HF ISOTOPES, U-PB AGES AND TRACE ELEMENTS OF ZIRCONS IN INTERMEDIATE GRANULITE XENOLITHS FROM CENOZOIC HANNUOBA BASALTS: SIGNIFICANCE FOR PETROGENESIS AND NEOARCHEAN-PALEOPROTEROZOIC CRUST-MANTLE INTERACTION BENEATH THE NORTH CHINA CRATON

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Abstract

The Hannuoba basalts, erupted at 22-10 Ma through the Trans-North China Orogen in the central part of the North China Craton (NCC), contain abundant peridotitic and mafic xenoliths. Previous studies on the mafic xenoliths suggest that major thermal events occurred between 180-80 Ma. Here, we report in situ Hf isotopes, U-Pb ages and trace elements of zircons from an intermediate granulite.

The granulite has the assemblage of Opx + Cpx + Pl in pyroxene-rich (HNB4) and plagioclase-rich (HNB3) layers. The compositions of Pl and pyroxene in HNB4 are very similar to those in HNB3, and show similar temperatures (880-900 ^{o}C). Zircons in HNB4 and HNB3 have similar ratios of different morphology (both including euhedral, subhedral and irregular), and similar length/width (2.2-2.5). Backscattered electron images reveal the presence of distinct cores in 60% of grains in HNB4 and 55% in HNB3. All zircons but two from HNB4 yield $^{207}Pb/^{206}Pb$ ages of 1877±19 Ma. HNB4-114, a grain with subhedral morphology, has an oscillatorily-zoned core (3097±17 Ma) and an unzoned rim (2824±17 Ma); HNB4-127, a grain with irregular morphology, has a euhedral core (2447±18 Ma) and an unzoned rim (1885±20 Ma). Similarly, all zircons except one from HNB3 have uniform $^{207}Pb/^{206}Pb$ ages (1832±20 Ma). HNB3-137, a euhedral zircon with uniform internal structure, gives a $^{207}Pb/^{206}Pb$ age of 2489±17 Ma. Most zircons from the granulite have around zero ∑Hf and 2.18-2.36 Ga TDM (Hf model age). The core of HNB-114 has TDM =2.63 Ga and ∑Hf up to +18.3. HNB3-137, with a 2489 Ma $^{207}Pb/^{206}Pb$ age, has ∑Hf =+5.70 and TDM =2.59 Ga. HNB3-132 and HNB3-134, two newly grown zircons with $^{207}Pb/^{206}Pb$ ages of 1885 Ma and 1964 Ma respectively, have ∑Hf of +9.2 ~ +10.2 and TDM =1.93-1.96 Ga.

The presence of Archean zircons with positive ∑Hf values suggests that the original source materials of the intermediate xenolith were extracted from the depleted mantle ca 2500 Ma ago, and were remelted during major thermal events associated with the 1.9 Ga collision and assembly between the Eastern and Western blocks at early Proterozoic, which resulted in the amalgamation of the NCC. Trace-element patterns of the zircons are similar to those of acidic granites, based on the classification tree of Belousova et al. (2002). This association may suggest that the lower crust represented by the xenolith experienced the later extraction of granitic melt and is itself the residue of partial melting, but further evidence is required.