Vol. 91 No. 3 pp. 1159–1160 ACTA GEOLOGICA SINICA (English Edition) June 2017

Research Advances

Tectonic Nature of the Northern Segment of the Jiao-Liao-Ji Belt: A Rift or Continental Collision Belt?

MENG En[1, *], WANG Chaoyang [1], LI Yanguang [2], CAI Jia [1], YANG Hong[1] and LI Zhuang[3]

1 *Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China*
2 *Xi'an Center of Geological Survey, China Geological Survey, Xi'an 710054, Shaanxi, China*
3 *School of Earth and Space Sciences, Peking University, Beijing 100871, China*

Objective

The tectonic characteristics and evolution of the Paleoproterozoic Jiao–Liao–Ji belt have been extensively studied in recent decades (Fig. 1a). Two main models have been proposed for the formation of this belt: a continental- or arc-continent collisional belt, and the opening and closure of an intra-continental rift. The main reasons for these ongoing debates are own to the complex composition, including metamorphosed volcano-sedimentary rocks, multiple pulses of granitic magmatism, meta-mafic intrusions, and tectono-metamorphic history. In addition, earlier work focused on the geochronology and metamorphic evolution, whereas the source properties, petrogenesis, and tectonic setting of the metamorphosed volcano-sedimentary sequence and meta-mafic intrusions are poorly understood.

Methods

Zircons were separated from representative samples. The internal structure of them was revealed by cathodoluminescence images. U-Pb dating and in situ Lu-Hf isotope analyses of rare earth elements in zircons were analyzed using LAMC-ICP-MS at the Laboratory Center, Xi'an Center of Geological Survey, Xi'an. Bulk rock major, trace, and rare earth element concentrations were obtained by X-ray fluorescence and inductively coupled plasma mass spectrometry (ICP-MS) at the National Research Center for Geoanalysis, CAGS, Beijing.

Results

The continuous support of the National Natural Science Foundation since 2013 has allowed us to conduct field surveys and petrological, geochronological, geochemical, and isotopic studies on the Paleoproterozoic metamorphosed volcano-sedimentary rocks of the South and North Liaohe, Ji'an, and Laoling groups, as well as meta-mafic rocks. The major progress is summarized as follows:

(1) The volcanic rocks of the lower part of the Ji'an group consists mainly of basaltic andesite, andesite, and dacite, along with minor basalt and rhyolite, which were erupted at ~2.18 Ga in an active continental margin setting, and metamorphosed at 1.91 and 1.85 Ga (Fig. 1b). Among them, the intermediate–basic rocks were derived by partial melting of a depleted lithospheric mantle that had been metasomatized by fluids or melts derived from a subducted slab, and the coeval acidic rocks were derived from the partial melting of juvenile crust and a small amount of ancient crustal material, possibly as old as the late Archean.

(2) The meta-mafic rocks of the central Liaodong Peninsula consist of amphibolite and metamorphosed gabbro and diabase, which were emplaced at ~2.15 Ga in a back-arc environment, and metamorphosed at 1.91 Ga (Fig. 1c). These rocks could be derived from a depleted mantle source, which had been metasomatized by subduction-derived fluids and underwent extremely minimal crustal contamination during magma evolution and ascent. Besides, Lu–Hf isotopic and previous geological data show two crustal growth events at 2.50 and 2.15 Ga.

(3) The early Precambrian basement in the Changhai area comprises granitic gneisses and metamorphosed sedimentary rocks, which records several episodes of Na–K-rich granitic magmatism (2543 and 2516 Ma), crustal growth (2.71–2.99 Ga), and crustal reworking (2.54–2.51 and 1.89 Ga), and suggests that multiple Meso- to Neoarchean magmatic events took place in the Liaonan Complex at ca. 2.84, 2.75, 2.67–2.61, 2.54, and 2.51 Ga and the region experienced two major juvenile crustal growth events at 2.71–2.99 Ga and 2.54–2.51 Ga, a local reworking at ca.2.51 Ga, and a major reworking event at ca. 1.90 Ga.

(4) The protolith of the meta-supracrustal rocks upper the Changhai basement rocks were deposited after 1.89 Ga and metamorphosed at 248 Ma (Figs. 1d–e), indicating that these rocks do not form part of the South Liaohe Group, and

* Corresponding author. E-mail: mengen0416@126.com

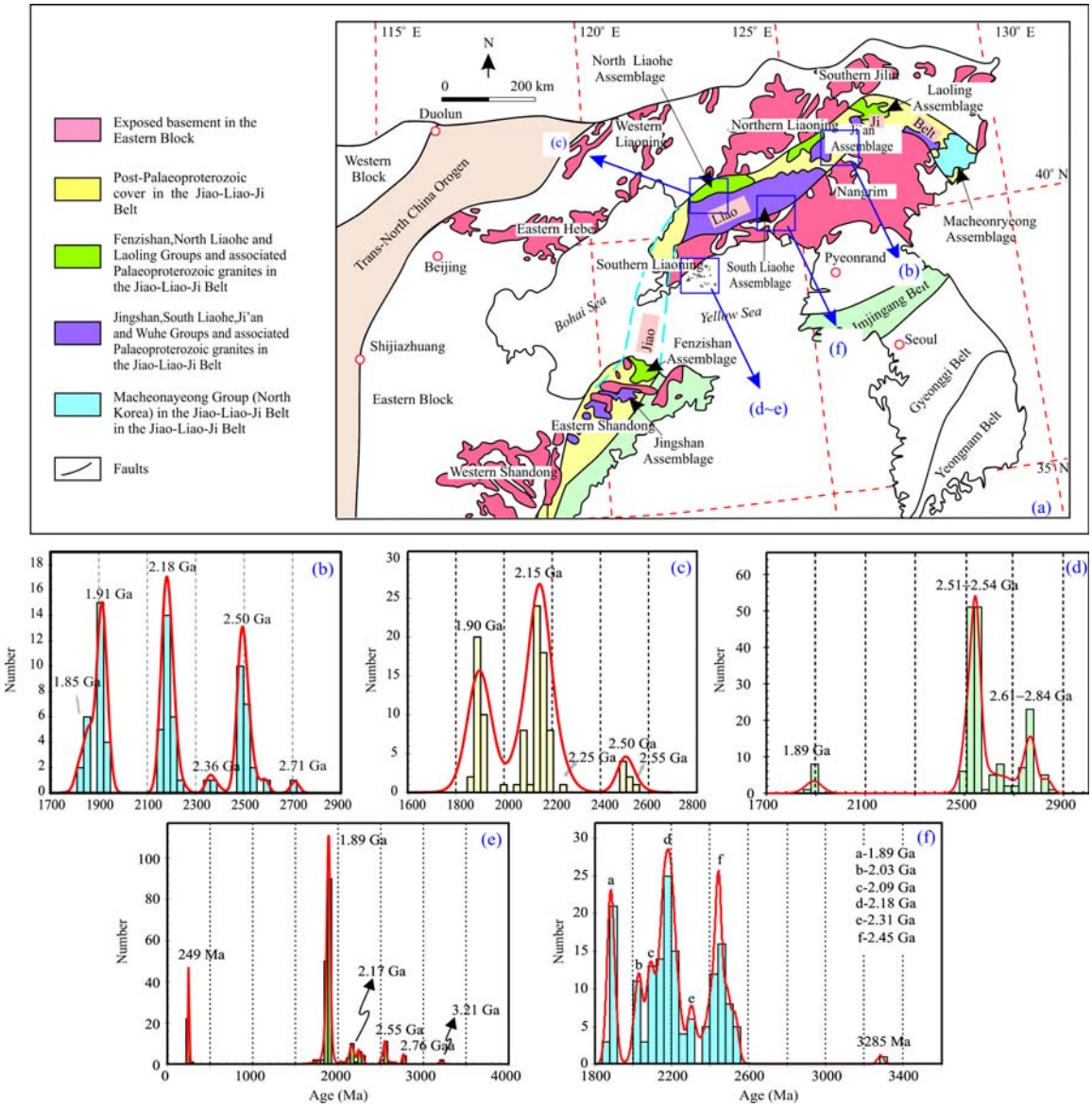

Fig. 1. Precambrian geological map showing the Eastern Block (a) and the age spectra for zircons (b–f) from the Paleoproterozoic rocks within the northern segment of the Jiao–Liao–Ji belt.

were likely derived from nearby basement granitoids and, to a lesser extent, Paleoproterozoic metamorphosed rocks in an active continental margin setting.

(5) The South Liaohe Group occurs throughout the Kuandian area. Our new data show that protolith of this group was likely deposited after 2035 Ma, with peak metamorphism at 1.90 Ga (Fig. 1f), and derived from Paleoproterozoic granites, coeval volcanic rocks, and Archean basement.

Conclusion

New geochemical, isotopic, and geochronological study together with regional geological data, suggests that, the Archean basement rocks of the Liaonan Block existed in the southeastern Liaoning Province. The evolution of the northern segment of the Jiao–Liao–Ji Belt could be related to arc-continental collision before the middle Paleoproterozoic. The Paleoproterozoic granites, metamorphic volcanic rocks and mafic intrusions within this belt could form in an arc-back basin setting, and the metasedimentary rocks be deposited later than 2.03 Ga. Besides, almost all these rocks were metamorphosed at ca. 1.90 and / or 1.85 Ga.

Acknowledgments

This research was supported by the National Science Foundation of China (grants No. 41572169 and 41202136), China Geological Survey (grant No. 12120114021601), and the Outlay Research Fund of the Institute of Geology, CAGS (grants No. J1507 and J1301).