INTERNATIONAL LITHOSPHERE PROGRAM

Activity Report 2025 – Task Forces / Coordination Committees

Project Title: Formation, character, history, and behavior of Earth's oldest lithospheres (2023-2027)

Project No.: 2023-TF1

PI(s): Chair: T. M. Kusky, China and T. M. Harrison, USA;

1. Highlights of recent ILP Task Force work/results

ILP Task Force 2023-TF-1 progressed smoothly in 2025. This year we published more than twenty SCI papers. Among these publications, five papers have acknowledged the ILP project support, including journals such as *Geology, EPSL,* and *JGR: Solid Earth*. Throughout the year, our group participated in ten academic conferences and project kick-off meetings, and Timothy Kusky delivered invited keynote and oral presentations at five domestic and international conferences including EGU2025-Vienna and CGU2025-Chengdu. Also in August 2025, our taskforce conducted a one-month field survey in the Pilbara Craton of Australia, and visited domestic and international academic institutions including the University of Western Australia, Institute of Geology and Geophysics Chinese Academy of Sciences, Guiyang Institute of Geochemistry, and China University of Geosciences (Beijing) for scientific research cooperation and exchange. Several important outcomes supported by this project are summarized as follows:

1) *Archean Tectonics*: Our recent work resolves the Neoarchean tectonic paradox in North China Craton by showing dome-and-basin structures formed through fold interference and magmatic pluton emplacement during modern-style plate convergence at ~2.5 Ga. Instead of stagnant-lid sagduction, they originated from polyphase deformation including arc collisions (2.7-2.55 Ga) and later continental collision with extrusion-related processes. This work was published in *Geology* (***Wang, L***., Wang, R.Z., Ning, W.B., ***Kusky, T***. 2025. *Geology*. https://doi.org/10.1130/G53210.1).

2) Archean Orogens: Our group reported a dramatic inverted metamorphic gradient across an Archean suture zone within the Zanhuang massif of the North China Craton. This inverted metamorphic gradient was documented to be formed during emplacement of thrust sheets during an Archean arc/continent collision, accommodating horizontal transport of at least hundreds of kilometers at 2.5 Ga. This finding highlights similar convergence rates and thermal structure of orogens between Archean and modern examples. This study was published in *Earth and Planetary Science Letters* (Zhong, Y.T., Stuwe, K., ***Kusky, T.M.*,*** et al. 2025. *Earth and Planetary Science Letters* 651: 119121. https://doi.org/10.1016/j.epsl.2024.119121)

3) Academic service: Our sub-group leader Prof. Lu Wang will serve as the editor-in-chief of *GSA Bulletin* in 2026, and group member Prof. Hao Deng will serve as the associate editor of *GSA Bulletin* to support the development of the journal.

2. Presence at international meetings/workshops (this year)

1) ***Kusky, T.M***., and ***Harrison, T***., 2025, Progress of the IUGS- International Lithosphere Program Task Force 2023-1 on early Earth Lithospheres, China Geological Union, Oct. 18-20, 2025, Chengdu, China.
2) ***Kusky, T.M.***, 2025, Can machine learning/big data help address the long-tailed data problem for interpreting early Earth tectonics and habitability? Invited Keynote Plenary talk at Mathematical modeling of Earth system Processes, The 202nd Science and Technology Frontier Forum, Oct 13-14, 2025, Zuhai, China.
3) ***Harrison, T.M.***, Bell, E., ***Kusky, T***. ***Wang, L***., Ning, W.B., Gordilho-Barbosa, R., 2025, Exploring Hadean zircons from Brazil and China, AGU Annual Meeting, Abstract # 1876479.
4) ***Kusky, T.M.***, 2025, The Mesoarchean Mulgandinnah shear zone, Pilbara craton: the world's oldest arc-slicing transform fault, Workshop on Tectonics in the Early Solar System, Earth Life Science Institute, June 4, 2025, Tokyo.
5) ***Kusky, T.M***., 2025, The Mesoarchean Mulgandinnah shear zone, Pilbara craton: the world's oldest arc-slicing transform fault, EGU General Assembly 2025, Session GMPV 4.4, April 28-May 1, Vienna, Austria.

3. Important publications of ILP Task Force members (max. five)

The following papers was authored by our ILP Task Force members and acknowledge support by this project:

1) **Wang, L.**, Wang, R.Z., Ning, W.B., ***Kusky, T***. 2025. North China Archean dome-and-basin structures; arc plutons, superimposed folds, or sagduction?. *Geology*. https://doi.org/10.1130/G53210.1
2) Zhong, Y. T., Stuwe, K., ***Kusky, T.****, Hauzenberger, C.A., Schorn, S., Wang, L. 2025. Inverted metamorphic gradient in the Zanhuang nappe/thrust system, north China indicates large-scale thrust stacking in an Archean Orogen. *Earth and Planetary Science Letters* 651: 119121. https://doi.org/10.1130/G49599.1.
3) Huang, B., ***Kusky, T.***, Fu, D. 2025. Neoarchean accretionary and collisional tectonics in the southern North China Craton: Implications for crustal growth and plate tectonic styles. *Precambrian Research* 420: 107730. https://doi.org/10.1016/j.precamres.2025.107730
4) **Wang, L.**, Lin, J.S., Ning, W.B., Polat, A., Gong, S.L., ***Kusky, T.*** 2025. Petrotectonics of chromite in Archean anorthosite-bearing layered intrusions: Implications for Archean tectonics. *GSA Bulletin*. https://doi.org/10.1130/B37309.1
5) Zhang, Z.J., ***Kusky, T.***, Chen, G.X., Cheng, Q.M. 2025. Earth's deep-time geodynamic evolution recorded by hafnium isotope perturbations. Journal of Geophysical Research: Solid Earth, 130, e2025JB031150. https://doi.org/10.1029/2025JB031150

4. New contacts (this year)

Sierd Cloetingh, Utrecth University
Bilel Haq, Sorbonne University, France, and George Mason University, USA
Lachlan Grose, Monash University, Australia

5. Usage of ILP funding (this year)

Supported by the ILP 2023-TF1, Timothy Kusky's group organized the "Archean Tectonic Styles: Constraints and Inferences" academic symposium in May 2025, which brought together over 150 experts from more than 40 institutions and universities, including the Chinese Academy of Sciences, Peking University, and Nanjing University, as well as academicians such as Zheng Yongfei, Zhai Mingguo, Zhao Guochun, Xiao Wenjiao, and Cheng Qiuming, fostering in-depth discussions on this international frontier topic. The workshop featured 33 oral presentations and 27 poster presentations. Additionally, in August

2025, the group conducted a month-long field survey in the Pilbara Craton of Australia, collecting a significant number of Archean rock and structural samples, greatly advancing the project's scientific objectives.

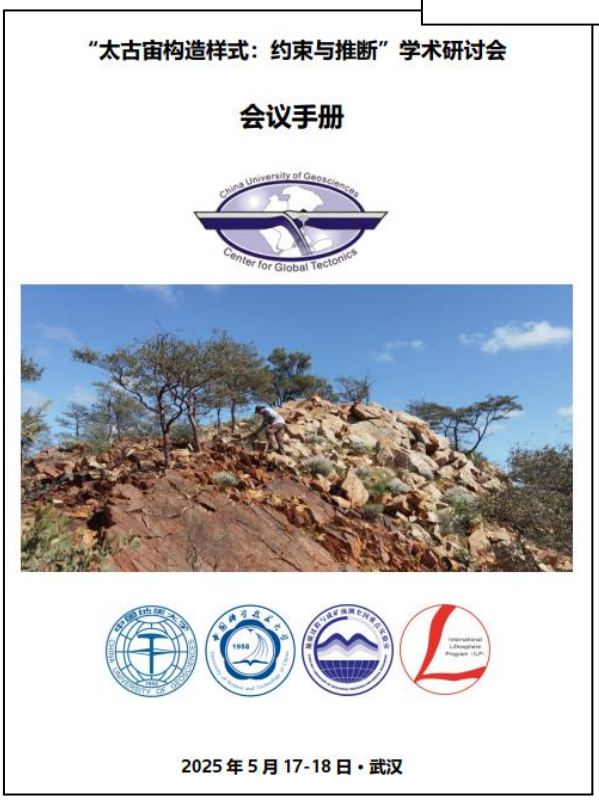
Furthermore, our program has funded the publication of 5 SCI papers in top geological journals such as *Geology, EPSL*, and *JGR: Solid Earth*. Remaining funds will be carried over to 2026.

6. Activities planned for 2026

Our ILP Task Force are currently planning to have an ILP 2023-TF1 discussion group at the EGU2026 meeting in Vienna. We are also in the detailed planning stages of new field work in the Pilbara and Yilgarn cratons, together with Australian colleagues.

Appendixes:
Pictures of activities in 2025

2025 May 17-18, with the support of the ILP project, our team held an academic seminar in Wuhan



2025 May 17-18 Conference Handbook for Academic Seminar

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Tim Kusky led a team to conduct field research in Australia from July 29th to August 30th, 2025