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Suprasubduction volcanic rocks of the Char ophiolite belt, East Kazakhstan: new geochemical and first geochronological data

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The Char ophiolite belt is located in the western Central Asian Orogenic Belt, a world largest accretionary orogen, which has evolved during more than 800 Ma. The Char belt formed during Kazakhstan - Siberia collision. It has been known for hosting fragments of Late Devonian-Early Carboniferous oceanic crust, MORB, OPB and OIB, of the Paleo-Asian Ocean (Safonova et al., 2012). The Char is surrounded by two Paleozoic island-arc terranes: Zharma-Saur in the west and Rudny Altai in the east, however, until recent times, no island-arc units have been found within it. We were the first to find island-arc units as tectonic sheets occurring adjacent to those consisting of oceanic rocks. In places, island-arc andesites cut oceanic basalts. The Char volcanic and subvolcanic rocks of a probable suprasubduction origin are basalt, microgabbro, dolerite, andesite, tonalite and dacite. The mafic to andesitic volcanics possessing low TiO_2 (0.85 wt.%av.) and show MgO vs. major elements crystallization trends suggesting two magma series: tholeiitic and calc-alkaline. The tholeiitic varieties are less enriched in incompatible elements then the calc-alkaline ones. Two samples are high-Mg and low-Ti andesibasalts similar to boninites.
The rocks possess moderately LREE enriched rare-earth element patterns and are characterized by negative Nb anomalies present on the multi-element spectra (Nb/Lapm = 0.14-0.47; Nb/Thpm = 0.7-1.6).The distribution of rare-earth elements (La/Smn = 0.8-2.3, Gd/Ybn = 0.7-1.9) and the results of geochemical modeling in the Nb-Yb system suggest high degrees of melting of a depleted harzburgite-bearing mantle source at spinel facies depths. Fractional crystallization of clinopyroxene, plagioclase and opaque minerals also affected the final composition of the volcanic rocks. Clinopyroxene monomineral thermometry indicates crystallization of melts at 1020–1180°. Melt inclusion composition based numerical calculations show that primary melts were derived at 1350–1530°C and 14-26 kbar and crystallized at 1150–1190°C (Simonov et al., 2010). All these features are indicative of a supra-subduction origin of rocks.
The age of gabbro, dolerite, andesite and tonalite was determined by LA ICP MS U-Pb zircon dating performed in the University of Kyoto, Japan. The andesites and tonalites yielded Carboniferous ages of ca. 322-336 Ma and the gabbro and dolerite appeared Devonian (387-395 Ma).
Thus, the Char volcanic rocks possess geochemical signatures of supra-subduction magmas and could be derived at high degree melting of relatively shallow mantle sources. The volcanic units probably formed at one or two island-arcs or at an intra-oceanic arc and continental margin arc during the Middle Devonian – Mississippian. Later, the island-arc units were probably accreted to the active margin of the Kazakhstan continent. The work was supported by RFBR Project no. 16-05-00313. Contribution to IGCP#592 of UNESCO-IUGS.

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