

Tectonic erosion at Pacific-type convergent margins: evidence from the western Central Asian Orogenic Belt

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Pacific-type convergent margins (PCM) and their related orogenic belts exist/form over subduction zones. PCM are places of major continental growth by island-arc juvenile magmatism and accretion, but they are also places of strong plate interactions and crust destruction. Accordingly there are two contrast types of PCM: accreting ones accompanied by the formation of accretionary complexes, and eroding ones accompanied by the tectonic erosion of accretionary wedge, fore-arc prism and volcanic arc and even by direct subduction of intra-oceanic arcs (Safonova et al., 2015). PCM are the only ways on the Earth surface to deliver surface materials to the deep mantle. The longer are the periods of tectonic erosion and subduction, the larger will be the volume of the material arriving to the mantle. Therefore, it is very important to highlight the periods of tectonic erosion in fossil PCMs to evaluate the amount of the surface material eroded in the past.

The objectives of our study were Pacific-type orogenic belts of the Central Asian Orogenic Belt (CAOB). There are dozens of accretionary complexes formed during the late Neoproterozoic-early Paleozoic (Transbaikalia, Altai-Sayan, central Kazakhstan, N. Tianshan), the Middle Paleozoic-early Carboniferous (S. Tianshan, East Kazakhstan, Mongolia); the late Carboniferous-Permian (Sikhote-Alin), and the Triassic-Neogene (Russian Far East). The most promising areas of tectonic and subduction erosion in the CAOB are eastern and central Kazakhstan, northern Tianshan and Transbaikalia (Safonova et al., 2017).

We have sampled and studied greywacke and/or turbiditic sandstones in three orogenic belts of the CAOB: the Char ophiolite belt and the Zharma arc terrane in eastern Kazakhstan, and Itmurundy ophiolite/accretionary belt in central Kazakhstan. IN total, we analyzed 11 samples for bulk rock geochemistry and U-Pb detrital zircon ages and four samples for Hf-in-zircon isotopes. The rocks have andesitic to dacitic major element composition. The samples from Char, Zharma and Itmurundy (early stage) have andesitic major element compositions; they yielded unimodal distributions of U-Pb ages peaked at 340-320 and 390-340 (Char), 350-330 (Zharma) and 470-450 (Itmurundy-1) Ma suggesting their intra-oceanic arc origin. More evidence for this comes from their positive Hf_t values -5.5-16.7, 7.2-15.2, 9.2-17.6, respectively –and the occurrence of sparse outcrops of volcanic rocks possessing supra-subduction geochemical affinities. In addition, the Char samples show positive epsilon Nd_t values: 6.0-7.6. Two younger samples from Itmurundy-2 have dacitic compositions and yielded multi-model U-Pb age probability curves peaked at 500-480, 1000-900, and 2500-2400 Ma suggesting a continental arc origin. Thus, on the one hand, the unimodal U-Pb age probability curves and the positive epsilon Nd and Hf values suggest an Ordovician intra-oceanic arc in the Itmurundy-1 area, and a late Devonian and possibly two early Carboniferous arcs in east Kazakhstan. On the other hand, the scarcity of outcrops of supra-subduction rocks suggests that those arcs were tectonically eroded during oceanic subduction.

References

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The tectonic map of Kazakhstan and adjacent areas

