China University of Geosciences

Center for Global Tectonics

2016 Annual Newsletter and Field Meeting 2nd Announcement

March 21, 2017

Greetings, from sunny California. Another adventurous and busy year has passed, the holidays are over, and most people are back at work teaching and with research. I attach here our annual newsletter, highlighting some of the progress in building the Center for Global Tectonics, and discuss some of the research that has been in the spotlight. You will also find with this report the second announcement of our annual Summer Field Meeting and trip, which this year will be held from Aug. 27-Sept. 2, and is entitled “Archean Mélanges and Superimposed Tectonomagmatic Events in the Zanhuang Complex, North China Craton: Structural Geology of a Late Archean Suture”. The theme of the research symposium on Aug. 28 is "Constraints on Archean tectonic style: melanges, metamorphism, geochronology, seismology, geochemistry and numerical modeling." If you are interested in participating, the meeting will be in Wuhan, and the post-meeting field trip will be in the Central Orogenic Belt of the North China Craton. Since the field trip can only accommodate 30 people, please let us know as soon as possible if you plan to attend.

Looking forward to seeing you all in 2017,

Tim Kusky
Director, Center for Global Tectonics
Menlo Park, CA

Research Highlights

Summary

Following the guidelines for the development and growth of the Center for Global Tectonics at China University of Geosciences, Wuhan, and collaborating institutions, we are happy to report significant progress in research, laboratory construction, establishment of a web site (under construction), team building, and addition of new members through faculty hires. The main research directions in the Center for Global Tectonics are focused on (1) the tectonic evolution of Precambrian terranes, (2) subduction zones, accretionary and collisional orogens, and ophiolites, and (3) the Tibetan plateau and orogenic belts.

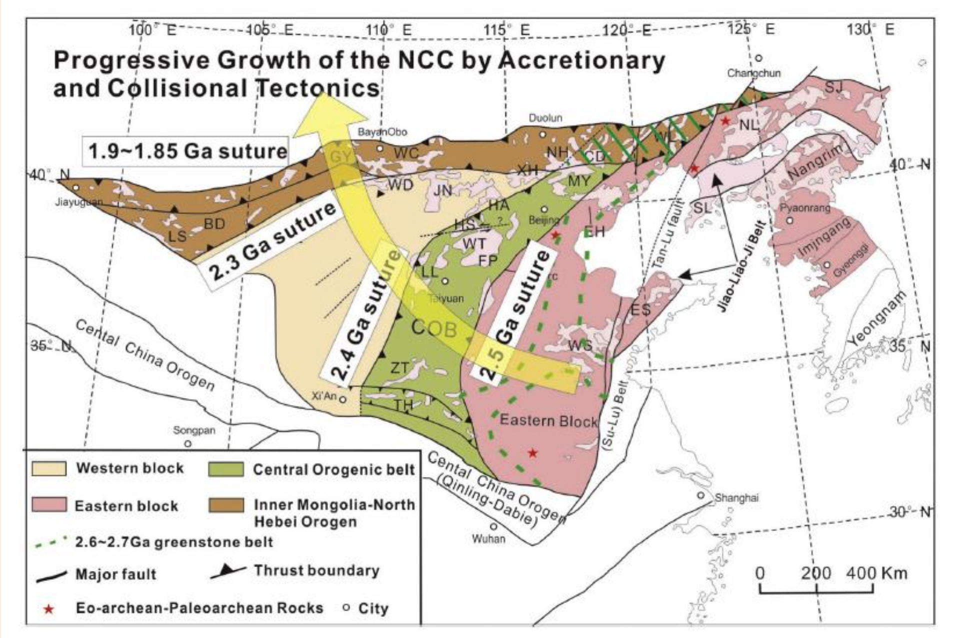
In 2016, the key members in the Center for Global Tectonics have published many international SCI-listed papers, including 3 papers in T1, 18 papers in T2, one paper in T3 and 8 papers in T4. In addition, the key members also have published 9 papers in domestic core journals. New projects have been funded as follows: four National Natural Science Foundations of China grants, one Youth Fund, one Tengfei plan—Central University Special Project, one open subject of Tibet Plateau Geological Research Center in the China Geological Survey, one project of international cooperation, one joint cooperative research project (with Cornell University), and several smaller or larger internal start up funds.

First direction: Precambrian tectonic evolution

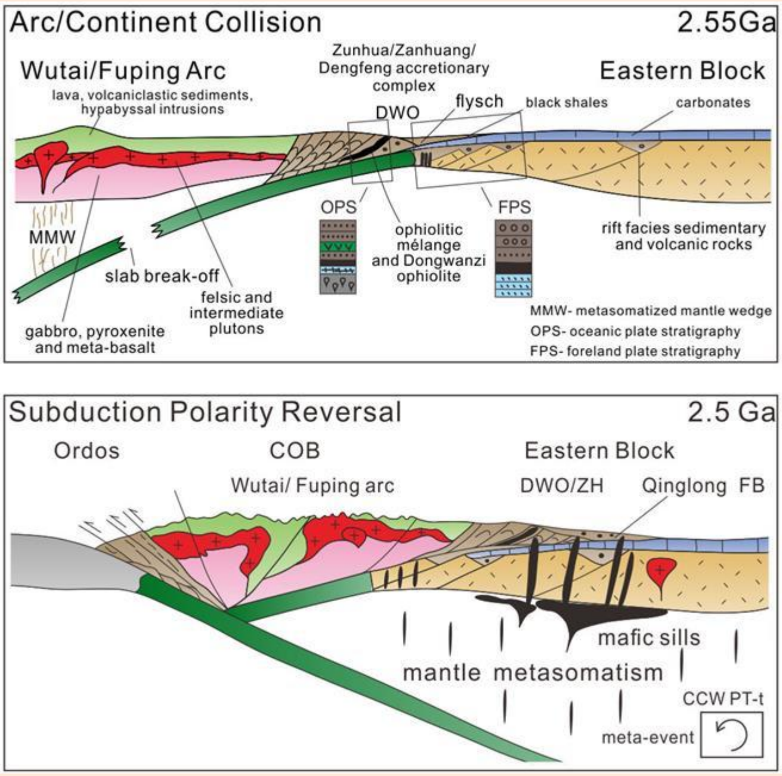
1.1 The main research contents and progress.

1.1.1 Precambrian tectonic evolution of the North China Craton

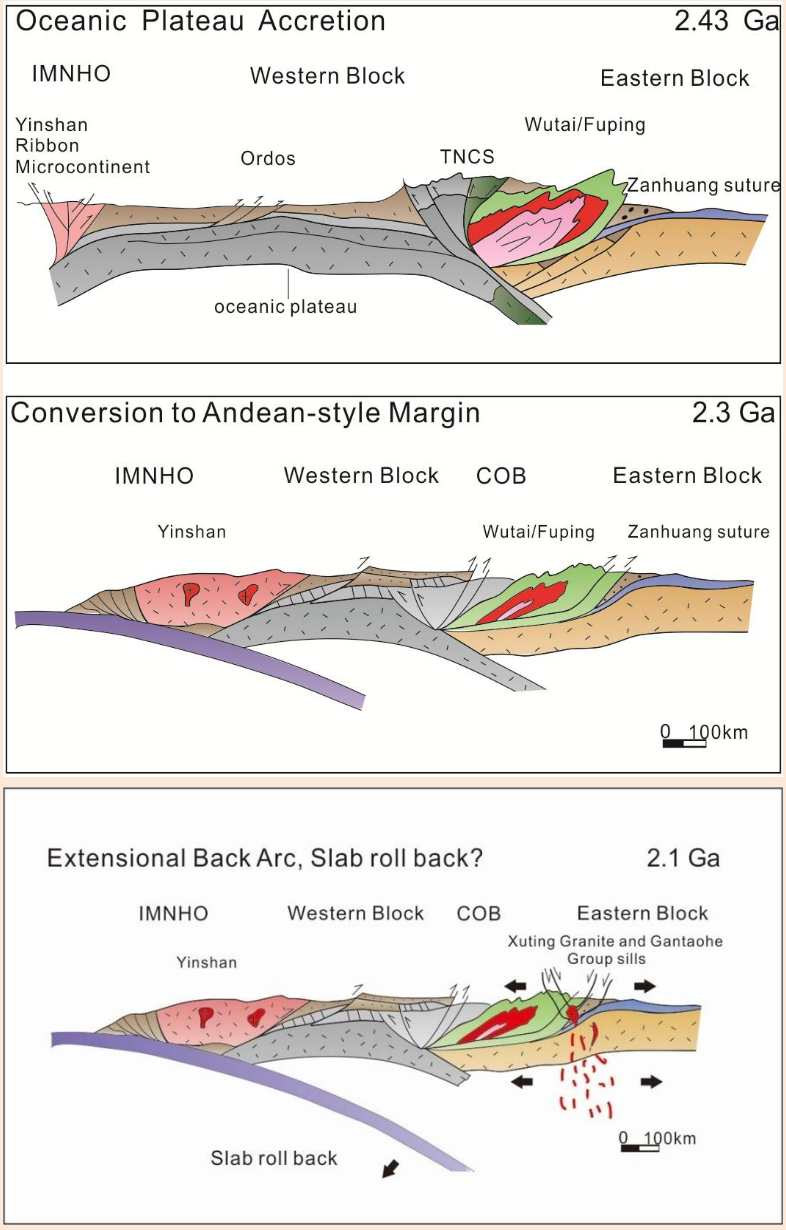
The North China craton consists of the Eastern Block, Western Block, and the intervening Central Orogenic belt, which is an arc terrane that collided with the Eastern Block at about 2.5 billion years ago. This year we made significant progress in understanding the evolution of this orogen, though detailed field mapping, structural and petrologic and geochronologic research, focused on the Jianping- Zunhua- Zanhuang- Dengfeng complexes, through which the 2.5 Ga suture runs.



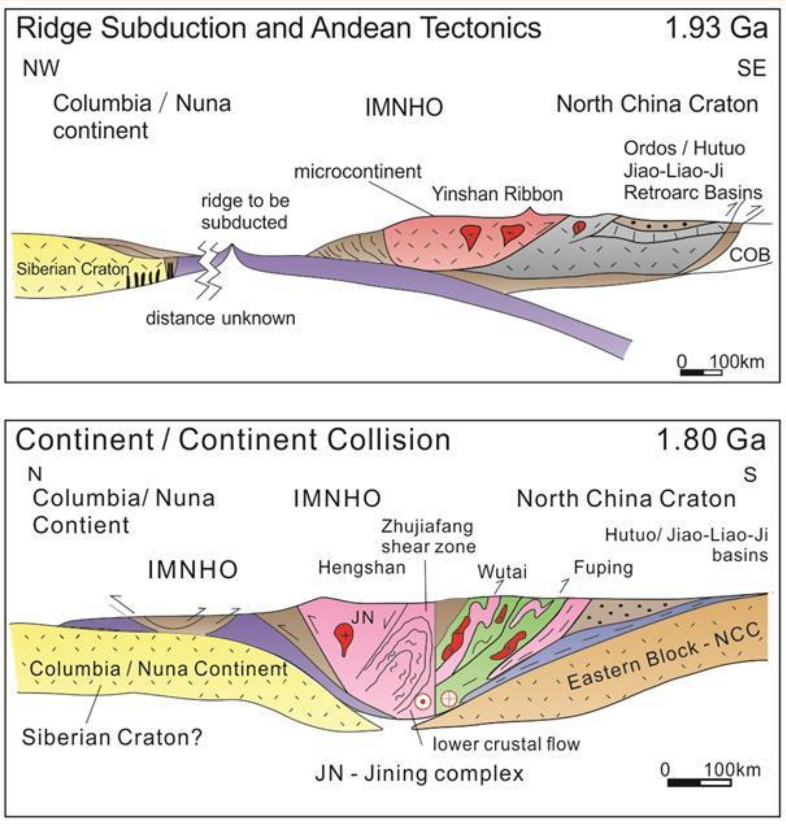
Professor Timothy Kusky and colleagues published an invited review for Earth-Science Reviews (2016, v. 162, 387-432: http://dx.doi.org/10.1016/j.earscirev.2016.09.002). Using comparative tectonic analysis, the review integrated many works from more than a decade of work on the North China Craton (NCC), and proposed a new division scheme and tectonic history of the NCC, proposing a model of progressive outward growth of the craton.



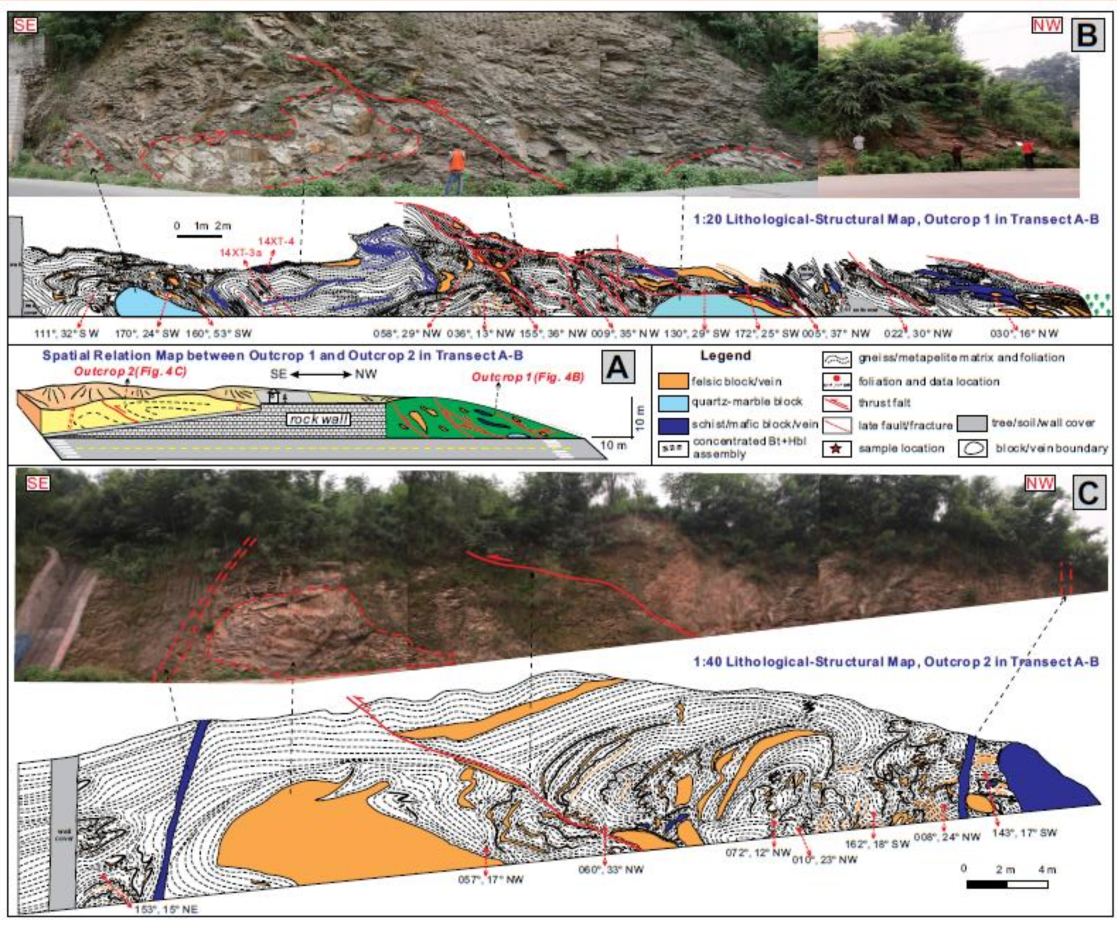
The article uses a multidisciplinary approach to define sutures, their ages, to determine their mode of formation and means of accretion or exhumation, and compares different stages in the evolution of the craton with modern analogues. It is suggested that the eastern unit of the craton consists of several different small blocks assembled between 2.6 and 2.7 Ga ago, that resemble fragments of accreted arcs from an assembled archipelago similar to those in the extant SW Pacific. A thick Atlantic-type passive margin developed on the western side of the newly assembled Eastern Block by 2.6–2.5 Ga. The Wutai-Fuping arc terrain collided with the west margin of the Eastern Block at 2.5 Ga. This was followed by an arc-polarity reversal, which led to a short-lived injection of mantle wedge-derived melts to the base of the crust that led to the intrusion of mafic dikes and arc-type granitoid (TTG) plutons with associated metamorphism. By 2.43 Ga, the remaining open ocean west of the accreted arc closed with the collision of an oceanic plateau now preserved as the Western Block with the collision-modified margin of the Eastern Block, causing further deformation in the Central Orogenic Belt. 2.4–2.35 Ga rifting of the newly amalgamated continental block formed a rift along its center, and new oceans within the other two rift arms, which removed a still-unknown continental fragment from its northern margin. By 2.3 Ga an arc collided with a new Atlantic-type margin developed over the rift sequence along the northern margin of the craton, and thus was converted to an Andean margin through arc-polarity reversal. Andean margin tectonics affected much of the continental block from 2.3 to 1.9 Ga, giving rise to a broad E-W swath of continental margin magmas, and retro-arc sedimentary basins including a foreland basin superimposed on the passive northern margin. From 1.88 to 1.79 Ga a granulite facies metamorphic event was superimposed across the entire continental block with high-pressure granulites and eclogites in the north, and medium-pressure granulites across the whole craton to the south. The scale and duration of this post-collisional event is similar to that in Central Asia that resulted from the Cenozoic India-Asia collision. We relate this continental collision event to the collision between the North China Craton and the Columbia (Nuna) continent. The North China Craton was rifted from the Columbia Continent at 1.78 Ga, as recorded by a suite of anorthosite, monzonite, granite and alkali granite along the north edge of NCC. After the igneous rocks intruded, rift valleys, graben, and mafic dikes formed, then the north margin of the craton evolved into an Atlantic type passive margin, indicating a long-term stabilization of the craton that lasted until the Paleozoic.



The NCC tectonic accretion style transformed around 2.5 Ga, from plate boundaries that are preserved with hundreds-thousands km length scale (reflecting archipelago-like acrcretion of arcs and microcontinents), to linear arcs with > 1,300 km length after 2.5 Ga. Accretion of different arcs, oceanic plateaus and ribbon continents saw the craton grow progressively towards the NW, in a style similar to the Superior Craton, possibly representing the gradual growth of the continent in the late Archaean (perhaps as part of the Kenorland Continent), then ended with its amalgamation and subsequent breaking-out from the Columbia (Nuna) continent in the Paleoproterozoic.



In related work, we have completed precise field mapping, tectonic modeling and geochronology on the Zanhuang melange in the Central Orogenic belt, revealing that the main deformation in the melange occurred before 2.5 Ga, constraining the timing of the suturing of the Wutai/Fuping arc in the COB with the Eastern Block. These results have been published in GSA Bulletin (Wang et al., 2016, doi:10.1130/B31479.1). Also, we have studied the petrology and geochemistry of the Zanhuang granitoids to discuss their formation age, origin and tectonic background and constrain the events of arc continent collision and arc polarity-reversal at 2.5 Ga, and published these results in Lithos (Wang et al., 2017, Lithos v. 268-271, p. 149-162, doi.org/10.1016/j.lithos.2016.10.028).

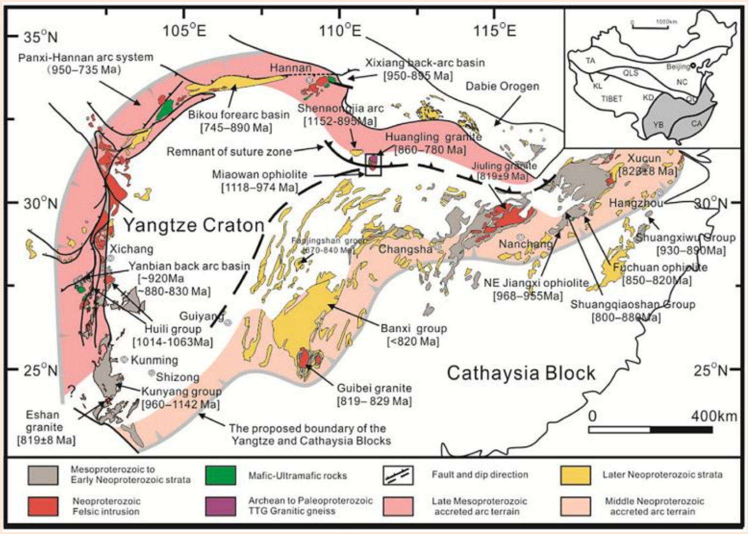


(A) Spatial relation map between outcrop 1 and outcrop 2 in transect A-B. Note that outcrop 1, outcrop 2, and the vertical concrete wall in between constitute a continuous profile. Bt—biotite; Hbl—hornblende. (B) Photo and 1:20 lithological and structural map of outcrop 1 in transect A-B. Location of outcrop 1 is shown in Figures 1C and 2A. (C) Photo and 1:40 lithological and structural map of outcrop 2 in transect A-B. Location of outcrop 2 is shown in Figures 1C and 2A. Note that outcrop 1 is dominated by thrusting, and outcrop 2 is dominated by folding quartzofeldspathic veins with generally northwest-dipping axial surfaces. The various blocks and matrices are thrusted and folded together composing the typical fold-and-thrust structures in an accretionary wedge. From Wang et al., 2017.

From further south in the North China Craton, the analysis of tectonics, petrology, geochemistry and isotope chronology were implemented on the 2.5 Ga Dengfeng greenstone belt in the southern part of North China Craton and the Central Orogenic Belt. We suggest that the meta-volcanic and sedimentary sequence in the Dengfeng greenstone belt represents a Neoarchean forearc subduction accretionary complex that was obducted onto the western margin of the Eastern Block at 2.5 Ga, and represents the fore-arc section of the Wutai/Fuping arc. This work was published in Precambrian Research (Deng et al., 2016, 275, 241-264, http://dx.doi.org/10.1016/j.precamres.2016.01.024).

1.1.2 Precambrian tectonic evolution of the Yangtze Craton and Cathaysia orogen

The South China "Block" is divided into the Yangtze Craton and the Cathyasian Orogen. In 2012, Songbai Peng and others from the Center for Global Tectonics proposed that a group of mafic and ultramafic rocks near the north margin of the Yangtze craton represents a Proterozoic ophiolite,



named the Miaowan ophiolite. This has become gradually accepted through data in a series of papers, and a number of field trips to the ophiolite with some world-renowned ophiolite experts. In a new paper Deng Hao and others (2016, Precambrian Research, 275, 241-264: doi.org/10.1016/j.precamres.2016.12.003) present new geochemical and geochronological data showing that the ophiolite (including serpentinized dunite, harzburgite, meta-gabbro, meta-diabase dikes, meta-basalt, meta- pillow basalt, and related calcarenite, pelite, chert) formed at a mid-ocean ridge in the Mesoproterozoic (1.12-1.1 Ga) and was later (circa 950 Ma) cut by gabbro, diorite, and dolerite formed in arc environment before it was obducted on to the margin of the Yangtze Craton.

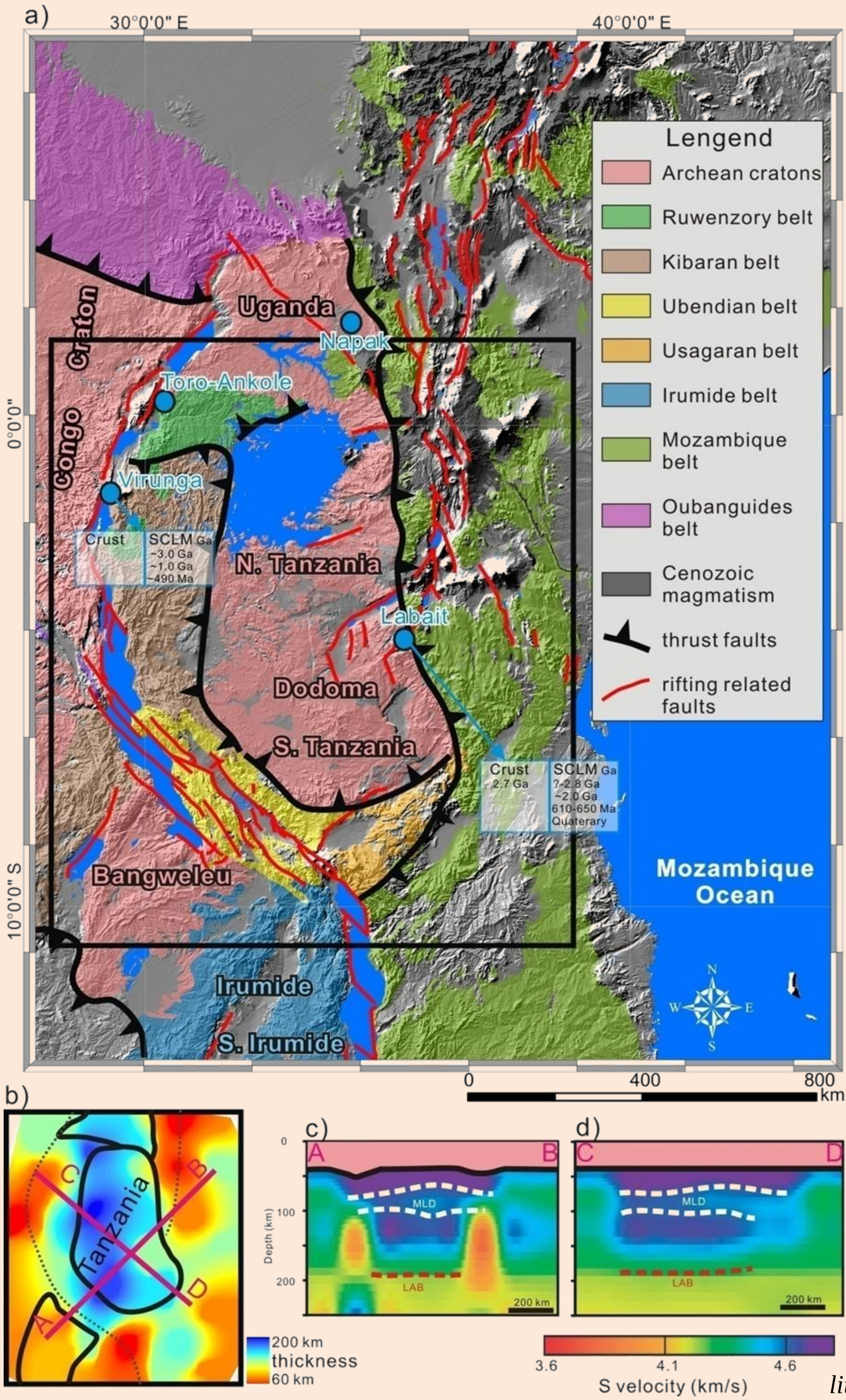
We document a previously unknown Neoproterozoic (0.94-0.93 Ga) metamorphic event within metasedimentary rocks from ophiolitic mélange in the Yangtze Craton，and this result provides crucial evidence of metamorphic geochronology for that basement of Yantze Craton underwent collisional orogenesis during the Neoproterozoic（Jiang et al., 2016, Precambrian Research 279, 37-56, http://dx.doi.org/10.1016/j.precamres.2016.04.004).

A dismembered Paleozoic ophiolite associated with high magnesium basaltic andesite-andesite series has been recognized in the southeast part of the Jiangnan Orogen (the orogenic belt between the Yangtze Craton and Cathaysia block in South China) demonstrating that subduction-accretionary orogenesis continued in this belt into Paleozoic times, including the obduction of oceanic crust on the Cathaysia block (Peng S. B. et al, 2016, *Earth Science*, 41 (5): 765-778).

Z.M. Zhang and others (2016, *Earth Science*, 41 (12):1977-1994) proposed that carbonate nodules preserved in the fourth member of the Sinian Doushantuo formation from the Zigui area are produced by the breakdown and release of solid gas hydrates in black mudstone followed by diagenesis and metasomatism, and and suggested that this is significant marker of the occurrence of gas hydrates in geologic history. Moreover, it is also an important geologic basis for searching for gas in Sinian and lower Palaeozoic sedimentary rocks from the Yangtze Craton.

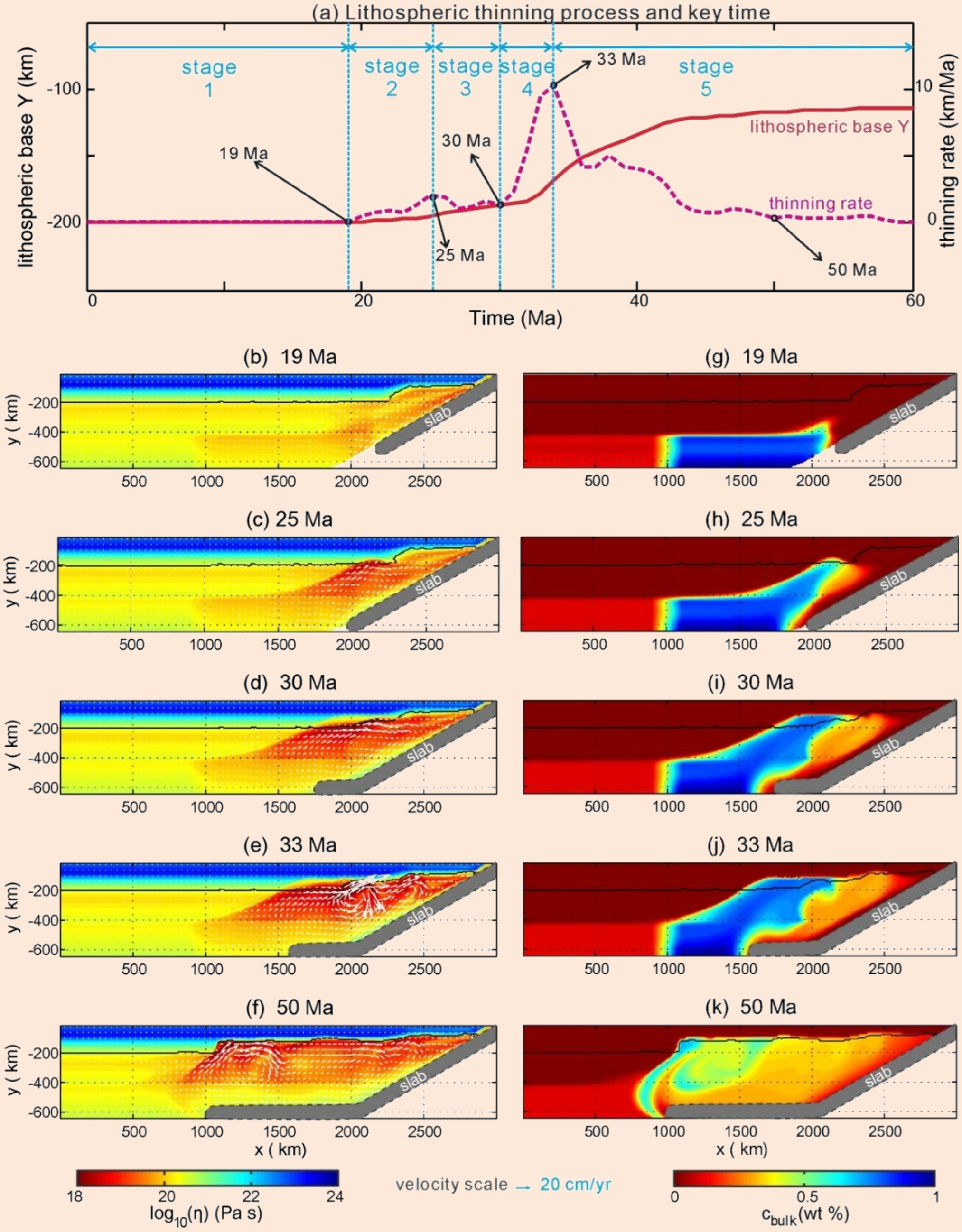
1.1.3 Comparative tectonic research on the destruction of the North China Craton and other cratons around the world

A combined study of geology, geophysics and geochemistry was carried out on the North China, North Atlantic, Pilbara, Superior, Slave, Wyoming. North Atlantic, and Tanzania Cratons to search for possible factors leading to loss of subcontinental lithospheric roots beneath some cratons. Possible mechanisms, that may act together, include extension, hydrolysis weakening, convective erosion, marginal collisions, and delamination along the mid-lithospere discontinuity (Wang Z. S. et al., 2016, The Journal of Geology 124, p. 699-721). Based on the conclusions of our comparative tectonic analysis, we have done geodynamic numerical modeling on the process of hydrolysis weakening and convective erosion, and suggest that subducted oceanic slabs will cause upwelling and dehydration melting of materials when the slab flattens out in the mantle transition zone, and the extra water will rise and weaken the lithosphere. Then the lithosphere will be eroded by strong convection in the overlying big mantle wedge (Wang Z. S. et al., 2016, Geophysical Research Letters 43, doi:10.1002/2016GL071186.).



Tanzania Craton and adjacent areas. a, Precambrian terranes and Cenozoic volcanoes, modified after Chorowicz (2005), Begg et al. (2009), and Mulibo and Nyblade (2013). b, Synthetic lithosphere thickness according to the migrated receiver function and tomography results (Adams et al. 2012; Wӧlbern et al. 2012; O'Donnell et al. 2013). c, d, S-wave velocity across sections A–B and C–D shown in b (Weeraratne et al. 2003). LAB p lithosphere -asthenosphere boundary; MLD p mid -lithosphere discontinuity; SCLM p subcontinental lithospheric mantle.

From Wang et al., 2016, J. Geology 124, p. 699-721.



Lithospheric thinning stage and removal mechanism for model with ~1 wt % MTZ water content. (a) The depth change and thinning rate during lithospheric thinning, with key time and stages labeled according to the thinning rate variation. (b–e) The viscosity and (g–k) bulk water content profile of the time section labeled in Figure 2a. Position of slabs is simplified according to the subduction rate u0 and time. Stage 1 (0–19 Ma): Slab downgoing to the MTZ. Stage 2 (19–25 Ma): Perturbation starting and water reaching the lithospheric base, thinning initiated. Stage 3 (25–30 Ma): Slab flattening and formation of the hydrous BMW. Stage 4 (30–33 Ma): Enlargement of the BMW and enhancement of secondary convection and lithospheric thinning. Stage 5 (33–60 Ma): Water exhausting and weakening of secondary convection. The evolution of these stages are not changed by changing the subduction rates (5 cm/yr, 10 cm/yr, and 15 cm/yr); only the time evolution is faster or slower. The faster the subduction rate is, the earlier each stage arrives, the shorter each stage becomes. From Wang et al., 2016, GRL 43, doi:10.1002/2016GL071186.

1.2 Annual scientific projects

[1]. Contact metamorphism in Zhoukoudian, Beijing. Surface Project, Chen Nengsong (Number: 41672060; Date:2017.1—2020.12)

[2]. Cooperation research of continental tectonics and evolution, International Cooperation (Cornell University and China University of Geosciences (Wuhan)), Timothy Kusky, Larry Brown, Larry Cathles.

1.3 Main achievements and articles:

In this research direction, our team published international articles as followings: three for T1, eleven for T2, one for T3, seven for T4 and three for Core Paper (in Chinese, T5). The papers are available on the CGT web site for downloading.

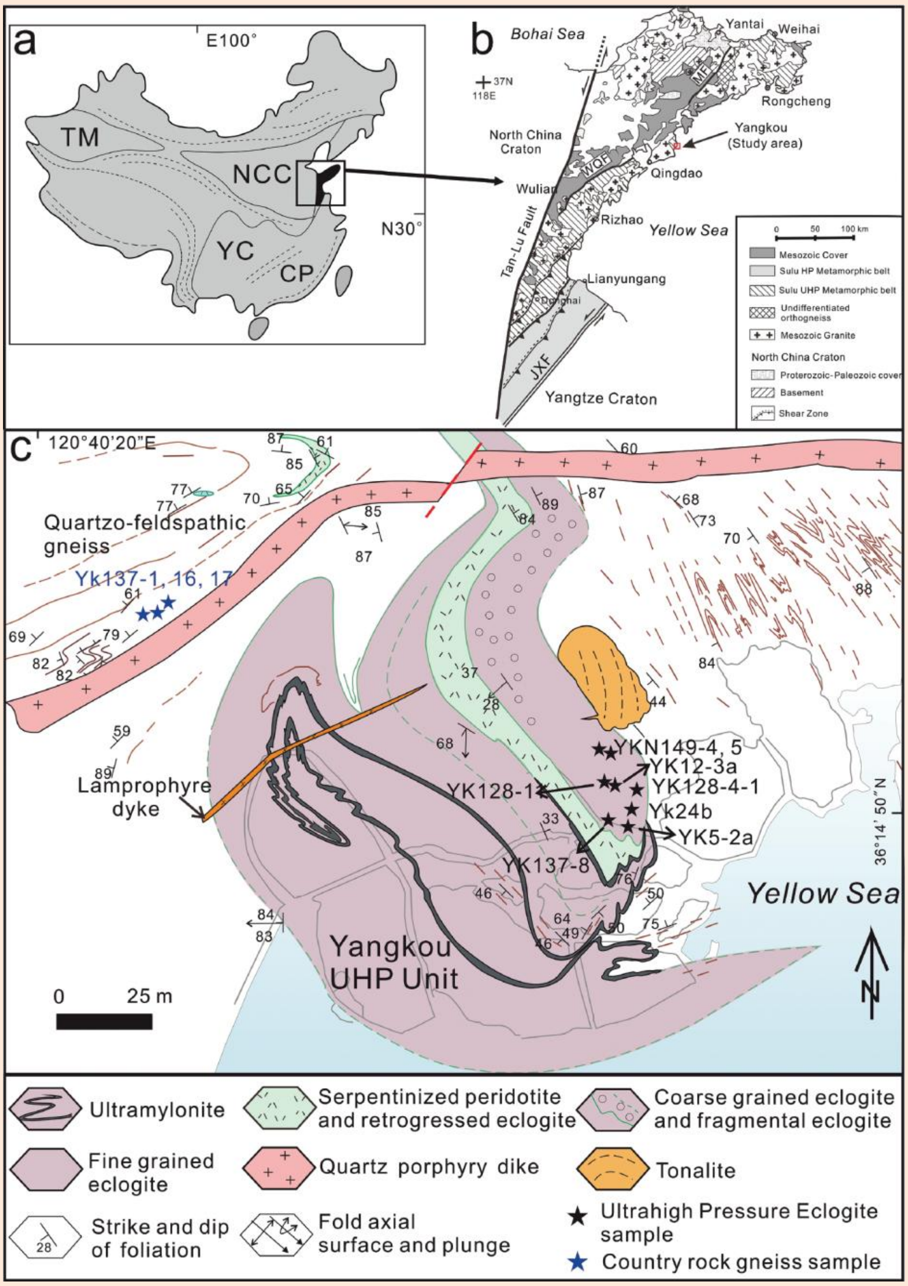
Field work on the Miaowan ophiolite, Yangtze Craton.

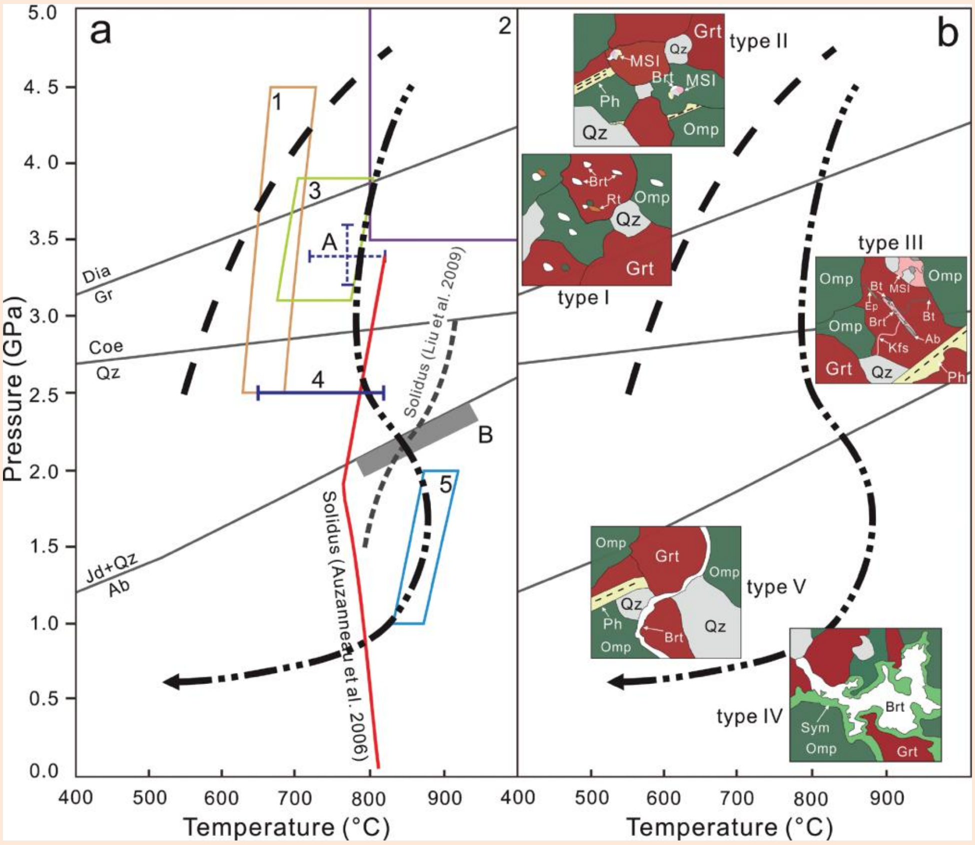
Second direction: Subduction zones, accretionary and collisional orogens, and ophiolites

2.1 The main research contents and developments

2.1.1 The evolution characters of melts and fluids of UHP metamorphic rocks during exhumation in Yangkou, Sulu belt.

We previously documented the first example of large-scale partial melting of eclogite from Yangkou Bay and General's Hill in the Sulu Orogen (Wang et al., 2015). In new work this year we completed a comprehensive analysis of multistage barites in the eclogite, including microstructural characters of melts and fluids crystallization, microstructure, petrology and geochemistry indicates that the barite has five growth- stages during prograde metamorphism through exhumation. The growth of barite records varied evolution tracks of micro-scale aqueous fluid within eclogite, supercritical fluid, and hydrous fluid, which changed with changing P-T conditions during the subduction -exhumation process, and provides key evidence for trace element (e.g., Ba, Sr) migration in the subduction channel. (Wang, S.J., et a., 2016, American Mineralogist, 101, pages 564–579).



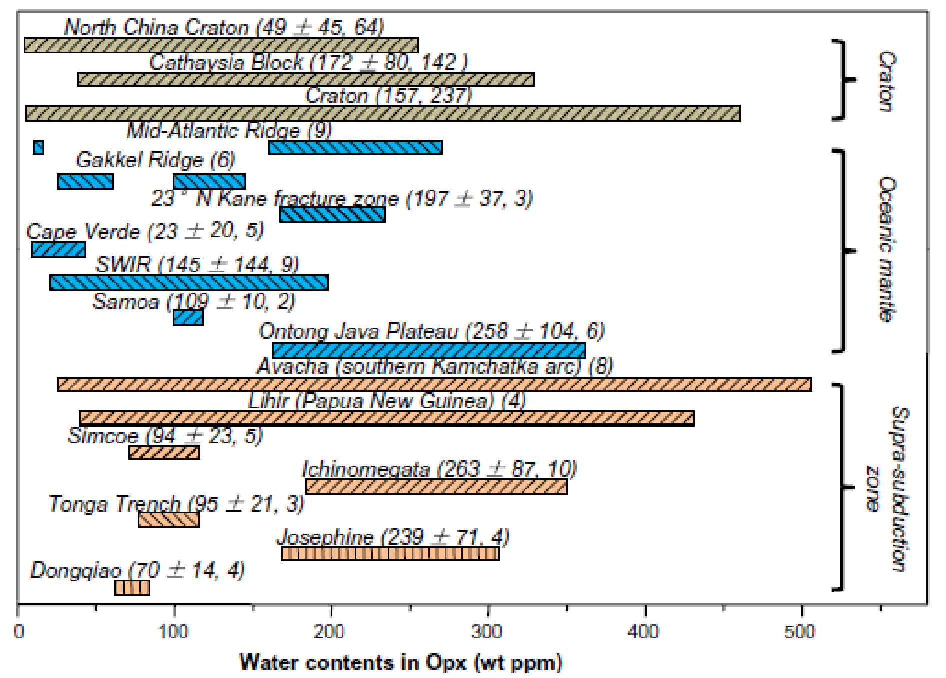


*(**a**) P-T path for the UHP eclogite at Yangkou in the central Sulu belt and (**b**) the different types of barite in relation to the P-T evolution (from Wang et al. 2016).*

Prof's Mike Brown and Lu Wang, with co-supervised Ph.D. student Sonjie Wang doing field work on UHP rocks and partial melting in the Sulu orogen.

2.1.2 The water and fabric of ophiolitic olivine in subduction zones

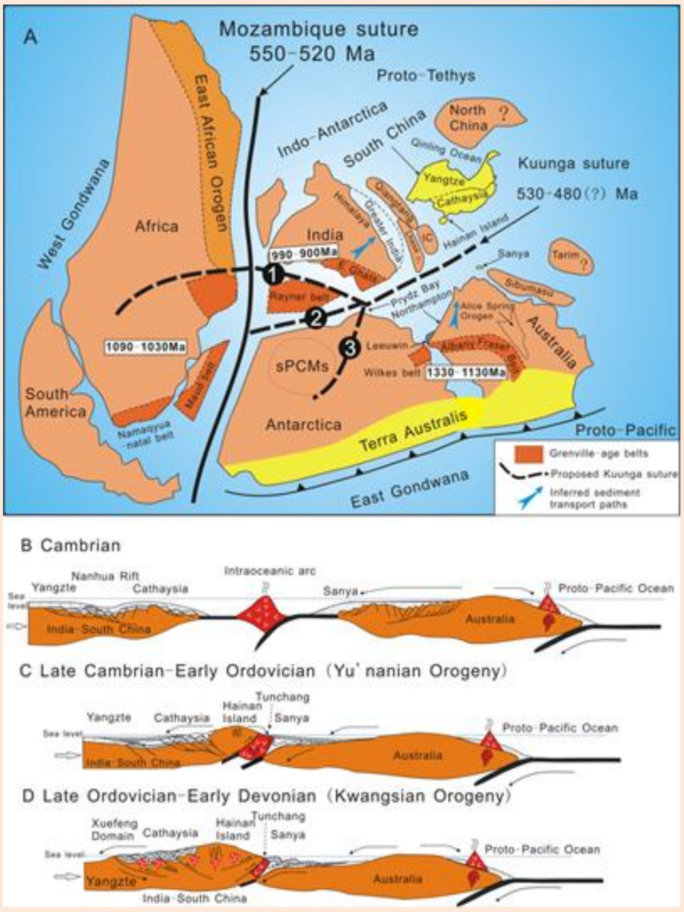
The constitutional water in Nominally Anhydrous Minerals (NAM's, such as olivine, pyroxene, garnet, especially in upper mantle) has great significance to understanding of many of Earth's deep interior geodynamics processes. At present, the research of constitutional water in NAM's of oceanic lithosphere is mainly restricted by samples (mainly from the deep sea drilling project and small amounts from peridotite xenoliths) and progresses slowly. After synthetic study of lithogeochemistry



and mineral constitutional water and fabrics of ophiolitic peridotite from the Dongqiao area, Tibetan Plateau, we suggest that the ophiolitic olivine was derived from a mantle wedge setting above a subduction zone. The water in olivine diffused and was lost, while the orthopyroxene contains a certain amount of constitutional water. Though low content, the water may represent original upper mantle water content. The low water content is consistent with A-type fabrics in olivine, which results from partial melting of host rocks and metasomatism with water-deficient melts. Our research could open a new window for further study of constitutional water content in oceanic lithosphere. (Wang, Y., Ren, H. and Jin, Z., 2016. Water and fabric in an ophiolitic peridotite from a supra-subduction zone. *Contributions to Mineralogy and Petrology*, *171*(3), pp.1-17. DOI 10.1007/s00410-016-1234-z)

2.1.3 Oriented inclusions from the North Qaidam UHPM belt, NW China: an electron backscatter diffraction study

Oriented inclusions of clinopyroxene, orthopyroxene, sodic amphibole and rutile have been identified in garnet from the Lvliangshan garnet peridotite massif in the North Qaidam ultrahigh-pressure metamorphic (UHPM) belt, northern Tibetan Plateau, NW China. Electron backscatter diffraction (EBSD) analyses demonstrate that nearly half of the measured intracrystalline clinopyroxene (8 out of 17) have topotactic crystallographic relationships with host garnet, that is, (100)Cpx//{112}Grt, (010)Cpx//{110}Grt and [001]Cpx//<111>Grt. One-fifth of the oriented sodic amphibole (23 out of 110) inclusions of have topotactic crystallographic relationships with host garnet, that is, (010)Amp//{112}Grt, (100)Amp//{110}Grt and [001]Amp//<111>Grt. Over a third of rutile (36 out of 99) inclusions also show a close crystallographic orientation relationship with host garnet in that one <103>Rt and one <110>Rt parallel to two <111>Grt while the axes of [001]Rt exhibit small girdles centred the axes of <111>Grt. But, no 'well-fit' crystallographic relationship was observed between orthopyroxene inclusions and host garnet. Considering a very long and complex history for the Lvliangshan garnet peridotite, we suggest that the low fit rates for these oriented minerals may result from several possible assumptions including different generations or multi-stage formation mechanisms, heterogeneous nucleation and growth under non-equilibrium conditions, and partial changes of initial crystallographic orientations of some inclusions. However, the residual quantitative 'well-fit' crystallographic information is sufficient to indicate that the nucleation and growth of many pyroxene, amphibole and rutile are controlled by the lattice of the host garnet. The revealed close topotactic relationships accompanied by clear shape orientations provide quantitative microstructural evidence demonstrating a most likely exsolution/precipitate origin for at least some of the oriented phases of pyroxene, sodic amphibole and rutile from former majoritic garnet and support an ultra-deep (>180 km depth) origin of the Lvliangshan garnet massif. (Xu Haijin et al., 2016, Journal of Metamorphic Geology, doi:10.1111/jmg.12208)



2.1.4 Intraplate Orogenesis in the Middle Paleozoic Kwangsian Orogen (460-400 Ma) in Southern China

In intraplate orogens tectonothermal activity occurs at a site removed from a plate margin and is considered to result from localization of far-field plate boundary stresses through a combination of pre-existing structural features and modification of lithospheric properties through fluid alteration, enhanced heat flow and potential thermal blanketing effects. The mid-Paleozoic Kwangsian Orogeny

(460–400 Ma) in the South China Craton is geodynamically associated with the far-field response to convergence along the northern margin of east Gondwana. Deformation is focused adjacent to the site of both early Neoproterozoic suturing of the Yangtze and Cathaysia blocks and mid-Neoproterozoic rifting within the craton. Furthermore, this region is one of high crustal heat flow and of widespread fluid release and localized crustal melting during orogenesis. In the late Neoproterozoic- Cambrian, the South China Craton constituted part of the lithosphere of greater India and was separated from Australia by the Kuunga Ocean. The closure of the Kuunga Ocean during Cambrian-Ordovician time, resulting in final assembly of Gondwana, permitted the stresses sourced from the Terra Australis accretionary orogen in East Gondwana to propagate inboard across the supercontinent. These stresses localized along the site of the Neoproterozoic Nanhua Rift Basin of South China resulting in basin inversion and development of the intraplate Kwangsian Orogeny. (Xu, Y. J. Cawood, P.A., and Du, Y.S., 2016, Amer. Jour. Sci., 316(4), 329-362. DOI 10.2475/04.2016.02]).

Participation in IGCP-649 - Probing the Oceanic Mantle

Several members of the Center for Global Tectonics participated in the IGCP-649 meeting "Probing the Oceanic Mantle, and Troodos ophiolite Field Excursion from May 15-20, 2016, in Cyprus. The meeting and guidebook were partly organized by CGT members Julian Pearce and Paul Robinson and the meeting including many members of CGT including directors T. Kusky and Wenjiao Xiao, Lu Wang, Wang Junpeng, and a group of students from Wuhan and Beijing.

CGT leaders T Kusky and Wenjiao Xiao with Geological Survey of Cyprus leaders on IGCP-649 trip.

CGT members JP Wang, T Kusky, L. Wang, and SB Peng, at the heart of the Troodos ophiolite.

2.2 Scientific research projects of the year

[1].2016.1-2019.12. General program from National Natural Science Foundation of China. Lu Wang. 41572182.

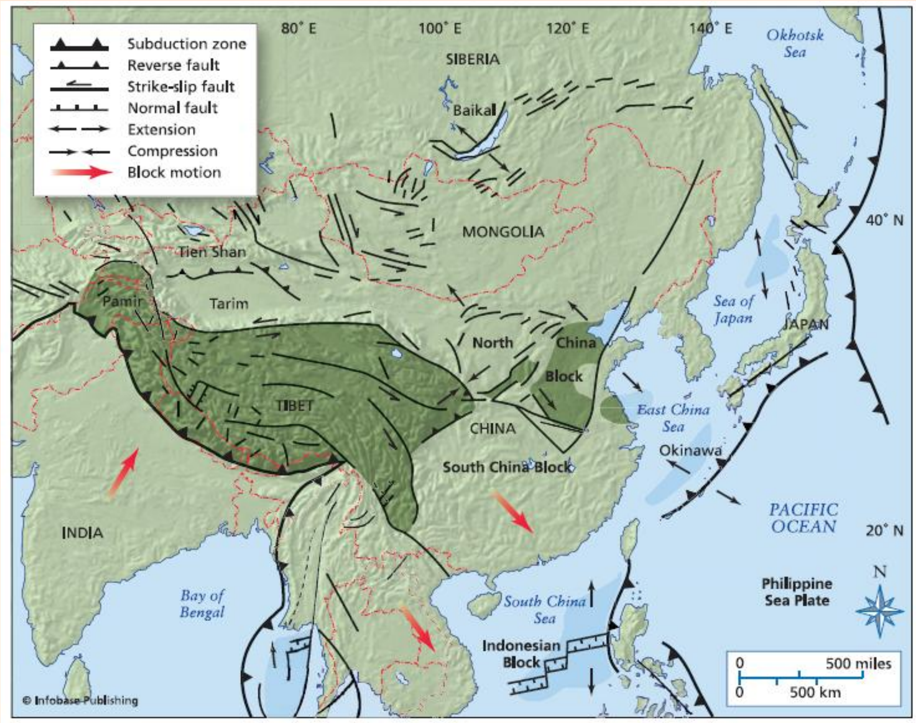
2.3 Major achievements and papers

6 international papers in T1 journals and 4 core journals have been published during 2015-2016. See the web page to download the articles.

Third direction: Research on Tibetan Plateau and orogenic belts

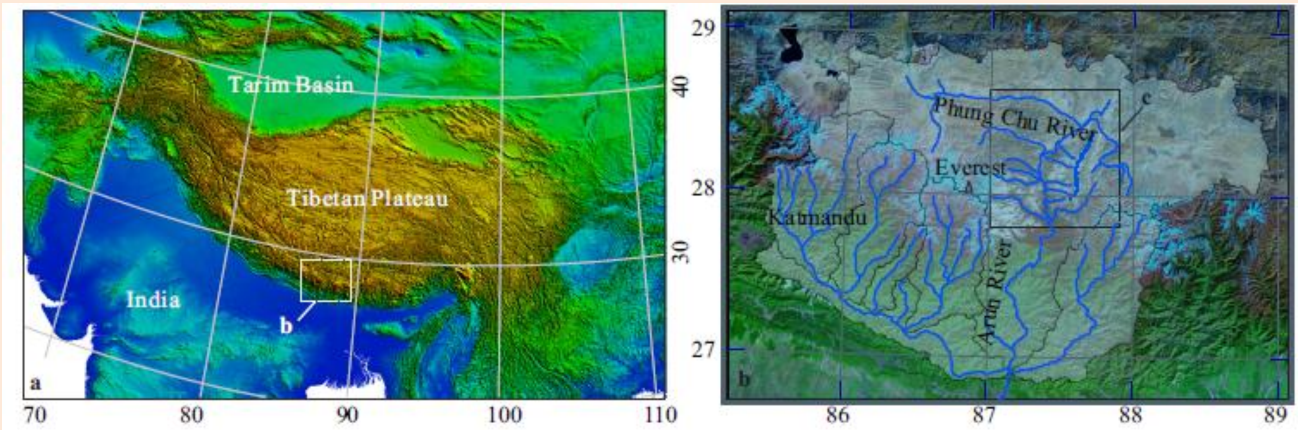
3.1 Major research contents and progress

The uplift of the Tibetan Plateau caused by the collision between India and Eurasia and their continuing interaction is one of the most important geological events on Earth since the Mesozoic. The southeastern Tibetan Plateau has very special tectonic landforms. As the site of proposed mid-crustal flow channels related to the escape and diffusion of plateau materials, it is the key area to study the mechanism of plateau growth and dynamics. However, little is known about the tectonic movement and dynamics of the early Cenozoic in the southeastern plateau. The understanding of this process is imperative for constraining the expansion process of the plateau since the Oligocene and it has important significance for understanding the mechanism of plateau expansion.

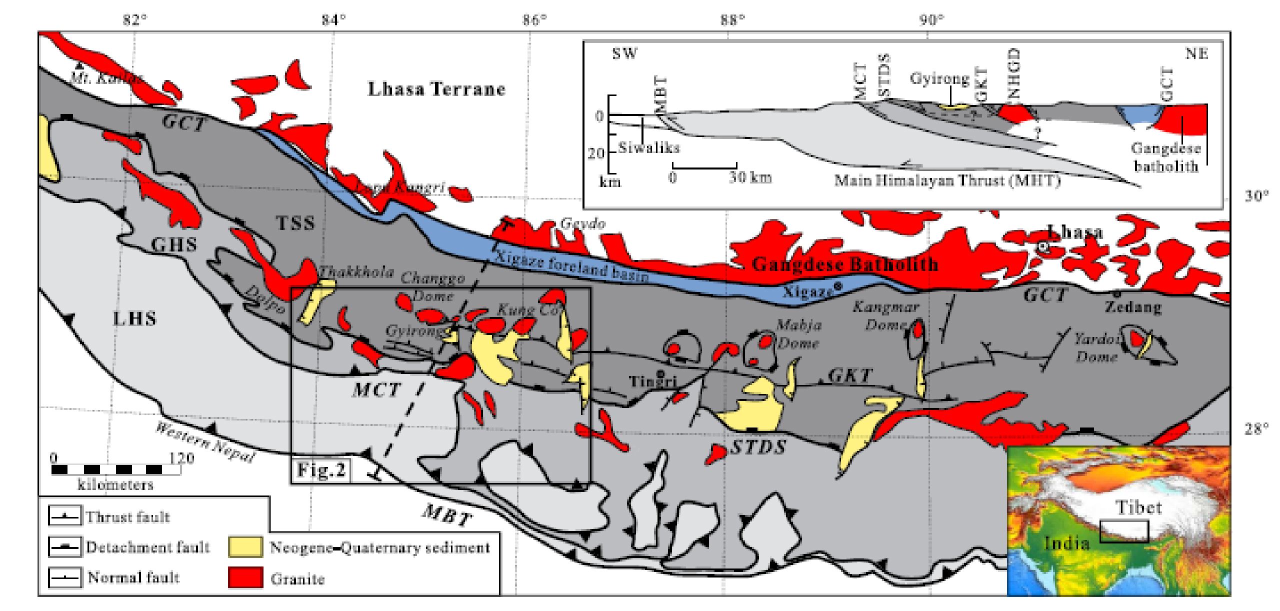


Map showing the main Cenozoic tectonic elelments of Asia, including the motion of Sotuh China and Indochina away from the Indian-Asia collision zone and Tibet. Map from Kusky et al., 2010, Kusky, 2010)

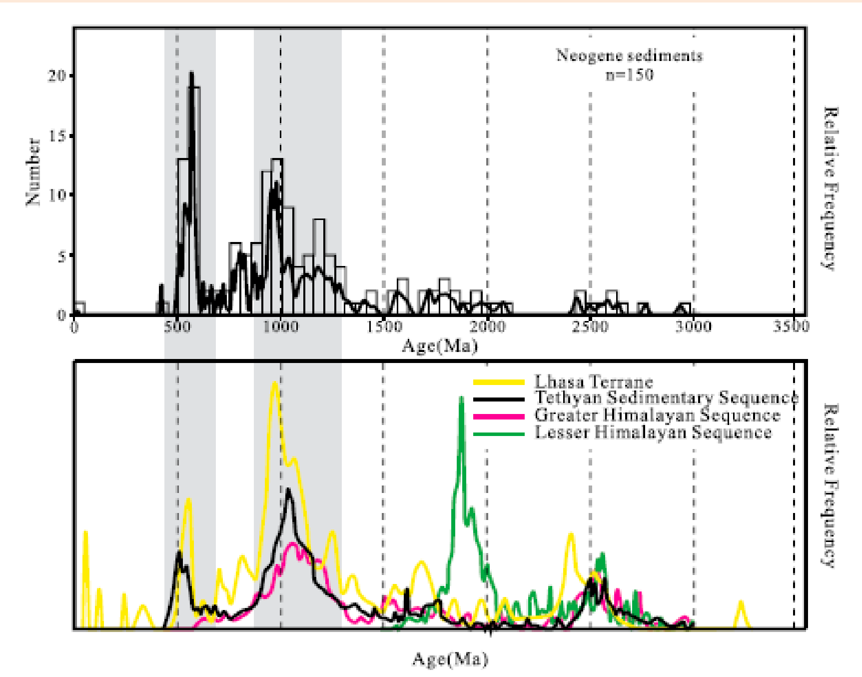
The southern slope of the Himalaya orogenic belt is a unique place to reveal active orogenic belt structures, surface interaction and the evolution of the landscape. Rivers including the Pumqu have successfully cut through the main watershed of the Himalaya and into the Zangnan Plateau. This study focuses on the low-temperature thermochronological analysis of the Pumqu River through apatite fission track and (U-Th)/He test, concluding that between 2.5-1.5 Ma the Pumqu bedrock channel experienced significantly accelerated erosion. Combined with landform analysis, we propose that the accelerated abscission event was driven by capture event when the Pumqu Quaternary river cut through the Himalaya orogenic belt, through the capture of large area watershed of Zangnan region, and accelerated erosion action downstream. (Wang A, Min K, Wang G. Quaternary channel-focused rapid incision in the Phung Chu-Arun River in Central Himalaya: Implications for a Quaternary capture event. Jour. Asian Earth Sci., 2016. http://dx.doi.org/10.1016/j.jseaes.2016.08.017)



The Gyirong basin, southern Tibet, contains the record of Miocene-Pliocene exhumation, drainage development, and sedimentation along the northern flank of the Himalaya. The tectonic controls on basin formation and their potential link to the South Tibetan Detachment System (STDS) are not well understood. We use detrital zircon (ZFT) and apatite (AFT) fission-track analysis, together with detrital zircon U-Pb dating to decipher the provenance of Gyirong basin sediments and the exhumation history of the source areas. Results are presented for nine detrital samples of Gyirong basin sediments (AFT, ZFT, and U-Pb), two modern river-sediment samples (ZFT and AFT), and six bedrock samples (ZFT) from transects across the Gyirong fault bounding the basin to the east. The combination of detrital zircon U-Pb and fission-track data demonstrates that the Gyirong basin sediments were sourced locally from the Tethyan Sedimentary Sequence. This provenance pattern indicates that deposition was controlled by the Gyirong fault, active since ~10 Ma, whose vertical throw was probably <~5000 m, rather than being controlled by normal faults associated with the STDS. The detrital thermochronology data contain two prominent age groups at ~37–41 and 15–18 Ma, suggesting rapid exhumation at these times. A 15–18 Ma phase of rapid exhumation has been recorded widely in both southern Tibet and the Himalaya. A possible interpretation for such a major regional exhumation event might be detachment of the subducting Indian plate slab during the middle Miocene, inducing dynamic uplift of the Indian plate overriding its own slab. (Shen, T. Y., Wang G. C., Leloup P. H., van der Beek P., Bernet M., Cao K., Wang A., Liu C., Zhang K. X., 2016. Tectonics, 35, doi: 10.1002/2016TC004149)



Simplified structural map and cross section (top inset) of Southern Tibet and the central Himalaya, after Burchfiel et al. [1992], Lee et al. [2000], Larson et al. [2010], Kali et al. [2010], Wang et al. [2011, 2014], and Leloup et al. [2015]. The box outlines location of Figure 2, and the dashed line indicates the position of cross section. Abbreviations: MBT, Main Boundary Thrust; MCT, Main Central Thrust; STDS, South Tibetan Detachment System; GKT, Gyirong-Kangmar Thrust; TSS, Tethyan Sedimentary Sequence; GHS, Greater Himalayan Sequence; LHS, Lesser Himalayan Sequence; and NHGD, North Himalayan Gneiss domes. Black box (bottom inset) shows the position of the main map in Asia.



Normalized probability density diagram (using Isoplot [Ludwing, 2012]) of detrital zircon U-Pb ages for Neogene sedimentary rocks of the Gyirong basin; the concordant and relative probability diagrams of individual samples are shown in the supporting information (Figure S4). (bottom) Detrital zircon U-Pb age populations of the main Himalayan sequences [DeCelles et al., 2004; Gehrels et al., 2011] and the Lhasa terrane [Kapp et al., 2007].

Fu Dong and Ali Polat in Qilian Shan working area.

3.2 annual scientific research projects:

[1] New projects of National Natural Science Foundation of China: Tectonic thermal geochronology and basin provenance analysis of Cenozoic tectonic and geomorphic processes in Southeast of Sichuan-Yunnan block", Cao Kai, (No. 41672195), ranked second.

[2] Open project of Chinese geological survey bureau of Tibetan Plateau Geology Research Center (12120101000015O014-29): Geochronology of the northwest part of the Yarlung Zangbo Suture Zone tectonic evolution, Liu Qiang

[3] Petroleum Southern Co: Geothermal resource utilization and protection investigation research of Hainan Fushan oilfield, Li Dewei (2016 - 2017).

[4] Tectonic Evolution of Qilian Shan, Central Asian Orogenic Belt, (GPMR), T. Kusky, A. Polat, V. Soustelle, B. Windley

3.3 Major achievements and articles:

2015-2016 this direction has published one T2 paper, one T4 paper and 3 Chinese papers.

Update on Laboratory Construction

1. Our new JEOL JXA-8230 EPMA has arrived, and set up in our newly renovated labs. We are currently finishing the calibration and testing with standards, and expect all to be ready for use in May of 2017. Welcome to come work with your samples! Responsible people: Timothy Kusky/Junpeng Wang; Lab Location, Center for Global Tectonics, Main Earth Science Building 106A.

Construction of the EPMA Lab. Lab Manager, Junpeng Wang: wangjp@cug.edu.cn

2. Fission track instrument: laboratory renovation has been completed, preliminary demonstration work has been completed; Responsible person: Guocan Wang/ Kai Cao; resettlement site: Main building 108A.

Newly renovated space for hosting the new CGT fission track laboratories, and the new Autoscan stage.

We have begun setting up the new fission track laboratories after the space has been renovated to specification. We are currently setting up the preparation facilities, and vibration-free setting for the high magnifications needed along with mechanical stability needed for the extreme positional accuracy required for fission track analysis. In our aim to build one of the best fission track facilities in the world, so we are basing our system on the Autoscan AS3000i microscope stage, regarded as the best stage available.

3. Microscope cathodoluminescence and research level microscope: has completed the preliminary investigation and the results of the investigation of the sample in other unit. Will be set up in 2018. Responsible person: Lu Wang; resettlement site: Main building 106B.

4. High-Pressure mineral physics lab construction. Lab construction is finished, and the instruments are currently being moved into place.

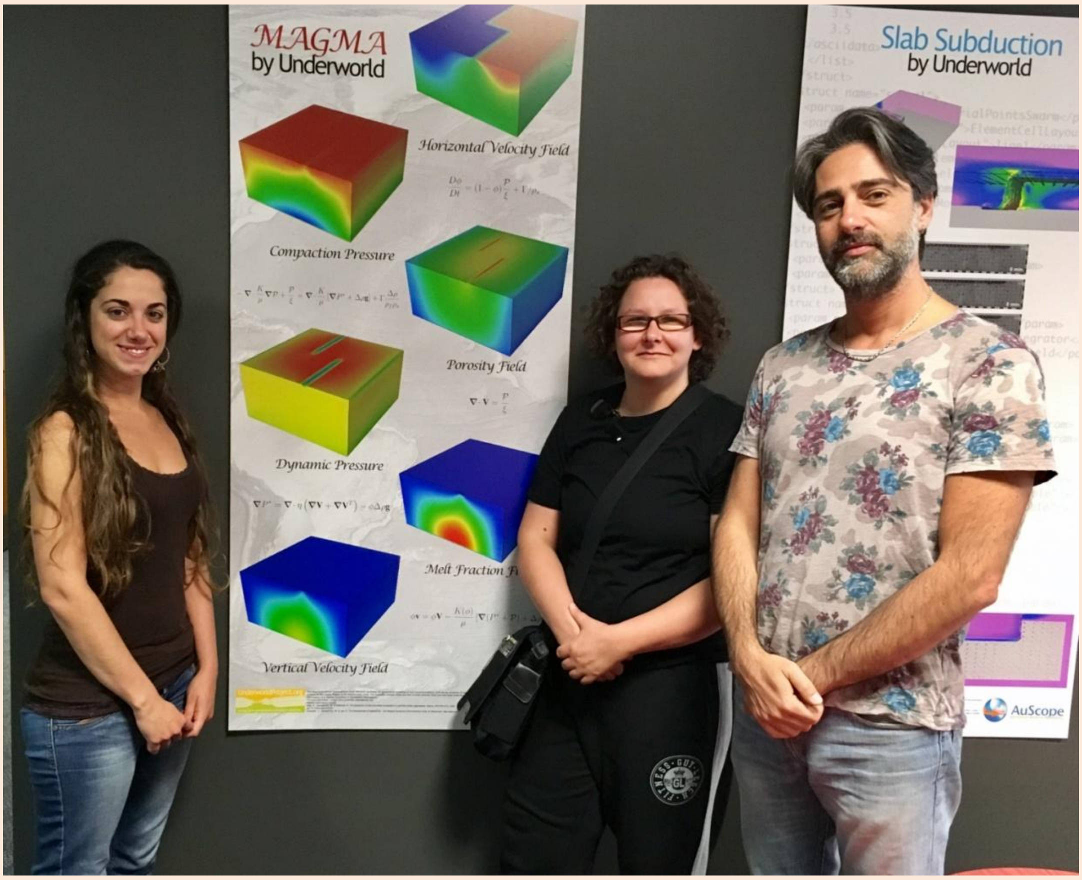
5. Web site construction

Our web site is up and running, and we are currently adding the data, links, and other material as it grows. For members, if you have material you wish to be posted, please contact Joe, our webmaster, at zhouzhipeng2010@qq.com, or zhouzhipeng@cug.edu.cn (cc to zhouzhipeng710@gmail.com)

http://cgt.cug.edu.cn/

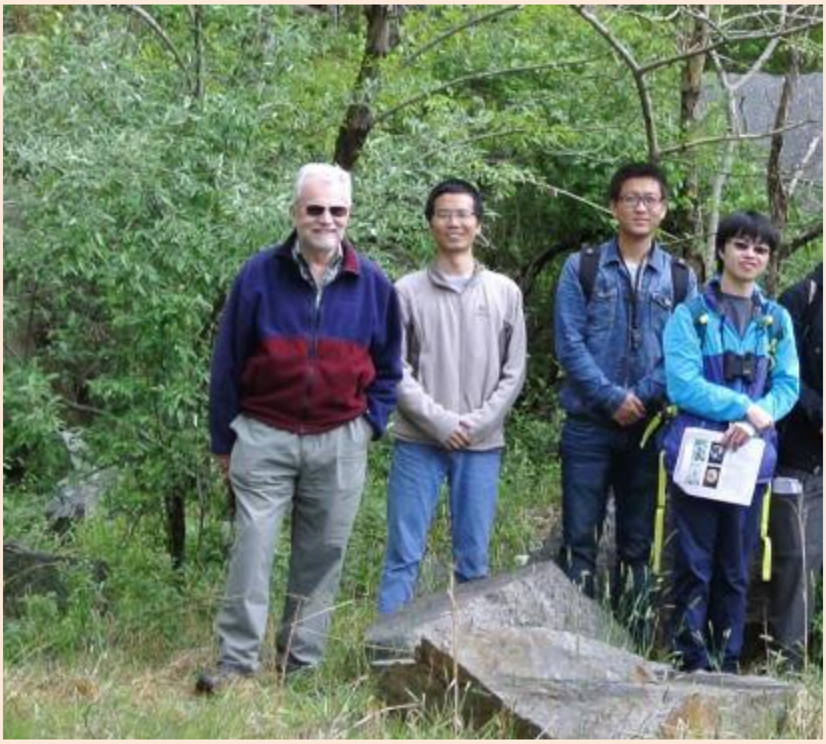
International Exchange of Faculty and Students

In 2016 we continued to exchange students with other member institutions. A few photos from these mutually beneficial exchange programs are shown below:



1) *Zhengsheng Wang, worked with Prof. Fabio Capitanio from Monash University on numerical modeling of convergent tectonics and subduction, and craton destruction, resulting in two publications (Jason is working in the lab and missed the picture).*

2) Deng Hao worked with Prof Ali Polat from Windsor University in Canada for one year, focusing on the geochemistry of Archean rocks in the North China Craton, resulting in several publications, and completion of his PhD.



3) Wang Sonjie (third from left) visited Prof Mike Brown (one of the foreign co-directors of CGT) at the University of Maryland for one year, finishing two papers in metamorphic geology.

Collaboration and Exchange with the U.S. Geological Survey

We have regular exchanges with the USGS in Menlo Park, through Walther Mooney (one of the foreign co-directors of CGT), who regularly hosts visiting Chinese and other young students and researchers. Kusky has worked with the USGS in various projects and aspects for more than 25 years, and the collaboration continues to grow and develop with new projects and generations of young students.

Walter Mooney with his team of visiting scientists at Menlo Park. Dr. Mooney regularly hosts groups of 2-6 visiting students and scientists, many from China, for collaborative projects with the CGT and other groups.

Tim Kusky working with George Plafker at the USGS on map compilation and structural analysis of mapping they completed together in the Bering Glacier Quadrangle, Alaska (field setting, below, George for scale).

Teaching Global Tectonics at University of Chinese Academy of Sciences

In addition to teaching two courses in tectonic at CUG Wuhan, T. Kusky and L. Wang annually offer a course on global tectonics to students who travel from various CAS institutes around China, to the campus north of Beijing in June, for the 2 week intensive course.

Members Honors, Awards

Associate professor **Kai Cao** was elected to “the reserve high-level young talent of Department of Earth Sciences” and “the young talent of China University of Geoscience” in 2016.

Tim Kusky was received by Wang Xiadong, Governor of Hubei Province, and awarded the "Chime Bell Award "in appreciation of outstanding contributions to the economic and social development of Hubei Province"

On the occasion of the 67th Anniversary of the Founding of the People's Republic of China, Mr. Wang Xiaodong, Governor of Hubei Province, requests the honor of your presence at the reception to be held in the Multi–Functional Hall of the Hubei Provincial Government Building (2nd Floor) at 18:00 on September 29th (Thursday), 2016.

Sincerely,

Wang Xiaodong
Governor of Hubei

(Dress Code: Formal)

R. S. V. P.

Tim Kusky was received by Chinese Premier Li Keqiang, Premier of the State Council, People's Republic of China for a symposium on the problems and risks of China's current economic and social development, and trends in future development, plus a dinner banquet hosted by the premier.

值此新春佳节来临之际，我谨代表中国政府，向您及家人表示诚挚的节日问候！对您为中国经济社会发展所做出的贡献表示衷心感谢！诚邀您于二〇一七年一月二十日下午五时在人民大会堂座谈并共进晚餐。

敬 请

光 临

中华人民共和国
国务院总理　李克强

On the occasion of the upcoming Chinese Spring Festival, I wish to extend, on behalf of the Chinese government, sincere greetings to you and your family and heartfelt gratitude to you for your contribution to China's economic and social development. I hereby request the pleasure of your company at a symposium and dinner at 5 p.m. on 20 January 2017 in the Great Hall of the People.

Li Keqiang
Premier of the State Council
The People's Republic of China

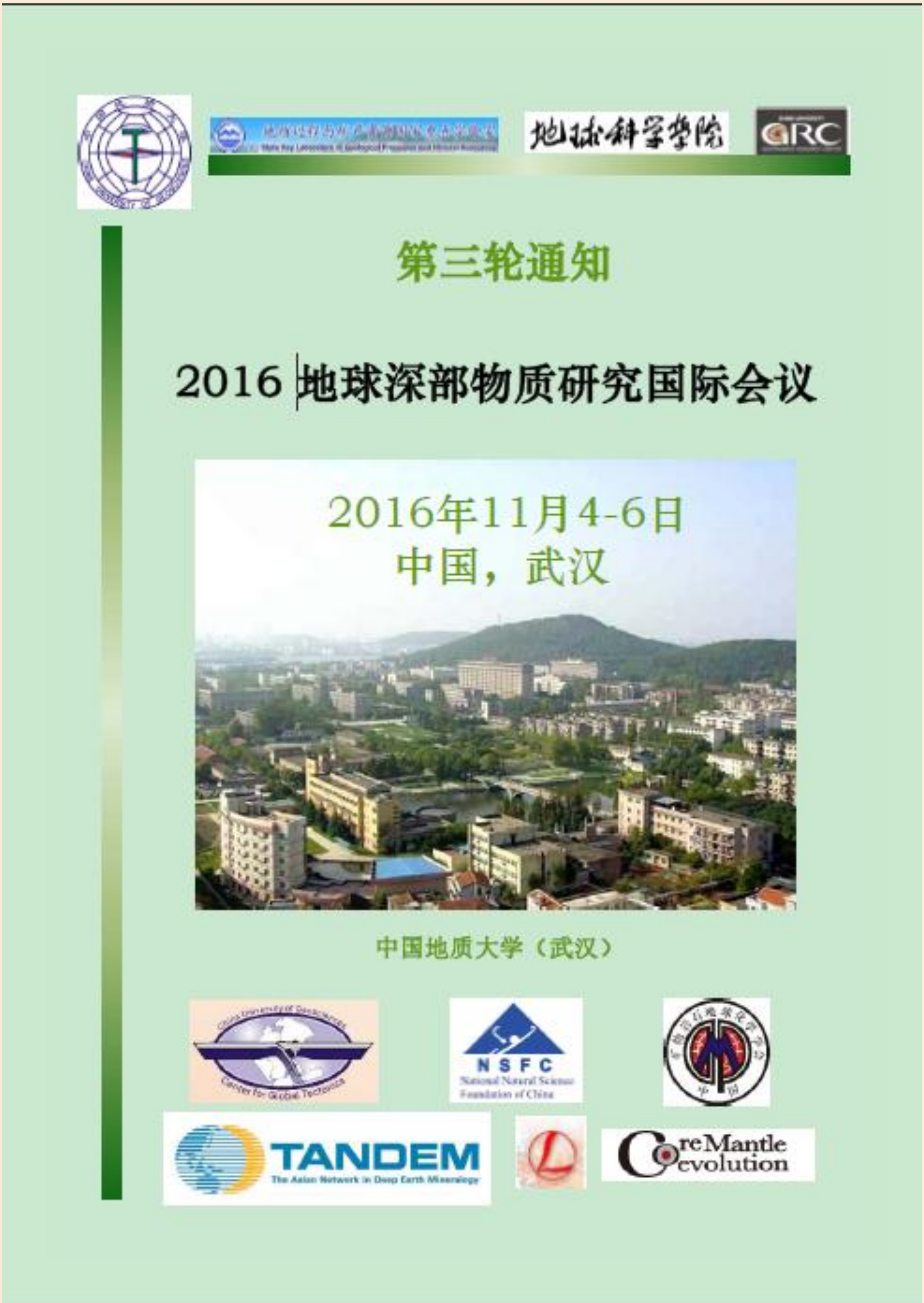
Four: Plan or advance in key projects and/or scientific achievements application

As a response to the “The Belt and Road Initiative” strategy of China, our center plans to enhance our cooperation and communication in geosciences with scientists from west Asia. Professor Timothy Kusky has made an international cooperation agreement with two universities in Turkey (Cukurova University and Middle East Technical University) for exchange of faculty and students between the universities, and for joint research. The program is currently funded by the Erasmus+ program of the European Commission. We, are applying for one international collaboration project to study the evolution of the Tethys Orogenic Belt and the forces controlling tectonic escape in zones of continental collision

We have forged another international exchange agreement with Oregon State University, for the mutual exchange of students and teaching between our campuses.

International meeting organization

Center for Global Tectonics held the **“2016 International Conference on Earth’s Deep Interior”** with the Chinese Society of Mineralogy, Petrology and Geochemistry in New Beacon Hotel, Wuhan, at 4-6th Nov., 2016. More than 140 registrants attended this meeting, including many world famous scholars (such as Eiji Ohtani., Takashi Yoshino, Brandon Rhymer, Eiichi Takahashi, Toshihiro Suzuki, Richard Wirth and many others) who delivered oral reports.



第三轮通知

2016 地球深部物质研究国际会议

2016年11月4-6日
中国，武汉

中国地质大学（武汉）

Co-host Seventh International Dyke Conference (Beijing, 2016.8.18-20)

10. Oceanic Dike Complexes: Sea Floor Spreading, Oceanic Plateaus, or Juvenile Arcs?

Scope: This session will focus on the characteristics of sheeted dike complexes preserved (and not present) in different ophiolites, and discuss the relative balance between rates of extension and magma supply at sea-floor spreading centers. Comparison with dike complexes from oceanic plateaus and juvenile arcs, and ways to discriminate them from those formed at oceanic spreading centers will be discussed.

Conveners: **Tim KUSKY & Paul ROBINSON**

Keynote address: **Tim KUSKY and Paul ROBINSON**

The CGT team organized two theme sessions at the 35th International Geological Congress meeting Aug 27-Sept 4, 2016, in Cape Town South Africa

Kusky, T.M., C. Sengor, and A. Faghih (Theme Session Organizers), 2016, Tectonics of Tethys with an emphasis on the geology of Turkey and Iran, and comparison with other Tethyan domains, 35th International Geological Congress, Cape Town, South Africa, Aug. 27-Sept 4, 2016.

Kusky, T.M., and Z.Q. Chen (Theme Session Organizers), 2016, Tethys birth to demise: Stratigraphy, Paleogeography ad Tectonic Evolution, 35th International Geological Congress, Cape Town, South Africa, Aug. 27-Sept 4, 2016.

Literatures, reports or posters on international/domestic meeting

Our center members have delivered more than 28 oral reports or posters at international and domestic meetings this year, including the AGU meeting, CGU meeting, Seventh International Dyke Conference, The International Workshop of Ar-Ar & Fission-track Dating: Tectonic-Petroleum Geochronology, 2016 international conference on the Earth's deep interior, the 2nd ICP-649 workshop, etc.

Some photos are shown below.

NengSong Chen, Seventh International Dyke Conference, Line B field trip, HongMen dyke near Mount. Tai

Dewei Li (the 4th from right), executive chairman and keynote review report, Xiangshan science conference, the 555th "Integrated innovation of deep geothermal energy system theory and system engineering" academic seminar, Beijing, 2016.4.7-8. This meeting was reported as front page on the Science and Technology Daily and China Science Daily.

Yajun Xu, Annual Meeting of Chinese Geoscience Union, 2016

An Wang (second from right), CGU, 2016

Foreign experts visiting to center

Many foreign/domestic visiting researchers came to our center for potential cooperation and academic communication, including the following reports done by some foreign professors.

Visiting Lecture Series

1. Geomorphic insights into the patterns and processes of active deformation in Tibet **Professor Eric Kirby.** University of Oregon Main building 412 2016.07.29

2. Mountain Building Processes in Continental Interiors:Lessons from the Gobl Corridor **Professor Dickson Cunningham.** Eastern Connecticut State University Main building 412 2016.07.07
3. Late Cenozoic Structural Evolution of the North Tibetan Foreland **Professor Dickson Cunningham.** Eastern Connecticut State University Main building 412 2016.07.08

4. Permian-Racent Tectonism in the Beishan and Northern China/Southern Mongolia Borderlands **Professor Dickson Cunningham.** Eastern Connecticut State University Main building 412 2016.07.09
5. Precambrian geodynamics: Geological evidence for changes in subduction style and the development of global plate tectonics **Professor Michael Brown,** University of Maryland Main building 412

6. Nucleation of Ductile Shear Zones, **Professor Giorgio Pennacchioni,** Universita' degli Studi di Padova

Professor Cao Shuyen and students hosting Prof. Giorgio Pennacchioni from Italy to study deformation of granitoids and strike slip faulting in southern China.

New Publications (2016) Listing CGT as Primary or Subsidiary Affiliation

Direction 1:

1. T.M. Kusky*, A. Polat, B.F.Windley, K. C. Burke, J.F.Dewey, W. S. F. Kidd, S. Maruyama, J. P. Wang. Insights into the Tectonic Evolution of the North China Craton Through Comparative Tectonic Analysis: A Record of Outward Growth of Precambrian Continents. Earth-Science Reviews, 2016. 162:387-432.(T1)

2. Wang, Zhensheng，Kusky, Timothy M.*，Capitanio, Fabio A. Lithosphere thinning induced by slab penetration into a hydrous mantle transition zone. Geophysical Research Letters, 2016. doi:10.1002/2016GL071186. (T1)

3. Junpeng Wang, Timothy Kusky*, Lu Wang, Ali Polat, Songjie Wang, Hao Deng, Jianmin Fu, Dong Fu. Petrogenesis and geochemistry of circa 2.5 Ga granitoids in the Zanhuang Massif: Implications for magmatic source and Neoarchean metamorphism of the North China Craton. Lithos, 2016. doi:10.1016/j.lithos.2016.10.028.(T2)

4. Hao Deng, Timothy Kusky*, Ali Polat, Chen Wang, Lu Wang, Yunxiu Li, Junpeng Wang. A 2.5 Ga fore-arc subduction-accretion complex in the Dengfeng Granite-Greenstone Belt, Southern North China Craton. Precambrian Research, 2016. 275:241-264.(T2)

5. Junpeng Wang, Timothy Kusky*, Lu Wang, Ali Polat, Hao Deng, Chen Wang, Songjie Wang. Structural relationships along a Neoarchean arc‐continent collision zone, North China craton. Geological Society of America Bulletin, 2016. 128:1-17.(T1)

6. Zhensheng Wang，Timothy M. Kusky*，Jianmin Fu，Yuefeng Yuan，Peimin Zhu. Review of Lithospheric Destruction in the North China, North Atlantic, and Tanzanian Cratons. The Journal of Geology, 2016.(T2)

7. Deng Hao, Timothy Kusky*, Peng Songbai, Wang Lu, Jiang Xingfu, Wang Junpeng. A Sheeted Dike Complex in the Protrozoic Miaowan Ophiolite Complex on the Northern Yangtze Craton: Recording Seafloor Spreading. Acta Geologica Sinica (English Edition),2016. 90:201(T4)

8. Wang Junpeng, Timothy Kusky* ,Wang Lu, Ali Polat, Deng Hao,Wang Chen, Wang Songjie. Structural Relationships along a Neoarchean Arc-Continent Collision Zone, North China Craton. Acta Geologica Sinica (English Edition), 2016. 90:242-243.(T4)

9. Youjun Zhang, Timothy Kusky*, Lu Wang, Jianwei Li, Peng Feng, Yang Huang &Roy Giddens.

Occurrence of gold in hydrothermal pyrite,western Taupo Volcanic Zone, New Zealand. Geodinamica Acta,2016. 28:185-198.(T4)

10. Deng Hao, Wang Junpeng, Timothy Kusky*, Wang Lu, Ali Polat. A Neoarchean Subduction Polarity Reversal Event in the North China Craton: Evidence from 2.5 Ga Mafic Dikes and Coeval Granites. Acta Geologica Sinica (English Edition),2016. 90:200.(T4)

11. Yan Zhan , Guiting Hou *, Timothy Kusky , Patricia M. Gregg. Stress development in heterogenetic lithosphere: Insights into earthquake processes in the New Madrid Seismic Zone. Tectonophysics,2016. 671:56-62.(T2)

12. Xingfu Jiang, Songbai Peng*, Ali Polat, Timothy Kusky, Lu Wang, Tuoyu Wu,Musen Lin , Qingsen Han. Geochemistry and geochronology of mylonitic metasedimentary rocks associated with the Proterozoic Miaowan Ophiolite Complex, Yangtze craton, China: Implications. Precambrian Research,2016. 279:37-56.(T2)

13. Dong Fu, Bo Huang, Songbai Peng*, Timothy M. Kusky, Wenxiao Zhou, Mengchun Ge. Geochronology and geochemistry of late Carboniferous volcanic rocks from northern Inner Mongolia, North China: Petrogenesis and tectonic implications. Gondwana Research,2016. 36:545-560.(T2)

14. Tuoyu Wu, Ali Polat*,Robert Frei, Brian J. Fryer, Kun-Guang Yang, Timothy Kusky. Geochemistry, Nd, Pb and Sr Isotope Systematics, and U-Pb Zircon Ages of the Neoarchean Bad Vermilion Lake Greenstone Belt and Spatially Associated Granitic rocks, Western Superior Province, Canada. Precambrian Research,2016. 282:21-51.(T2)

15. Peng Peng*,Richard E. Ernst,Guiting Hou,Ulf Söderlund,Shuanhong Zhang,Michael Hamilton,Yigang Xu,Steven Denyszyn,Daniel Mège,Sergei Pisarevsky,Rajesh Srivastava. Dyke swarms: keys to paleogeographic reconstructions. Science Bulletin,2016. 61:1669-1671.(T3)

16. Ali Polat*, Thomas Kokfelt, Kevin C. Burke, Timothy Kusky, Dwight Bradley, Annika Dziggel, Jochen Kolb. Lithological, structural, and geochemical characteristics of the Mesoarchean Tartoq greenstone belt, South-West Greenland, and the Chugach-Prince William accretionary complex, southern Alaska: Evidence for uniformitarian plate-tectonic processes. Canadian Journal of Earth Sciences,2016.(T4)

17. Han Qingsen, Peng Songbai*, Ali Polat, Timothy Kusky. A Paleoproterozoic (Orosirian) Ophiolitic Mélange, North Yangzte Craton. Acta Geologica Sinica (English Edition),2016. 90:215-216.(T4)

18. Lu Wang, Heng Wang, Chuan He, Nengsong Chen*, M. Santosh, Min Sun, Qinyan Wang, Lanlan Jin, Fanxi Liao. Mesoproterozoic continental breakup in NW China: Evidence from gray

gneisses from the North Wulan terrane. Precambrian Research 281, 521-536.（T2）

19. Hassan Abdelslam Mustafa, Qinyan Wang, Nengsong Chen*, Fanxi Liao, Min Sun and Meshaal Abdelgadir Salih. 2016. Geochemistry of Metamafic Dykes from the Quanji Massif: Petrogenesis and Further Evidence for Oceanic Subduction, Late Paleoproterozoic, NW China. Journal of Earth Sciences 27(4), 529 -544.（T4）

20. Deng Hao, Peng Songbai*, Ali Polat, Timothy Kusky, Jiang Xingfu, Han Qingsen, Wang Lu, Huang Yang, Wang Junpeng, Zeng Wen, Hu Zhengxiang. 2016. Neoproterozoic IAT Intrusion into Mesoproterozoic MOR Miaowan Ophiolite, Yangtze Craton: Evidence for evolving tectonic settings. Precambrian Research. http://dx.doi.org/10.1016/j.precamres.2016.12.003. (T2). (Online).

21. Lin Musen, Peng Songbai*, Jiang Xingfu, Ali Polat, Timothy Kusky, Wang Qing, Deng Hao. 2016. Geochemistry, petrogenesis and tectonic setting of Neoproterozoic mafic–ultramafic rocks from the western Jiangnan orogen, South China. Gondwana Research, 35: 338-356. http://dx.doi.org/10.1016/j.gr.2015.05.015. (T2)

22. Jiang Xingfu, Peng Songbai*, Ali Polat, Timothy Kusky, Wang Lu, Wu Tuoyu, Lin Musen, Han Qingsen. 2016. Geochemistry and geochronology of mylonitic metasedimentary rocks associated with the Proterozoic Miaowan Ophiolite Complex, Yangtze craton, China: Implications for geodynamic events. Precambrian Research, 279: 37-56. http://dx.doi.org/10.1016/j.precamres.2016.04.004. (T2)

23. 彭松柏*，刘松峰，林木森，吴长峰，韩庆森. 2016. 华夏早古生代板块俯冲作用(I): 来自岑溪地区糯垌蛇绿岩的新证据. 地球科学，41（5）:765-778;

24. 彭松柏*，刘松峰，林木森，吴长峰，韩庆森. 2016. 华夏早古生代板块俯冲作用(II): 来自岑溪地区大爽高镁-镁质玄武岩-安山岩的新证据. 地球科学，41（6）:931-947;

25. 张明正，彭松柏*，张利，方家松，张先进，韩庆森. 2016. 秭归地区震旦系陡山沱组碳酸盐岩结核成因新认识及其地质意义. 地球科学，41（12）:1977-1994;

Direction 2:

1. Wang Songjie, Wang Lu*, Brown Michael, Feng Peng. Multi-stage barite crystallization in partially melted UHP eclogite from the Sulu belt, China. American Mineralogist, Volume 101, pages 564–579, 2016（T2）

2. Wang Yongfeng*, Ren Huaping, Jin Zhenmin, 2016. Water and fabric in an ophiolitic peridotite from a supra-subduction zone. Contributions to Mineralogy and Petrology 171: 22. doi:10.1007/s00410-016-1234-z.（T2）

3. 任华萍，王永锋*，向树元，宋鹏飞，2016. 西藏马攸木地区雅江南带方辉橄榄岩的显微构造特征及其矿物结构水的初步研究. 岩石学报 32（6）：1653-1662.

4. 徐海军，张超，武云，陶明. 2016. 文象花岗岩的成分、结构和成因机制. 地球科学，41(9): 1511-1525.

5. Xu, H.J., Wu, Y. 2016. Oriented inclusions of pyroxene, amphibole and rutile in garnet from the Lüliangshan garnet peridotite massif, North Qaidam UHPM belt, NW China: an electron backscatter diffraction study. Journal of Metamorphic Geology. Doi: 10.1111/jmg.12208（T2）

6. 徐海军，赵素涛，武云. 2016. 单斜辉石中石英出溶体的显微结构和成因机制. 地球科学，41(6): 948-970.

7. 陶明，徐海军. 2016. 玛瑙的结构、水含量和成因机制. 岩石矿物学杂志, 35(2): 333-343.

8. 赵珊茸，徐畅，徐海军，张保民 & 刘惠芳，2016. 海南文昌二辉橄榄岩中辉石出溶结构的结晶学取向分析. 岩石学报, 32(06): 1644-1652.

9. Li, Z., Li, J., Cooke, D. R., Danyushevsky, L., Zhang, L., O Brien, H., Lahaye, Y., Zhang, W. & Xu, H., 2016. Textures, trace elements, and Pb isotopes of sulfides from the Haopinggou vein deposit, southern North China Craton: implications for discrete Au and Ag–Pb–Zn mineralization. Contributions to Mineralogy and Petrology, 171(12). DOI 10.1007/s00410-016-1309-x（T2）

10. Xia, Q., Wang, H., Zhou, L., Gao, X., Zheng, Y., Van Orman, J. A., Xu, H. & Hu, Z., 2016. Growth of metamorphic and peritectic garnets in ultrahigh-pressure metagranite during continental subduction and exhumation in the Dabie orogen. Lithos, 266-267, 158-181. （T2）

11. Xu, H.J.*, Zhang, J.F., Wang, Y.F., Liu, W.L., 2016. Late Triassic alkaline complex in the Sulu UHP terrane: Implications for post-collisional magmatism and subsequent fractional crystallization. Gondwana Research, 35, 390-410. （T2）

Direction 3:

1. Shen, T. Y., Wang G. C., Leloup P. H., van der Beek P., Bernet M., Cao K., Wang A., Liu C., Zhang K. X., 2016. Controls on Cenozoic exhumation of the Tethyan Himalaya, from fission-track thermochronology and detrital zircon U-Pb geochronology in the Gyirong basin area, southern Tibet. Tectonics, 35, doi: 10.1002/2016TC004149. (T2)

2. 李德威.地球三级层流隆陷构造系统的关联机理. 大地构造与成矿学，2016， 40（4）：625－642.

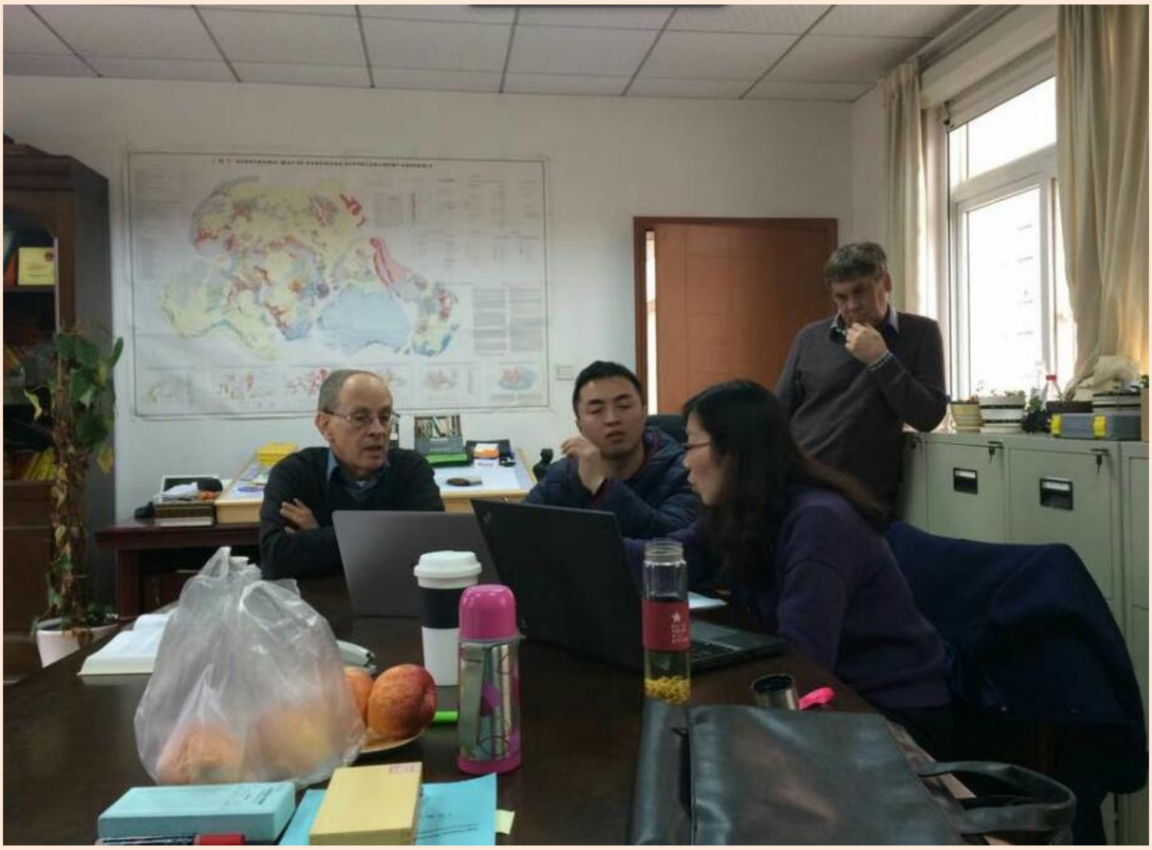
3. An Wang, Kyoungwon Min, Guocan Wang. 2016. Quaternary channel-focused rapid incision in

the Phung Chu-Arun River in Central Himalaya: Implications for a Quaternary capture event. Journal of Asian Earth Sciences. 129: 243–253（T4）

Tim Kusky
Menlo Park, CA
Feb. 22, 2017

Parting Shots.....(some fun photos of our group and colleagues in action together)

Mike Brown, trying to convince students and Kusky for the past presence of supercritical fluids.



Contemplating next years research on nano-scale mineral inclusions with Richard Wirth, GFZ, Boom, Lu Wang, and Kusky.

The "crew" in Troodos, Cyprus.

Teaching Global tectonics to the new generation at CUG. Waiting for the results in the future…