Coevolution of Paleo-Tethys and Rheic: New tectonic constraints from Iran and Turkey

Yang Chu[1,2]*, Bo Wan[1], Ling Chen[1,2], Wei Lin[1,2], Mark B. Allen[3], Morteza Talebian[4], Ibrahim Uysal[5], Guangyao Xin[6]

[1] *Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China*
[2] *University of Chinese Academy of Sciences, Beijing, China*
[3] *Department of Earth Sciences, University of Durham, Durham, UK*
[4] *Institute for Earth Sciences, Geological Survey of Iran, Tehran, Iran*
[5] *Department of Geological Engineering, Karadeniz Technical University, 61080 Trabzon, Turkey*
[6] *School of Resources and Safety Engineering, Chongqing University, Chongqing, 400044, China*
* *chuyang@mail.iggcas.ac.cn*

In the Paleozoic, one large ocean once separated the Eurasia of the north and the Gondwana of the south, but it has two names, Paleo-Tethys and Rheic, suggesting different tectonic history. The Paleo-Tethys represent the ocean from east Asia to Middle East regions and vanished in Early Mesozoic, while the Rheic existed across the Europe and finally closed in Carboniferous. The two oceans coevolved for a long time, but the interaction and mutual effect at subduction and collision stages are not well understood. Initiation processes of ocean spreading, subduction and collision are crucial in plate tectonics, so resolving the timing for these turning points may greatly enhanced the precision and accuracy of reconstruction of the two oceans, especially for the western Paleo-Tethys.

In NE Iran, we find that all the Paleozoic clastic rocks record two major zircon U-Pb age groups peaked at ~800 Ma and ~600 Ma. Consistency in age patterns show a dominant provenance from Neoproterozoic basement of the north Gondwana and a long-lasting passive margin sedimentation after the spreading of the Paleo-Tethys. This environment was interrupted by initial collision between the Turan (Eurasia) and Central Iran (Gondwana) Blocks with massive coarse clastic deposition, i.e. the protolith of the Mashhad Phyllite, in a peripheral foreland basin on the Paleozoic passive margin. The Mashhad Phyllite yields a striking provenance change from passive margin to active margin. The Paleozoic ages reveal a long-lived subduction zone at the south Turan Block initiated since the latest Ordovician. More importantly, the provenance shift better constrains the initial collision timing with the maximum deposition age of the Mashhad Phyllite (~228 Ma) refining the evolution history of Paleo-Tethys.

Based on our new results and previous data, we compare the tectonic history of the Paleo-Tethys in its western segment with eastern Rheic, and further discuss the interaction between the Rheic and Paleo-Tethys. We find existence of a lateral subduction zone plays a crucial rule in initiating new subduction zone after an old oceanic plate vanishes and two continents collides, while a lateral collision can also result into shallowing of subducted slab and preservation of coeval compressional structures. These new insights help us to better interpret the emplacement of high-pressure metamorphic rocks during subduction and subduction zone jump when the Rheic and Paleo-Tethys coevolved.

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