Clastic terrigenous rocks in Pacific-type orogenic belts and their significance

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The subduction of oceanic crust and the formation of associated magmatic and sedimentary complexes on the Pacific-type convergent margins (PCM) are the most important processes in the geological history of the Earth. Magmatic arcs formed at PCM can be destroyed by the subduction or surface erosion (Scholl, von Huene, 2007). The destruction of supra-subduction igneous rocks and the transportation of eroded material into the fore-arc basin and deep-water trough leads to the formation of specific clastic rocks- greywacke sandstones. Such sandstones are almost identical in composition to the igneous rocks of the parental arcs and contain detrital zircons, the age of which corresponds to the time of supra-subduction magmatism. On the contrary, the sandstones of the continental arcs reflect in their composition an increase in the proportion of sialic sources and contain older detrital zircons than the associated subduction igneous rocks. In case of partial or complete disappearance of supra-subduction rocks due to subduction erosion or their hidden under thrusts, greywackes carry the most important information. If the geochemical characteristics of sandstones correspond to the average composition of the mafic and intermediate island-arc magmatic series, their isotopic composition corresponds to the juvenile crust (positive eNd(t) in whole-rock and eHf(t) in zircons), and the distribution of U-Pb ages of detrital zircons has a unimodal character, then the initial arc was intra-oceanic. If the composition of sandstones assumes the dominance of andesites and acidic differences in the sources area, their values of eNd(t) and eHf(T) have negative values, and the distribution of U-Pb ages of detrital zircons is polymodal, then the continental arc (or active continental margin) was most likely destroyed (Dickinson, Suczek, 1979). In the process of subduction and accretion, sandstones accumulating in the deep-sea trough are part of the accretionary prism along with rocks of oceanic origin.

In intra-continental orogens, such as the Central Asian Orogenic Belt (CAOB), the largest Phanerozoic orogen in the world, formed during the evolution and closure of the Paleo-Asian Ocean (Zonenshain et al., 1990), sandstones are part of accretionary complexes, and are also widely developed in sections of fore-arc and back–arc basins. Due to the complex structure of the CAOB the question of the nature (juvenile or recycled) and the balance of the crust is still debatable. The main obstacle in solving this issue is the process of erosion of island arcs composed

of magmatic complexes with juvenile characteristics. This factor affects the balance of juvenile and recycled crust and its shift in favor of the latter, which can lead to erroneous interpretations.

U-Pb dating of detrital zircons and a comprehensive study of the composition of clastic rocks allows us to establish the nature of the parental magmatic arc. So the results of the study began to be brought quite accidentally and to a constant change in the data on U-Pb dating, including geochemical and isotope data, for a several regions of China, the Altai Mountains, Mongolia, Kyrgyzstan and Transbaikalia. At the same time, there are still practically no study considering the entire set of data on such rocks (geological, petrographic, geochemical, isotopic) (Safonova, Perfilova, 2023), although they play an important role in constructing paleotectonic reconstructions of the Pacific-type convergent margins.

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Dickinson W.R., Suchek K.A., 1979. Plate tectonics and sandstone composition. Bulletin of the American Association of Petroleum Geologists, 63(12), 2164-2182.

Safonova I., Perfilova A., 2023. Preserved and disappeared intraoceanic arcs of the Paleoasiatic Ocean: data from Kazakhstan. National Science Review 10(2), nwac215.

Scholl D. V., von Huene R., 2007. Recycling of the Earth's crust in modern subduction zones in relation to the past — problems of growth and preservation of the continental fundamental crust, geochemistry of the mantle and reconstruction of the supercontinent. Memoirs of the Geological Society of America, 200, 9-32.

Zonenshain, L.P., Kuzmin, M.I., Natapov, L.M., 1990. Geology of the USSR: a plate tectonic synthesis. Geodynamic Monograph. American Geophysical Union, Washington, Geodynamics Series 21, 242 p.