

Early Paleozoic Ocean in the North Qaidam: Constraints from Kaipinggou Ophiolite



CHEN Danling*, ZHU Xiaohui, REN Yunfei and TUO Yu

State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an, 710069, China

Citation: Chen et al., 2020. Early Paleozoic Ocean in the North Qaidam: Constraints from Kaipinggou Ophiolite. Acta Geologica Sinica (English Edition), 94(supp. 1): 6. DOI: 10.1111/1755-6724.14428

Abstract: The North Qaidam orogenic belt (NQOB) lies at the northeast margin of Tibet Plateau, between the Qilian massif to the north and Qaidam massif to the south. It consists of predominantly gneisses and marbles with minor eclogite and garnet peridotite, and is known as an Early Paleozoic continental deep subduction ultrahigh pressure (UHP) metamorphic belt in northwest China. Recently some studies suggest that the NQOB experienced oceanic deep subduction prior to the continental deep subduction. However, the records of ocean events are rarely preserved because of the complex multi-stage transformation. Therefore, whether the Early Paleozoic ocean exists and the formation, nature and evolution of the Early Paleozoic ocean in North Qaidam are still in controversies.

In this contribution, we report a new discovered SSZ-type ophiolite suite in Kaipinggou area, the western segment of the NQOB. The ophiolite is mainly composed of peridotite, gabbro, basalt, boninite, andesitic porphyrite and plagiogranite. In which, the basalt and homogeneous gabbro are both enriched in LILE and depleted in HFSE, and display flat or LREE-depleted REE patterns, similar to the MORB-like geochemical characteristics of fore-arc basalts; the boninite exhibits characteristics of fore-arc boninites with high Si and Mg, but low Ti and Ca contents; the andesitic porphyrite is enriched in LILE but depleted in HFSE, similar to island arc magmatic rocks. Rock assemblage and their geochemical characteristics suggest that this SSZ-type ophiolite was formed in fore-arc setting of intra-oceanic arc. The plagiogranite is a low-potassium tholeiite metaluminous granite with low trace elements contents, slight enrichment of LREE, depletion of HREE and positive Eu anomaly; combining with $\varepsilon_{\text{HF}}(t)$ values (13.8–17.1) of zircons, the plagiogranite could be originated from partial melting of gabbros. LA-ICP-MS zircon U–Pb dating yielded the crystallization ages of 535 ± 2 Ma, 513 ± 3 Ma and 510 ± 3 Ma for two cumulate gabbros and one homogeneous gabbro, respectively, and a formation age of 492 ± 8 Ma for the plagiogranite.

All these data suggest the existence of an Early Paleozoic ocean in the North Qaidam, and the initial subduction of the oceanic slab occurred earlier than 535 Ma.

Key words: SSZ-type ophiolite suite, geochemistry, zircon U–Pb dating, the North Qaidam

Acknowledgements: This work is granted by National Natural Science Foundation of China (Grants 41802056, 41472053, 41430209, 41402051 and 41421002).

References

- Song, S., Niu, Y., Zhang, G., and Zhang, L., 2018. Two epochs of eclogite metamorphism link ‘cold’ oceanic subduction and ‘hot’ continental subduction, the North Qaidam UHP belt, NW China. Geological Society, London, Special Publications 474.
- Song, S.G., Zhang, L.F., Niu, Y.L., Su, L., Song, B., and Liu, D.Y., 2006. Evolution from oceanic subduction to continental collision: a case study from the northern Tibetan Plateau based on geochemical and geochronological data. *Journal of Petrology*, 47: 435–455.
- Yang, J.S., Song, S.G., Xu, Z.Q., Wu, C.L., Shi, R.D., Zhang, J.X., Li, H.B., Wang, Y.S., Liu, Y., Qiu, H.J., Liu, F.L., and Maruyama, S., 2001. Discovery of coesite in the North Qaidam Early Paleozoic ultrahigh pressure (UHP) metamorphic belt, NW China. *Acta Geologica Sinica*, 75(2): 175–179 (in Chinese with English abstract).
- Zhang, G., Song, S., Zhang, L., and Niu, Y., 2008. The subducted oceanic crust within continental-type UHP metamorphic belt in the North Qaidam, NW China: Evidence from petrology, geochemistry and geochronology. *Lithos*, 104: 99–118.
- Zhang, J.X., Mattinson, C.G., Yu, S.Y., Li, J.P., and Meng, F.C., 2010. U–Pb zircon geochronology of coesite-bearing eclogites from the southern Dulan area of the North Qaidam UHP terrane, northwestern China: spatially and temporally extensive UHP metamorphism during continental subduction. *Journal of Metamorphic Geology*, 28: 955–978.

About the first author

CHEN Danling, female, born in 1967 in Danfeng County, Shaanxi Province; doctor; professor of Department of Geology, Northwest University. She is now interested in the study on high-pressure/ultrahigh-pressure metamorphic geology. E-mail: dlchen@nwnu.edu.cn; phone: 029-88303257, 18992855271.

* Corresponding author. E-mail: dlchen@nwnu.edu.cn