Geophysical Research Abstracts
Vol. 16, EGU2014-6697, 2014
EGU General Assembly 2014

Accretionary history of the Altai-Mongolian terrane: perspectives from granitic zircon U-Pb and Hf-isotope data

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The Central Asian Orogenic Belt (CAOB) consists of many tectonic terranes with distinct origin and complicated evolutionary history. Understanding of individual block is crucial to reconstruct the geodynamic history of the gigantic accetionary collage. This study presents zircon U-Pb ages and Hf isotopes for the granitoid rocks in the Russian Altai mountain range (including Gorny Altai, Altai-Mongolian terrane and CTUS suture zone between them), in order to clarify the timing of granitic magmatism, source nature, continental crustal growth and tectonic evolution.

Our dating results suggest that granitic magmatism of the Russian Altai mountain range occurred in three major episodes including 445∼429 Ma, 410∼360 Ma and ∼241 Ma. Most of the zircons within the Paleozoic granitoids present comparable positive εHf(t) values and Neoproterozoic crustal model ages, which favor the interpretation that the juvenile crustal materials produced in the early stage of CAOB were probably dominant sources for the Paleozoic magmatism in the region. The inference is also supported by widespread occurrence of short-lived juvenile materials including ophiolites, seamount relics and arc assemblages in the north CAOB. Consequently, the Paleozoic massive granitic rocks maybe not represent continental crustal growth at the time when they were emplaced, but rather record reworking of relatively juvenile Proterozoic crustal rocks although mantle-derived mafic magma was possibly involved to sever as heat engine during granitic magma generation. The Early Triassic granitic intrusion may be product in an intra-plate environment, as the case of same type rocks in the adjacent areas. The positive εHf(t) values (1.81∼7.47) and corresponding Hf model ages (0.80∼1.16 Ga) together with evidence of petrology are consistent with the interpretation that the parental magma of the Triassic granitic intrusion was produced from enriched mantle-derived sources under an usually high temperature condition which is likely due to basaltic magma that underplated the lower crust.

Our data combined with evidence of the regional geology enable us to conclude that the Gorny Altai and Altai-Mongolian terranes possibly have similar tectonic natures, but represent two separate accretionary systems before Devonian collision. The accretion and amalgamation processes resulted in the Paleozoic granitoid magmatism and caused the two terranes to merge as a composite tectonic domain at the Siberian continental margin.