Arc-continent collision zones are primary sites of net continental crustal growth: Evidence from Neoproterozoic and Mesozoic magmatic rocks in the periphery of the Yangtze craton

YONG-FEI ZHENG* AND ZI-FU ZHAO

School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China (yfzheng@ustc.edu.cn)

Neoproterozoic granitoids and gabbros in the periphery of the Yangtze craton are characterized by the arc-like patterns of whole-rock trace element distribution, the zircon U-Pb ages of 830 to 740 Ma and the bimodal composition of zircon Hf isotopes. Negative $\varepsilon_{Hf}(t)$ values with middle Paleoproterozoic Hf model ages occur in its southern and northeastern margins, whereas positive $\varepsilon_{Hf}(t)$ values and late Mesoproterozoic Hf model ages occur in its western, northern and southeastern margins. The contrasting features are attributed to reworking of ancient and juvenile crusts, respectively, which formed by continental and oceanic arc magmatism in response to the Grenvillian subduction of oceanic crust during assembly of supercontinent Rodinia. Additional zircon U-Pb dates gave 960 to 860 Ma for arc-continent syncollisional magmatism, signifying continental accretion around the Yangtze craton. Thus, the arc-continent collision zones are primary sites of net continental crustal growth.

On the other hand, Mesozoic intrusive and volcanic rocks along the Dabie-Sulu orogenic belt, typical continent-continent collision zone in east-central China, are characterized by the arc-like patterns of whole-rock trace element distribution and negative zircon $\varepsilon_{Hf}(t)$ values with Paleoproterozoic-Archean Hf model ages. They are clearly derived from reworking of the ancient crust that is part of the arc-continent collision orogen in the early Neoproterozoic. So far no syncollisional magmatism has been identified in the Triassic collision zone between the South and North China Blocks. Thus, the continental collision zone is not a primary site of net continental crustal growth. A plate-rift model is therefore advanced to account for various observations of petrology, geochemistry and tectonics, with tectonic collapse of collision orogens as the basic cause for crustal reworking. This model has potential applications to other orogens (e.g., Himalaya-Tibet and Central Asian Orogenic Belt) where preexisting arc-continent collision zones would have been consumed by continental collision.

Carbonate-salt inclusions in spinel-group minerals of the Merensky Reef and Phalaborwa complex

L.M. ZHITOVA[1], E.Y. ZHITOV[1], V.V. SHARYGIN[2] AND E.N. NIGMATULINA[2]

[1]Novosibirsk State University, Novosibirsk, 630090, Russia (zhitova@uiggm.nsc.ru, vzhicki@academ.org)
[2]V.S.Sobolev Institute of Geology and Mineralogy SB RAS, Novosibirsk, 630090, Russia (sharygin@uiggm.nsc.ru)

The primary multiphase solid inclusions have been studied in chromite from pyroxenite-pegmatites of the Merensky reef and in magnetite from phoscoritic carbonatite of the Phalaborwa complex to compare compositions and formation conditions. Chromites of the Merensky reef central zone (the Dwars River area, eastern Bushveld, 2054±22 Ma) are zoned and associated with orthopyroxene $En_{82\text{-}60}$. Their core-to-rim variations are (in wt.%): Cr2O3-41.2-10.2; FeOt-33.5-20.0; Al2O3-18.5-54.4; MgO-4.9-13.8. Solid inclusions (size - 10-200 µm) in chromite have oval or polygonal shape and commonly contain calcite, dolomite, quartz, NaCl, KCl, REE-apatite, MSS globule, ilmenite, zircon, magnetite and rare K-Na-phlogopite and clino- and orthopyroxene.

Magnetite from phoscoritic carbonatite at Loolekop mine of the Phalaborwa complex (~2060 Ma) approaches ideal $FeFe_2O_4$ with minor TiO_2 (1.0-1.7), MgO (1.2-1.7), Al_2O_3 and MnO (up to 0.2 wt. %). Solid decay microstructures of magnetite-ilmenite-ulvospinel and individual large lamellae of picroilmenite are common in magnetite. Multiphase inclusions (size - 10-300 µm) have rounded or irregular shape and vary in mineral composition from carbonate to carbonate-silicate-oxide-chloride. Dolomite, calcite, apatite, picroilmenite, phlogopite, magnesite, brucite are essential minerals in such inclusions. Minor phases are fairchildite, baddeleyite, uranothorianite, strontianite, witherite, barite, celestine, Ca-Ba-carbonate, bastnaesite-(Ce), Na-REE apatite, NaCl, KCl, Fe-Ni-Co-Cu sulfides and Au-Ag alloys. The carbonate inclusions usually vary in calcite-dolomite ratio and calcite sometimes contains perthitic dolomite.

The similarity in phase composition of carbonate-salt solid inclusions in the spinel-group minerals of the Merensky reef and the Phalaborwa complex seems to be evidenced about the possible participation of carbonate melt during crystallization of the Merensky reef pyroxenite-pegmatites. Contamination of mafic melt by carbonatite liquid or separation of initial melt into mafic silicate and carbonate components most likely to be dominating processes of their evolution.

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