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Research Advances

Neoproterozoic Banded Iron Formation in the Central Tianshan, NW China: The Shalong Example

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Objective

Banded Iron Formations (BIFs) are ferruginous chemical sedimentary rocks that precipitated throughout the Precambrain, which constitute the most important iron resources in the world. The majority of BIFs were developed in the Neoarchean and early Paleoproterozoic periods (3.2–1.8 Ga), which are well known and have been mined for centuries. Another type of the BIFs which was formed in the Neoproterozoic period (0.85–0.7 Ga) is much smaller in scale but widespread on the Earth and record important information of the evolution of the Earth. The Neoarchean and Paleoproterozoic BIFs have been well studied and understood, while few detailed studies on Neoproterozoic BIFs have been made, and only a few modern geochronology studies were carried out on Neoproterozoic BIFs.

Located in the Central Tianshan tectonic zone within the southern part of the Central Asian orogenic belt, the recently discovered Shalong iron deposit shows the typical BIF characteristics. The Shalong iron deposit has 14 Mt of iron reserves at iron ore grade of 25%–30%. The orebodies are stratiform and bedded, which occur as stratabound deposits in the host Precambrian metamorphic volcanic and sedimentary rocks. The metallic minerals are mainly magnetite, with minor amounts of hematite and ilmenite. The gangue minerals are dominated by quartz, amphibole and plagioclase. Typical textures of the ores are banded and bedded. In this study, we focused on the zircon U-Pb geochronology study of the Shalong iron deposit in an attempt to constrain the timing of this deposit.

Methods

Based on detailed field investigations, representative samples were collected for zircon U-Pb dating. Zircon grains were extracted using density and magnetic separation techniques. The zircons were mounted in an epoxy mount and polished down to half section. CL images are used to guide the U-Pb analysis. Zircon LA-ICP-MS U-Pb analyses were performed on an Agilent 7500 ICP-MS with a New Wave UP213 nm laser ablation sampler at the State Key Laboratory for Mineral Deposits Research, Nanjing University.

Results

The dating samples were collected from the interlayered metavolcanic (quartz mica schist) between two ore beds of the Shalong iron deposit. Zircon grains from the quartz mica schist are characterized by light brown, transparent to semi-transparent, euhedral and prismatic crystals. Zircon grains are generally 80–150 μm long with length/width ratios of 1:1–2:1, showing clear oscillatory zoning and with high Th/U ratios (>0.46), suggesting a typical igneous origin. Fourteen analyses from 14 zircon grains show uranium concentrations from 49 to 654 ppm, thorium from 32 to 1028 ppm, and high Th/U ratios (0.46 to 1.57).

These analyses are concordant and consistent and yield $^{206}Pb/^{238}U$ ages ranging from 739 to 783 Ma. Fourteen concordant analyses form a tight cluster on the concordia curve, and yield a weighted mean $^{206}Pb/^{238}U$ age of 760.4±6.7 Ma (MSWD= 0.86, Fig. 1), which is interpreted as the formation age of the protolith of the quartz mica schist. For the zircons were separated from the metavolcanic rocks interlayered with the orebodies and closely associated with the ores, it is believed that the age of the protolith of the studied rocks can constrains the age of the iron ore-forming event.

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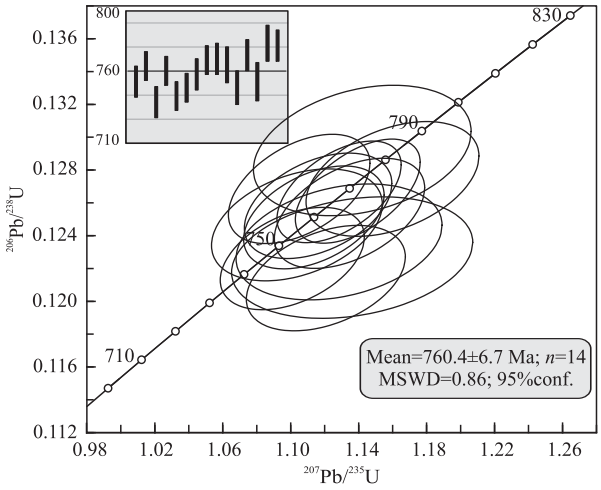

Fig. 1. U-Pb concordia diagram and weighted average $^{206}Pb/^{238}U$ age of zircon grains from the host rock of the Shalong iron deposit.

Conclusion

Based on our new LA-ICP-MS zircon U-Pb age constraints, we proposed that the Shalong iron deposit was formed in Neoproterozoic. Combined with the geological characteristics of BIFs of the Shalong iron deposit, this new finding suggested that the Shalong iron deposit was an example of Neoproterozoic BIFs. Therefore, a detailed study of the Shalong iron deposit will not only give important information on the origin of the worldwide Neoproterozoic BIF, but also provide critical implications on the tectonic evolution of the Central Tianshan tectonic zone as well as the Central Asian Orogenic Belt.

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