quaternary slip rates along the main fault zones of the western Tibetan Plateau (Karakorum fault) and establishment of the deformation habit along the westernmost boundary of the eastward extrusion of plateau materials (Longmu–Gozha Co fault); (2) study of seismic activity of important fault zones in eastern Tibet (Xianshuihe, Litang), with suggestion of a southeastward increase in slip rates along the most active fault in China (Xianshuihe); (3) determination of late Quaternary extension rates in different segments of the Yadong–Gulu rift, with the suggestion that extension rates decrease from north to south due to the Beng Co dextral fault at its northern end; and (4) study of glaciation patterns in southeastern Tibet with a proposal that the main glacial advances correlate with the coldest periods of Northern Hemisphere cooling cycles, with glaciers being more sensitive to variations in temperature than precipitation.

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
Excellent Young Scientists Fund				
No.	**Chief Investigator**	**Project**	**Duration**	**E-mail address**
1	LIU Yan	Genesis of carbonatite-related REE deposits	2020-2022	ly@cags.ac.cn
2	LIU Yingchao	Mineral Deposit	2020-2022	lychappy@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 and	2017-2021	jinxchi@cags.ac.cn
4	ZHANG Jianxin	Linking metmorphism 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

International (Regional) Cooperation and Exchange Projects				
No.	**Chief Investigator**	**Project**	**Duration**	**E-mail address**
1	CHEVALIER Marie-Luce	Spatio-temporal variation of kinematic characteristics and seismic hazard assessment along the Xianshuihe fault system	2021-2025	mlchevalier@hotmail.com
	CHEVALIER Marie-Luce	Tectonic geomorphology and imaging of geohazard effects along two major strike-slip faults in Central Asia and China	2020-2021	mlchevalier@hotmail.com
2	YU Changqing	Dense profile probing depth extent of Pengguan Complex and Longmenshan Fault	2018-2020	geoyucq@hotmail.com
3	YANG Jingsui	Diamond in Oceanic Peridotites-Chromitites and Deep Recycled Mantle in the Global Ophiolite Record	2018-2022	yangjsui@cags.ac.cn
4	LI Haibin	Fault Friction over Time: Coseismic Weakening and Postseismic Healing in situ	2016-2020	lihaibing@163.com
Major Research Plan				
No.	**Chief Investigator**	**Project**	**Duration**	**E-mail address**
1	ZENG Lingsen	Mesozoic magmatism in the Himalayan orogenic belts and the tectonic processes along the Northern Indian continental margin	2021-2024	zenglingsen@cags.ac.cn
2	YANG Tiannan	Reconstructing the Neotethyan subduction kinematics of the Zagros orogenic belt	2021-2024	yangtn@cags.ac.cn
3	PAN Xiaofei	Metallogenesis of superlarge W-Cu ore systems in South China: exsampled byZhuxi and Dahutang ore deposits	2021-2024	pan_smile0551@sina.com
4	LIU Fulai	Properties of multiple major metamorphic-tectonic deformation events and their constraints on the migration-enrichment process of the critical metal cobalt in the composite orogenic belt	2021-2024	lfl0225@sina.com
5	YANG Zhiming	Origin of porphyry Cu deposits in postcollisional setting: case studies from the Gangdese belt in southern Tibet	2020-2023	zm.yang@hotmail.com

6	LI Qiusheng	Crust-Mantle Interaction and Deep Background of Tungsten Mineralization in Nanling-Wuyi Conversion Zone	2020-2022	lqs1958@163.com
7	LU Zhanwu	Studies of the lithospheric stucture and its relationship to deep background of beryllium-tin-tungsten polymetallic mineration in the Cuonadong Dome, southern Tibet	2020-2022	luzhanwu78@163.com
8	ZHANG Hongrui	The enrichment and emplacement mechanism of cobalt in the Lanping-Simao cobalt belt, western Yunnan	2020-2022	hongrui_1982@126.com
9	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
10	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
11	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
12	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
13	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

General Projects

No.	Chief Investigator	Project	Duration	E-mail address
1	LI Suping	Comparative morphology and radiation of early angiosperm pollen in Northeast China and Portugal	2021-2024	lisuping@cags.ac.cn
2	ZONG Pu	Effect of the end-Devonian Hangenberg Event on brachiopod faunas: case studies from western Junggar and South China	2021-2024	zongpu0501@163.com
3	YAO Jianxin	Research on the boundary stratotype of Anisian (Middle Triassic) in Southwest China	2021-2024	yaojianxin@cags.ac.cn
4	MENG Fancong	Genesis of graphite-bearing meta-mafic rocks in the serpentinite from Qingshuiuqan area, East Kunlun, NW China	2021-2024	mengfancong@yeah.net

5	LIU Yongqing	Sedimentary anatomy of temperate glacier deposits-A case study from the Yuermeinak glacier of the Cryogenian Marinoan age, Akesu, Xinjiang, NW China	2021-2024	liuyongqing@cags.ac.cn
6	WANG Dan	Petrogenesis of Archean ultramafic-mafic rocks from Guyang, Inner Mongolia: implications for the nature of mantle and tectonic regime on early Earth	2021-2024	wangd221@gmail.com
7	ZHOU Xiwen	Genesis and metamorphic evolution of Archean supracrustal rocks in the Jiapigou region, Southern Jilin Province	2021-2024	xwzhou@cags.ac.cn
8	ZHANG Yinghui	Phase equilibria on the Metamorphism and Partial Melting of the west margin in Trans-Hudson Orogen	2021-2024	yhzhang@sina.cn
9	ZHANG Jianxin	Deformation-metamorphism feedback of the ductile shear zones in the northern West Qinling Orogen and their insight into orogenesis	2021-2024	zjx66@yeah.net
10	ZHENG Yong	Thrust-nappe and uplift of Longmen Shan, eastern Tibet: New insights from direct dating on klippen	2021-2024	zygeology@163.com
11	ZHAO Lei	The origin of seamounts in northern West Junggar and their tectonic significance	2021-2024	360359537@qq.com
12	FU Changlei	Geological record and timing of subduction initiation in the Lajishan paleo-ocean basin	2021-2024	changlei.fu@cags.ac.cn
13	ZHAI Qingguo	Ophiolite in the Zangbei Lake area, Tibetan Plateau: New constraints on the tectonic evolution of the Bangong-Nujiang Tethyan Ocean	2021-2024	zhaiqingguo@126.com
14	ZHU Zhiyong	Calibration of Barium Isotope Fractionation Fractor between K-Feldspar and Granitic Melt	2021-2024	zhiyong_zhu@cags.ac.cn
15	ZHANG Zhiyu	A systematic study on fluid mineralization of the giant Dahutang tungsten orefield in Jiangxi Province: a case study of the Dalingshang ore district	2021-2024	zhangzhiyu@cags.ac.cn
16	WANG Haiyan	Tectonic deformation and suture pattern of the eastern part of the Central Asia orogenic belt	2021-2024	hyanwhy@126.com
17	YANG Ben	Systematics and biostratigraphy of the early Cambrian small shelly fossils in South Sichuan	2020-2023	benyang@cags.ac.cn

18	WU Guichun	The Conodont Biostratigraphy of Triassic on the Western BangongCo-Nujiang Fault Zone	2020-2023	1874267892@qq.com
19	ZHANG Cong	The metamorphic geology studies on the Sumdo Paleo-Tethys (U)HP subduction zone from the Lhasa terrane and its constrains on the opening of the Neo-Tethys Ocean	2020-2023	congzhang@pku.edu.cn
20	XIANG Hua	The activity models of Ti-bearing minerals and Ti isopleths thermobarometers study	2020-2023	xianghua2710@gmail.com
21	KOU Caihua	Petrogenesis for the Neoproterozoic mafic-ultramafic rocks in the western Jiangnan Orogen: constrains from the in-situ analyses on single mineral grains	2020-2023	caihuakou@163.com
22	LIU Shoujie	P-T-t evolution and overprinting of high-grade poly metamorphism in the Central Zone of Limpopo Belt, South Africa	2020-2023	sjliu@bjshrimp.cn
23	LIU Pinghua	A combined study of In situ U–Pb dating of monazites in thin sections by laser ablation split stream and garnet geochronology using microsampling: a case study of Neoarchean meta-supracrustal rocks in Gongchangling and Mengjiatun, North China Craton	2020-2023	lph1213@126.com
24	ZHANG Jin	Formation mechanism, deformation processes and tectonic settings of ophiolitic mélanges in the northern Alxa Block	2020-2023	zhangjinem@sina.com
25	GUO Lei	Formation mechanism of Early Cretaceous asymmetric granitic domes in NE Asia and its constraint on crustal extensional processes	2020-2023	guolei_cn@sina.com
26	WANG Huan	Physical-chemical properties of the pseudotachylytes in the Longmen Shan fault belt and their seismic rupture mechanisms at seismogenic	2020-2023	wanghuan4585@126.com
27	LI Jin	Cd isotopes application in reconstructing marine primary productivity during the interglacial Cryogenian period	2020-2023	lijin80119@hotmail.com
28	CHAI Peng	Refined ore-forming process of the Naozhi intermediate sulfidation epithermal gold-polymetallic deposit in Yanji area, Jilin province	2020-2023	cx001chaipeng@163.com
29	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

30	LIU Pengju	Microfossils from the early Cambrian in the Yangtze Platform and its biostratigraphic signification	2019-2022	pengju@cags.ac.cn
31	JI shu'an	Study on the Late Cretaceous protoceratopsid fauna from Alxa region, Inner Mongolia	2019-2022	jishu_an@sina.com
32	HUANG Hao	paleogeographic analysis of Permo- Carboniferous fusulinids in the Changning-Menglian Belt, western Yunnan	2019-2022	geohaohuang@gmail.com
33	ZHANG Zeming	High-grade metamorphism and partial melting of the eastern Himalayan orogen	2019-2022	zzm2111@sina.com
34	SHEN Tingting	Petrology and exhumation mechanism of ultradeep subducted serpentinites and enclosed eclogites from southwestern Tianshan	2019-2022	ttshen@pku.edu.cn
35	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
36	DONG Xin	Metamorphism and partial melting of the metabasic rocks in Yadong region, Himalayan orogen	2019-2022	dongxin5811935@163.com
37	WU Cailai	Petrogenesis of Palaeozoic granites in the southern Altun terrane and their significance in continental dynamics	2019-2022	wucailai@126.com
38	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
39	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
40	XIE Hangqiang	Neoarchean and Paleoproterozoic tectono -thermal events in Eastern Hebei Province and their implications	2019-2022	rock@bjshrimp.cn
41	SHI Yuruo	Geochronology and origin of the Cenozoic volcanic rocks in Tengchong area	2019-2022	shiyuruo@bjshrimp.cn
42	SI Jialiang	The identification of new earthquake fossils and their implications to the seismic fault activity	2019-2022	gongrenbaqin@126.com
43	LIANG Dongliang	Paleomagnetic records to decipher the Cenozoic collision process between the Pamir and the Southwestern Tian Shan	2019-2022	pillar131@163.com

44	CAO Hui	Microstructure and tectonics- Tectonochronology study of monazite LASS and micro-drilling	2019-2022	caohuicugb@hotmail.com
45	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
46	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
47	GAO Li'e	Behavior of radiogenic isotopes during cruatal anatexis in the Himalayan orogenic belt	2019-2022	liegao09@163.com
48	ZHU Xiangkun	The controlling factors for the termination of global-scale Precambrian banded iron formations	2019-2022	xiangkun@cags.ac.cn
49	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
50	YIN Jiyuan	Uplift and exhumation of West Tianshan since the late Paleozoic: Constraints from	2019-2022	dongxin5811935@163.com
51	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
52	HE Zhenyu	Xingxingxia area, Eastern Xinjiang, NW China: Petrogenesis and their implications for the composition of the ancient crust	2018-2021	ahhzy@163.com
53	ZHANG Hongrui	Cenozoic deformation and related Pb-Zn-Cu mineralization in the Lanping basin	2018-2021	hongrui_1982@126.com
54	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
55	SU Dechen	Meso-Neoproterozoic seismic records and multi-stage rifting in the North China Craton	2018-2021	sudechen@163.com
56	DU Lilin	Implication of 2.7Ga and 2.1-2.0 Ga magmatic events in Fuping Complex, central of the North China Craton	2018-2021	dulilin7310@cags.ac.cn
57	WANG Fang	Multiple metamorphism and geochronology of metamorphic complex in southwestern margin of Yangtze Block	2018-2021	wangfang_mr@163.com

58	WANG Wei	The Neoarchean anatexis of the eastern North China Craton and its geological significance	2018-2021	wuchangyuww@sina.com
59	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
60	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
61	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
62	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
63	WANG Tao	Rock assemblages and accretionary orogenic processes of the Lajishan mélange in the Central Qilian belt	2018-2021	real_wt@126.com
64	SUN Jian	The recycling of marine sediments and rare-earth-element mineralization: a multiple-isotope study	2018-2021	sunjiantc@163.com
65	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
66	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
67	SONG Yucai	Giant accumulations of barite and metals in the world-class Mehdiabad Pb-Zn deposit, Iran	2018-2021	song_yucai@aliyun.com
68	CHEN Wen	Study on Titanite (U-Th)/He Dating Technique	2018-2021	chenwenf@vip.sina.com
69	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

70	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
71	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
72	MENG Fancong	Genetic mineralogy of garnet peridotite-eclogite from the Polar Urals, Russia	2017-2020	mengfancong@yeah.net
73	CHEVALIER Marie-Luce	Tectonic activity along the Xianshuihe fault zone and deformation model constraint of the eastern Tibetan Plateau	2017-2020	mlchevalier@hotmail.com
74	LIU Pinghua	Multiple metamorphic events of the eastern Alxa-Langshan Precambrian metamorphic complex, western Inner Mongolia	2017-2020	lph1213@126.com
75	LIU Yongqing	The Late Jurassic eolian depositional associations in North China, and its implications of palaeoclimate and palaeogeography	2017-2020	liuyongqing@cags.ac.cn
76	LYU Junchang†	Study of the Ganzhou Dinosaurian Fauna from Ganzhou district, Jiangxi Province	2017-2020	lujc2008@126.com
77	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
78	XU Xiangzhen	Detailed FIB and TEM studies from the different types of mantle peridotite	2017-2020	xuxiangzhensjl@aliyun.com
79	YAN Zhen	Study on tectonic evolution of the early Paleozoic Lajishan trench-arc system	2017-2020	yanzhen@mail.iggcas.ac.cn
80	YI Zhiyu	Record of rapid apparent polar wander in East Asia and its significance	2017-2020	yizhiyu09@gmail.com

Yong Scientists Fund

No.	Chief Investigator	Project	Duration	E-mail address
1	ZHU Jianjiang	Petrological study of graphite-rich eclogite from Chinese southwestern Tianshan UHP metamorphic belt and its implication for the migration and evolution of carbon-bearing fluids in subduction zone	2021-2023	zjj19901216@126.com

2	TANG Yue	Petrogenesis of rodingite in ophiolite—A case study on rodingite in the Bange area, northern Tibetan plateau	2021-2023	245494037@qq.com
3	YAN Lili	Crystal-rich enclaves in high-silica volcanic rocks from Yandangshan, eastern Zhejiang: Insights into the magma reservoir evolution processes	2021-2023	llyan0625@163.com
4	YAN Lilong	Crustal anatexis of the Leo Pargil dome in SW Tibet and its implications for the along-strike variations of the Himalayan orogenic belt	2021-2023	lilong_yan@qq.com
5	FAN Xianke	The unidirectional solidification textures in the giant Dahutang tungsten deposit, Northwest Jiangxi Province, China: Implications for the evolution of primary magmatic fluids and tungsten mineralization	2021-2023	fanxianke@cags.ac.cn
6	ZHENG Jianbin	Sedimentologic and paleogeographic implications of Late Paleozoic clastic rocks in the central zone of the Changning-Menglian Belt in western Yunnan, China	2021-2023	zhengjianbin@cags.ac.cn
7	ZHANG Wen	The helium migration and enrichment process of crust-derived helium in natural gas fields traced by noble gases	2021-2023	wenzhangcn@outlook.com
8	LI Pengchuan	Mineralization age, genesis mechanism and tectonic implication of two types of iron deposits in the Baishan area, southern Jilin Province	2021-2023	lipengchuan@foxmail.com
9	ZHANG Beihang	Structural characteristic and geochronology of the shear zone in the central Alxa Block, and its implications on the tectonic evolution of the Central Asian Orogenic Belt (CAOB)	2021-2023	276925733@qq.com
10	XU Wang	Triassic tectonic evolution of the Qiangtang Block, Tibetan Plateau: Constraints from metamorphism and geochronology of eclogites in central Qiangtang	2021-2023	wangxugeo@cags.ac.cn
11	WANG Xiaoran	Study on Fine 3-D Velocity Structure and Vp/Vs distribution of Lithosphere Mantle-Tomography Analysis based onBroadband Dense Array	2021-2023	wxr_1119@163.com
12	SHANG Xiaodong	Evolution of Ediacaran Tianzhushania in the Yangtze Gorges area and its biostratigraphic implications	2020-2022	shangxdong@sina.com
13	YAN Zhen	Research on Early Permian carbonate buildups in Xing-Meng area	2020-2022	yanzhen20071239@126.com

14	WANG Yunfeng	Cu precipitation mechanism in Tinggong porphyry Cu deposit, Tibet	2020-2022	wangyunnfeng@163.com
15	ZHAO Zhongbao	Forming and Tectonic Evolution of the Longriba Fault, Inside the Eastern Tibetan Plateau	2020-2022	zhaozhb04@163.com
16	GE Maohui	The formation age and metamorphism of the supracrustal rocks of the Mashan Complex in the Jiamusi Block and its tectonic implication	2020-2022	gmh19900125@126.com
17	ZHANG Heng	Paleoproterozoic magmatic and metamorphic events in southwestern Yangtze Block and their tectonic implications	2020-2022	heng0520@126.com
18	WANG Xun	Study on the controlling mechanisms and the environmental effects of the early Mesoproterozoic oceanic oxygenation event in North China	2020-2022	xunwang90@163.com
19	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
20	JI Lei	P-T-t-D evolution of Barrovian sequence in the south segment of Ailao Shan complex belt	2019-2021	jileicags@126.com
21	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
22	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
23	ZHANG Lei	Formation depth of pseudotachylyte in the Longmen Shan thrust belt constrained by rock magnetism	2019-2021	zhanglei881102@126.com
24	ZHU Junbin	Triassic sedimentary sequences in Linxi area of Inner Mongolia and their tectonic implications	2019-2021	zhujunbin0819@163.com
25	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
26	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
27	BAO Zemin	Methodology of Rare Earth Element TOF-SIMS In-situ Analysis in Zircon	2019-2021	baozm@bjshrimp.cn

28	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
29	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
30	ZHONG Ning	Palaeoearthquake investigation of late Quaternary lacustrine sediments at Shawan in the upper reaches of the Min River	2019-2021	zhongning19860304@126.com
31	BO Jingfang	Research on Middle Triassic scleractinian coral fauna from the Poduan Formation in southwestern Guizhou	2018-2020	jingfangbo@foxmail.com
32	WEI Yi	Palaeoelevation evolution of Tibetan Plateau hinterland during the Eocene - Oligocene: Evidences from ostracods and isotope	2018-2020	ostracods@126.com
33	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
34	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
35	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
36	CHENG Ting	High precision U-Pb isochron dating of carbonate minerals	2018-2020	chengting1005@hotmail.com
37	CHAI Peng	Tracking oxygen fugacity of multiphase magmatic processes and study on petrogenesis of Ermi reduced porphyry copper deposit	2017-2019	cx001chaipeng@163.com
38	LONG Tao	High spatial resolution simultaneous dating and determination of trace elements in xenotimes by SHRIMP	2017-2019	longtao@bjshrimp.cn
39	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
40	WANG Dan	The study of sedimentary N-isotopic compositions in the Nanhua basin during the Cryogenian interglacial period	2017-2019	njuwangdan@163.com
41	WANG Huan	Microstructural, mineralogical and geochemical characteristics of the Wenchuan earthquake fault zone and their deformation mechanisms	2017-2019	wanghuan4585@126.com

42	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
43	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
44	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
45	WANG Yafei	Research on ancient crustal materials in Anshan and eastern Hebei	2017-2019	pengfei4783@163.com
46	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
47	YANG Shaohua	Overring plate properties constraint subduction evolution: the example of the Lhasa Terrane	2017-2019	yangshaohua09@sina.com

† Deceased October 2018

4.2 Projects funded by the Ministry of Science and Technology

No.	Chief Investigator	Project	Duration	E-mail address
1	HOU Zengqian	Deep structure and ore-forming process of main mineralization systems in the Tibetan Orogen	2016-2020	houzengqian@126.com
2	LU Zhanwu	Fine structure of the lithosphere and deep processes in the main collision zone of the Tibetan Plateau	2016-2020	luzhanwu78@163.com
3	LI Qiusheng	Fine lithospheric structure and deep processes of the side colliding belt of Tibetan plateau	2016-2020	lqs1958@163.com
4	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
5	ZHANG Zeming	Deep Earth processes and ore-forming events in the Tibetan Orogen	2016-2020	zzm2111@sina.com
6	QIN Kezhang	Deep structure and ore-forming process of the composite orogenic-metallogenic systems in NE China	2017-2020	kzq@mail.iggcas.ac.cn
7	ZHANG Jin	3D lithosphere framework of compound orogenic belt of North China and its metallogenic background	2017-2020	zhangjinem@sina.com
8	WANG Tao	Methodology on deciphering the material architecture of the lithosphere	2019-2024	taowang@cags.ac.cn
9	HUANG He	Methodology on deciphering the material architecture of the lithosphere beneath typical regions of the accretionary orogenic belt	2019-2024	huanghecugb@126.com
10	WANG Tao	New methods for tracing deep material and the theory and methodology for revealing the three-dimensional lithospheric composition architecture	2019-2024	taowang@cags.ac.cn
11	ZHU Xiangkun	Metal isotopes tracing technique of atmospheric oxygenation associated with deep carbon and oxygen cycle	2019-2024	xiangkun@cags.ac.cn

12	KUANG Hongwei	Meso- to Neoproterozoic stratigraphic frame and depositional event correlation in China	2016-2020	kuanghw@126.com
13	TONG Ying	Integration of the tectonic-magmatism- mineralization studies in metallogenic systems	2018-2021	yingtong@cags.ac.cn
14	LIU Yanxue	Prototype restoration and structural reconstruction of typical Uranium-bearing basins and its constraints on deep mineralization	2018-2021	lyxue@sohu.com
15	GUO Lei	Big data extraction and mapping technology of deep-time petrology	2019-2023	guolei_cn@sina.com
16	GAO Rui and LU Zhanwu	Fine structure and shallow response of lithosphere in key areas	2019-2022	ruigao126@126.com luzhanwu78@163.com
17	DING Xiaozhong	The compilation of the lunar digital geological map	2015-2020	xiaozhongding @sina.com
18	LIU Dunyi	International lunar research station - lunar chronology research	2020-2023	liudunyi@bjshrimp.cn
19	HOU Zengqian	Supply path and security strategy of strategic key mineral resources in China	2019-2020	houzengqian@126.com
20	LIU Yan	Distribution of mineral resources and their potential assessment	2018-2022	ly_0620@126.com
21	LONG Tao	Development of multiple receivers for a new secondary ion mass spectrometer	2018-2021	longtao@bjshrimp.cn
22	LIU Dunyi	Study of the lunar impact flux	2020-2022	liudunyi@bjshrimp.cn
23	KUANG Hongwei	The last glaciation of Precambrian and the evolution of earth, environment and life	2020-2022	kuanghw@126.com

24	ZHANG Heng	Metallogenesis and prospecting prediction of copper and gold polymetallic deposits in Zhusileng and Wuliji area, Alxa area, Inner Mongolia	2020-2024	heng0520@126.com
25	LI Shan	"Top-Notch Young Professional" of"National High-level Personnel of Special Support Program"	2019-2021	lishan428@163.com
26	YANG Zhiming	"Scientific and Technological Leading Scientist" of "National High-level Personnel of Special Support Program"	2019-2020	zm.yang@hotmail.com

项目编号：2019YFA0708600　　密　级：公开

国家重点研发计划
项目任务书

项目名称：揭示三维岩石圈物质架构的理论方法体系
所属专项：变革性技术关键科学问题
指南方向：5. 揭示三维岩石圈物质架构的理论方法体系
推荐单位：自然资源部
项目管理专业机构：科学技术部高技术研究发展中心
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：王涛
执行期限：2020 年 06 月 至 2025 年 05 月

中华人民共和国科学技术部制
2020 年 07 月 15 日

Fig. 4.2.1 This ongoing project is part of the "Key scientific issues of transformative technology" project in the Framework of National Key Research and Development Program of China.

4.3 Projects funded by the China Geological Survey

No.	Chief Investigator	Project	Duration	E-mail address
1	GUO Lei	Basic geological survey of the material and evolution of the crust circle in the key sections of Alxa and Southeast Tibet	2019-2021	guolei_cn@sina.com
2	ZHU Xiangkun	Basic geological survey of Meso- Neoproterozoic epigenetic system in Eastern Hebei and Yangtze Gorges	2019-2021	xkzhu0824@gmail.com
3	LIU Pinghua	Basic geological survey of Precambrian structural belt in the central and eastern part of North China Craton	2019-2021	lph1213@126.com
4	ZHANG Jin	Basic geological survey of Northen Organic Belt between Xilamulun and Hegenshan	2019-2021	zhangjinem@sina.com
5	LIU Yongqing	Basic geological survey of basin- mountain system in the northern part of Eastern Mountain System	2019-2021	liuyongqing@cags.ac.cn
6	HUANG Hao	Basic geological survey of typical palaeobiota and key strata in Western Mongolia, western Henan and northwestern Hubei	2019-2021	hh1936@163.com
7	YAN Zhen	Basic geological survey of Dulan and Tianshui in the Central Orogenic System	2019-2021	yanzhen@mail.iggcas.ac.cn
8	LI Wenhui	Deep geological survey in key areas of Gangdese tectonic belt	2019-2021	dereklee1984@126.com
9	GAO Li'e	Regional geological survey of Maga malashan tectonomagmatic belt in southern Tibet	2019-2021	liegao09@163.com
10	PAN Jiawei	Regional geological survey of large fault zone in northen and eastern Bayan Kara block	2019-2021	panjiaweibb@gmail.com
11	QI Xuexiang	Regional geological survey of Lhasa-Tengchong tectonomagmatic belt	2019-2021	qxuex2005@163.com

12	WANG Tao	Special investigation on key geological problems of Permo Carboniferous in North China	2019-2021	real_wt@126.com
13	ZHAO Lei	Tectonic evolution of China and compilation of International Asian tectonic map	2019-2021	zhaolei224@126.com
14	DING Xiaozhong	Renewal and sharing of geological maps of land and sea areas in China	2019-2021	xiaozhongding@sina.com
15	TONG Ying	Database construction and sharing application of basic Geology (Petrology)	2019-2021	yingtong@cags.ac.cn
16	REN Liudong	Geological background analysis of large-scale resource base in metallogenic domain of ancient Asia	2019-2021	ldren@cags.ac.cn
17	WANG Xuri	Investigation and protection monitoring demonstration of important Paleontological fossils in China	2019-2021	wang198109@163.com
18	LIU Yan	Basic marine geological survey of the Philippine Sea and its adjacent areas	2021-2021	ly_0620@126.com

5.1 Attendance at International Conferences

WANG Tao and colleagues attended the 2020 Goldschmidt Conference (online)

The 2020 Goldschmidt Conference was held virtually, June 21–26, 2020. Drs WANG Tao, TONG Ying, GUO Lei, LIU Yan, SUN Jian, SUN Chao, CHE Xiaochao, and WANG Xun attended online, providing the following presentations and discussion: “Granitoid source and orogeny types”; “MC–ICP–MS U-series dating of the Panxian Dadong Paleolithic site at Guizhou, Southern China”; and “Diversity of Carbonatite-related rare-earth-element deposits: insights from the Mianning-Dechang Belt”; “Biogeochemical Cycling of Nutrient Elements Following the Early Mesoproterozoic Oxygenation Event”, among others.

Fig. 5.1.1. CHE Xiaochao attends Goldschmidt Virtual 2020.

5.2 Foreign visits by members of the Institute

ZHANG Hongrui visited the University of Oslo for collaborative research (Oslo, Norway)

Invited by Professor Trond H. TORSVIK, Assistant Director of the Centre of Earth Evolution and Dynamics (CEED), a Norwegian Centre of Excellence hosted by the Department of Geosciences at the University of Oslo, Dr. ZHANG Hongrui visited CEED during January 14–March 9, 2020, for collaboration in the writing of joint papers on the evolution of the Tethyan region by Gplates.

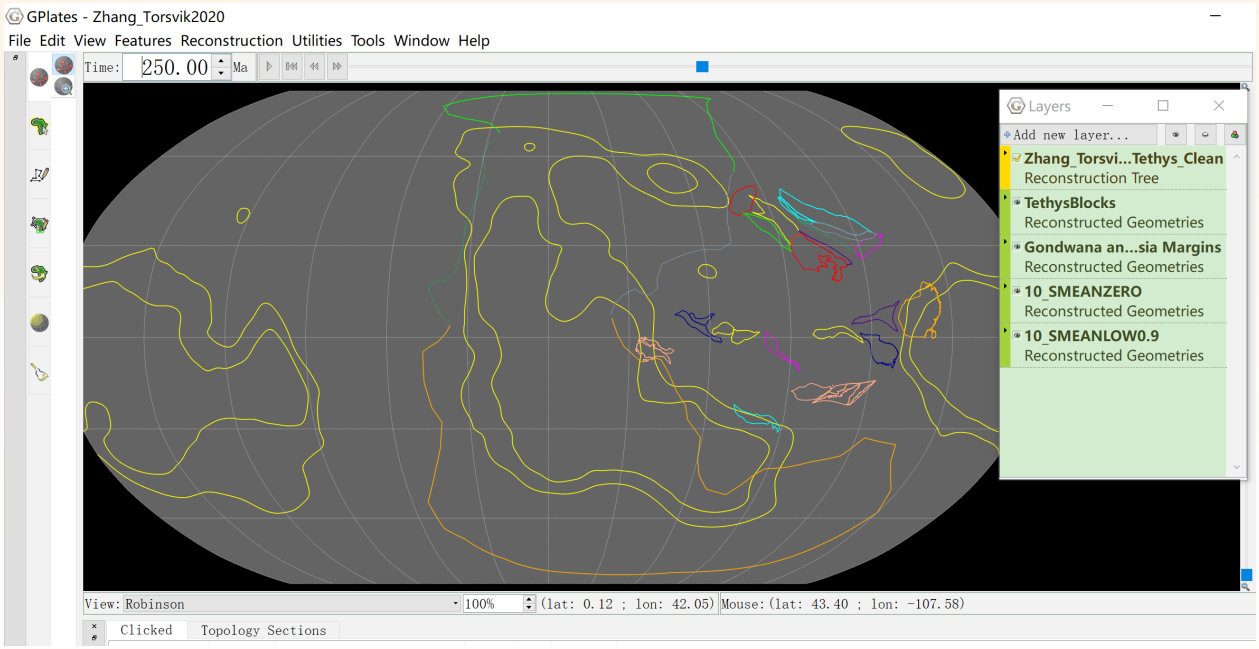

Fig. 5.2.1. The operation interface of Gplates (software).

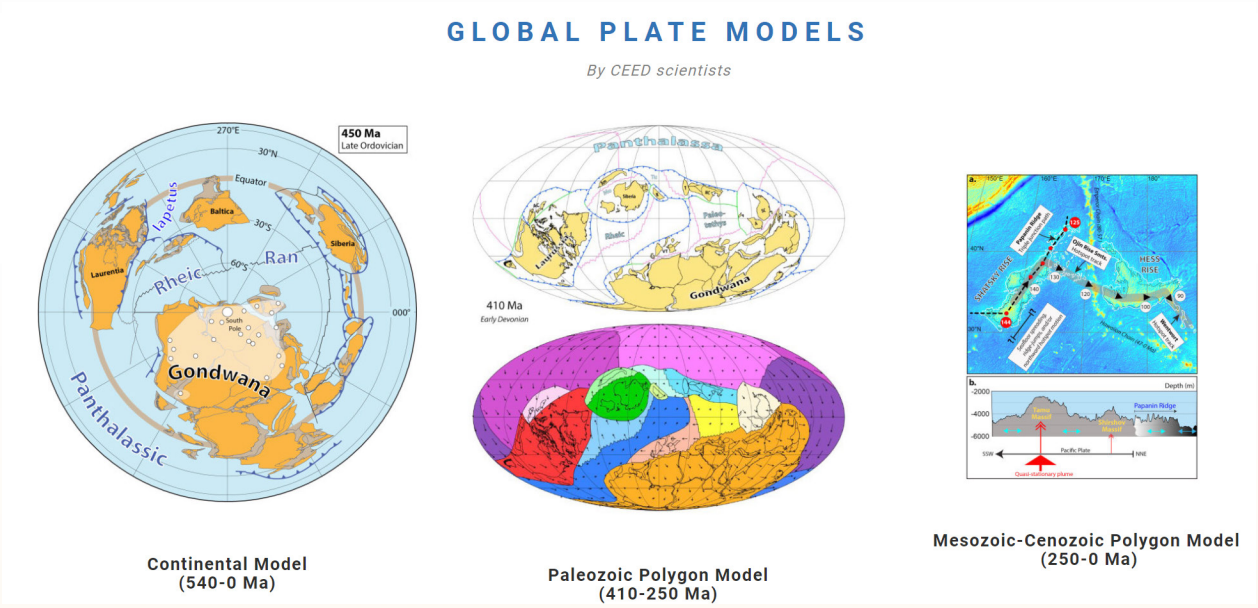

Fig. 5.2.2. Global Plate Models by CEED scientists.

LI Shan undertook visiting research at the Geology Department of Trinity College Dublin, Ireland

Invited by Associate Prof. David CHEW, Head of Geology, Geology Department of Trinity College Dublin, Ireland, Dr LI Shan worked as a visiting research fellow supported by the China Scholarship Council, during March 3–July 19, 2020. Studies involved the thermal evolution history of granites in an accretive orogenic belt (southern margin of

the Central Asian Orogenic Belt) and the formation and evolution of the granite source area and continental crust in a collision orogenic belt (Sumatra, Indonesia).

Fig. 5.2.3. LI Shan and Prof. David CHEW at the Geology Department of Trinity College Dublin.

LI Suping conducted cooperative research at the Leibniz University, Hannover, Germany

Invited by Prof. Ulrich HEIMHOFER of Institute of Geology, Leibniz University Hannover, Germany, Dr. LI Suping joined his research group as a visiting scholar, cooperating in research on Cretaceous palynoflora and the evolution of early angiospermous pollen in China; June 25, 2019 to July 19, 2020.

Fig. 5.2.4. LI Suping (middle) and her fellow researchers during a field trip to areas of Hameln, Hannover.

XIANG Zhongjin visited University of Otago, Dunedin, New Zealand

Invited by Prof. James D. L. WHITE, Head of the Department of Geology, University of Otago, New Zealand, Dr. XIANG Zhongjin visited this university for collaborative research as a visiting scholar from 20 October 21, 2019 to April 9, 2020. The work involved analysis of clastic deposits from submarine eruptions, both relatively young deposits in New Zealand at Kakanui, and older deposits in the Qinling Orogen, China. The studies also involved fieldwork at Kakanui, together with petrographic observations of both Kakanui and Qinling rocks.

Fig. 5.2.5. Areas of the field trip in South Island, New Zealand.

SONG Yucai conducted cooperative research at the Colorado School of Mines, Golden, USA

Invited by Prof. David LEACH of the Department of Geology and Geological Engineering, Colorado School of Mines (CSM), USA, Dr. SONG Yucai undertook cooperative research as a visiting scientist from December 25, 2019 to October 27, 2020. This continued the important work on carbonate hosted ores and geological investigations of the role of evaporites and base metals. The research involved isotope and geochemicaI analyses, and petrographic studies.

Fig. 5.2.6. Studying ore samples with Prof. David LEACH (right) at CSM.

6. Important Academic Activities in 2020

6.1 International conferences organized and/or held by the Institute

The 1st Workshop of the International Lunar and Planetary Research Center of China (ILPRCC)

The ILPRCC 1st Workshop, themed “Samples and remote sensing research related to the Chang'e 5 mission”, was successfully held online, September 23–27, 2020. Fourteen experts from USA, Australia, Sweden, the UK, Holland, Japan, Russia, and China were invited to make academic presentations. More than 60 ILPRCC core members and their research teams attended the workshop online, sharing research results and experiences in the field of lunar and planetary sciences. LI Pengde, Vice President of China Geological Survey gave an opening address.

Lunar and planetary science is a significant part of the Earth sciences, and an important means of understanding the origin and evolution of the Solar System. To promote international cooperation in the field of lunar and planetary sciences, Prof. LIU Dunyi from the Beijing SHRIMP Center and Prof. Alexander NEMCHIN from Curtin University, Australia, jointly initiated the establishment of the ILPRCC in 2019. The ILPRCC unites over 20 scientists and technical experts globally who have engaged in lunar and planetary science research. It is an international academic platform for regular exchange of ideas, discussion of methodology, definition of cutting-edge issues and challenges in planetary sciences, promotion of the development of lunar and planetary sciences, improvement of China’s research level and international standing in planetary sciences, and the training of top talent.

Fig. 6.1.1. Experts exchange ideas at the ILPRCC 1st Workshop.

6.2 Other Academic Activities

The 2020 Academic Workshop of the Institute of Geology, January 15, 2021

To facilitate the exchange and discussion of scientific and technological results obtained during 2020, the Institute of Geology held its 2020 Academic Workshop on 15 January, 2020. About 200 researchers and postgraduate students, including leaders of the Institute, attended.

The Workshop comprised three parts: (1) Academicians ZHAI Mingguo, HOU Zengqian, and XIAO Wenjiao, and Senior research fellows WU Chunming, WAN Yusheng, and ZHU Xiangkun et al. gave invited speeches, presenting their research achievements; (2) the Director of the Key Laboratory of Deep-Earth Dynamics, Ministry of Natural Resources, was invited to deliver special reports concerning progress and planning at the laboratory; and (3) suggestions were put forward for further research, including team and scientific and technological platform construction at the Institute concerning frontier problems in geosciences.

The Workshop was a great success and facilitated exchange and discussion of ideas, while promoting 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 the geology of China, but also provides a platform for academic exchanges among young geologists.

Fig 6.2.1. Researchers and students attending the Workshop

Activities to popularize geological knowledge

To popularize scientific knowledge, during 2020 the Institute provided six offline activities, two live TV shows, two online lectures, five online videos, two exhibition boards, seven articles, and about twenty articles and reports on the official website of China Geological Survey. One set of micro-videos titled "One Minute Geology" were produced and released. In addition, as scientific consultants, researchers of the Institute participated in the production of two films and the recording of three science popularization programs by CCTV and other media.

Fig 6.2.2. On April 22, two popular videos titled “Walking into the long-term observation station of the China Continental Scientific Drilling project” and “The story of mountain building” were uploaded on the website of the Institute. They were produced by Research Associate ZENG Xiangzhi and Assistant Research Fellow ZHAO Zhongbao, respectively.

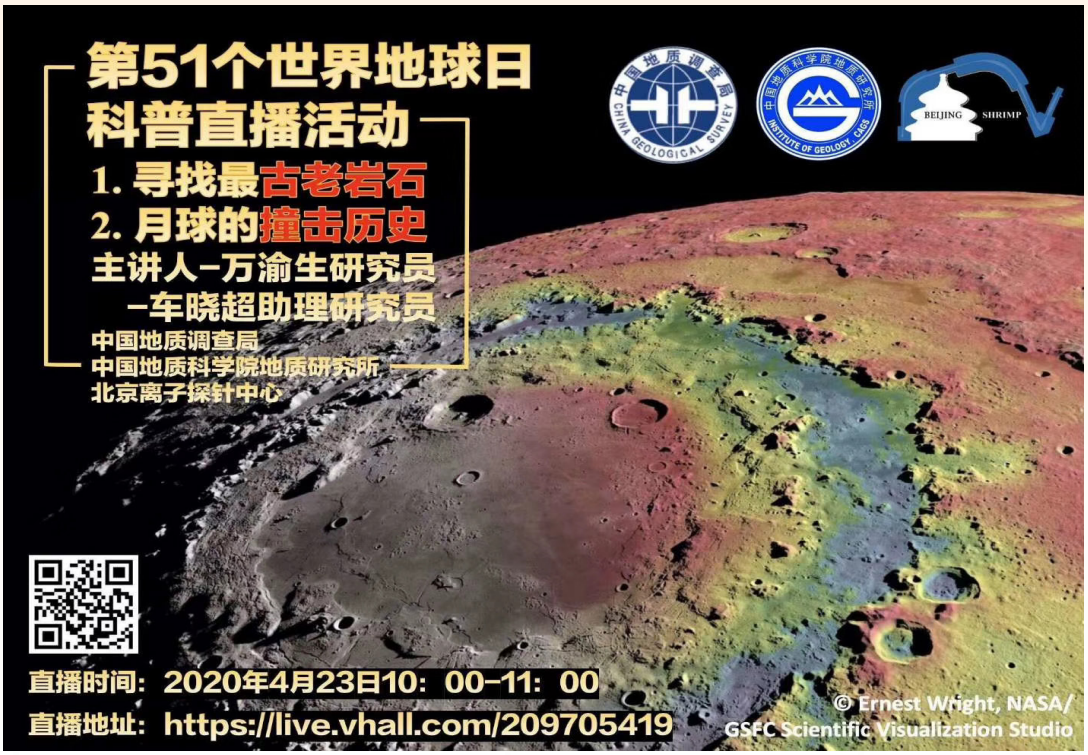

Fig 6.2.3. On April 23, Researcher WAN Yusheng and Research Associate CHE Xiaochao of the Beijing SHRIMP center gave online lectures on popular science.

Fig 6.2.4. On September 15, 2020, the Institute carried out research–study activities with the theme of "approaching Earth Science" jointly with Donghai High School in Jiangsu Province at the China Continental Scientific Drilling project long-term observation station.

Fig 6.2.5. On August 31, 2020, Researcher SU Dechen gave a popular science lecture titled "Baikal Lake and Danxia landform" in the Geological Museum of Danxia Mountain World Geopark.

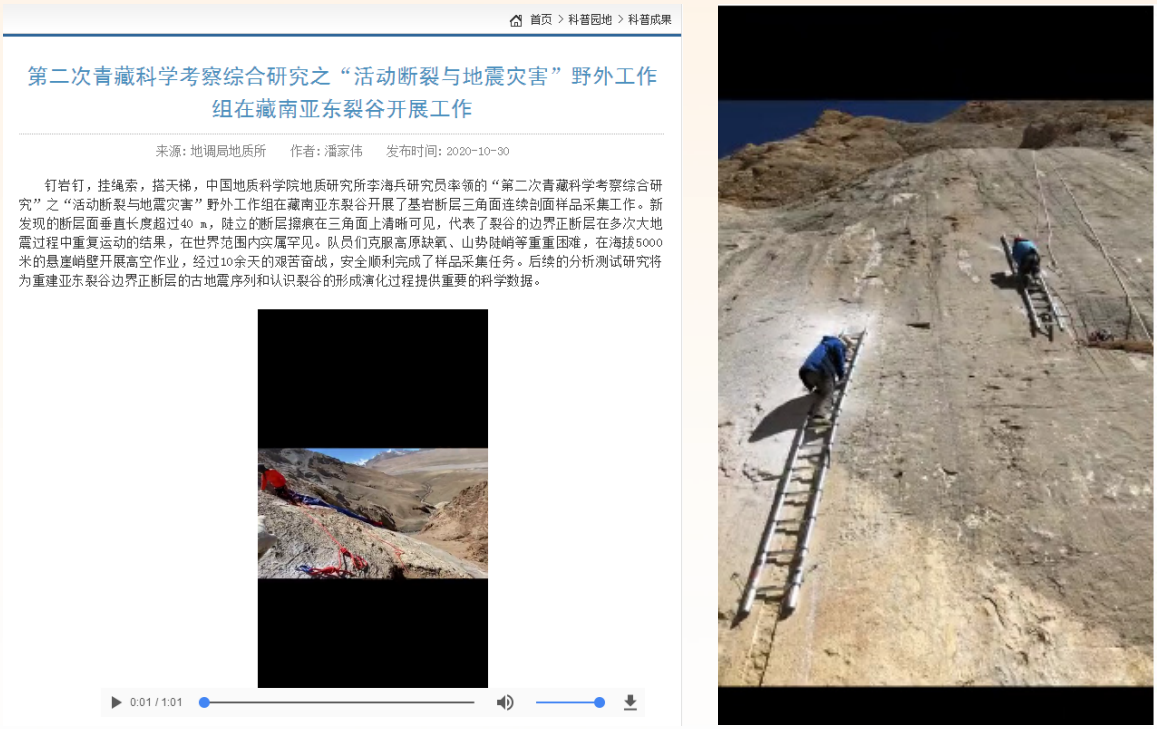

Fig 6.2.6. “Active fault and seismic hazard” group of the Second Tibetan Plateau Scientific Expedition and Research project worked in the Yadong rift, southern Tibet.

Fig 6.2.7. Wechat series video of “One minute geology”.

7. Postgraduate Education

Twenty-five graduate students were awarded diplomas at the 2020 Graduation Ceremony

Eleven doctoral and fourteen postgraduate students completed their studies and were awarded degrees in 2020, among whom two postgraduate students would further their studies as Doctoral Degree candidates, and five doctoral graduates as postdoctoral fellows. ZHU Zhicai and WANG Jianlong won the title of Excellent Graduates of Beijing General Colleges and Universities; BAI Wenqian won the CHENG Yuqi Excellent Graduate Award; ZHU Zhicai, WANG Jianlong, and WANG Huining received the CHENG Yuqi Excellent Thesis Award; ZHU Zhicai, WANG Jianlong, and XU Qian were awarded the academic "Outstanding Graduate" honor of the Chinese Academy of Geological Sciences; and eighteen additional graduate students received the academic "Excellent Student" honorary title of CAGS. HAO Guangming, WANG Mingqian, ZHU Zhicai, and LIU Xiaojia were awarded the title of Excellent Student Leaders of CAGS. ZHANG Jibiao, WANG Wei, and WANG Haitao won the national scholarship for graduate students in 2020.

Fig 7.1. On August 11, the Institute released the commemorative graduation video.

Fig 7.2. On July 14, Academician REN Jishun was invited to give lectures for postgraduates and employees.

Fig 7.3. On Januray 14, 2021, the Institute held a postgraduate commendation meeting.

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Bai Huaqing, Kuang Hongwei, Liu Yongqing, Peng Nan, Chen Xiaoshuai, Wang Yuchong. 2020. Marinoan-aged red beds at Shennongjia, South China: evidence against. Palaeogeography, Palaeoclimatology, Palaeoecology, 559: 109967.

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