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Lithospheric low-volume volcanism in the Middle-Amur basin and Tien Shan: Inherited geochemical signatures of terrains originated in closed paleoocean structures

I. Chuvashova (1,2), A. Mikolaichuk (3), S. Rasskazov (1,2)

(1) Institute of the Earth's crust, Russian Academy of Sciences, Irkutsk, Russian Federation (chuvashova@crust.irk.ru), (2) Irkutsk State University, Irkutsk, Russian Federation, (3) Central Asian Geology-Geophysical Association, Bishkek 720481, Kyrgyzstan (alexander@mikolaichuk.com)

Cretaceous-Paleogene volcanic and subvolcanic rocks from Tien Shan were studied by many authors intended to clarify the origin of this mountainous uplift. In terms of geochemical data, the rocks were examined as resulted from activity of a mantle plume (Grachev, 1999), a small plume (Sobel, Arnaud, 2000) or a lateral branch of the Deccan superplume (Mikolaichuk, Simonov, 2006; Simonov et al., 2008). The volume of volcanic rocks occurred in an area of ca. 100×103 km2 does not exceed, however, 10 km3. From variations of electrical conductivity, estimated from magnetotelluric sounding and measurements of parameters in deep-seated xenoliths, the mantle structure beneath Tian Shan was assumed to be strongly affected by subduction processes related to the Late Paleozoic closing of the Turkestan paleoocean (Burtman, 2006; Bagdasarov et al., 2011), therefore, the reactivated Cretaceous-Paleogene volcanism is expected to express geochemical signatures of the structural inhomogeneities beneath the mountainous uplift. Similarly, low-volume Late Miocene volcanic eruptions occurred in the Middle Amur basin that inherited a closed paleoocean structure, under the central part of which there exists a dome-shaped uplift of the dense (eclogitic?) mantle at a depth of 80 km, as inferred from magnetotelluric sounding and density modeling. Under the adjacent Sikhote-Alin orogenic belt, the surface of the dense mantle abruptly drops to a depth of 200 km, whereas under the Jiamusi–Khanka–Bureya massif dips more gently with clear fragmentation of the overlying mantle (Kirillova, 2009).

From new geochemical data on volcanic rocks that inherited signatures of terrains originated in the closed paleoocean structures, we define the two tectonic units with different character of magmatic sources in each case. The Northern Tien Shan is comparable to the Eastern part of the Middle Amur basin in terms of 1) short episodes of volcanism (61–53 Ma and 11–4 Ma, respectively) and 2) identical liquids that were derived from the garnet-bearing mantle (basanites, leucitites, and foidites) and from the crust (basalts, andesitic basalts, and andesites). The Southern Tien Shan is like the western part of the Middle Amur basin by longer volcanic activity (122–46 Ma and 22.0–0.3 Ma, respectively). All liquids from the Southern Tien Shan were produced in the garnet-free shallow mantle. Evolution of a picrobasalt–phonolite series from this single source was provided here only by temperature variations. Similarly, the western part of the Middle Amur basin was also dominated by magmatism originated at the mantle level, although some liquids were produced with increasing role of garnet in the source region. We suggest that long-term low-volume magma supply from a fixed depth was due to control of processes by lithospheric layering, whereas short-term reactivation of both mantle and crustal sources was provided by shear displacement of the lithosphere.

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