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Collision-derived Late Cenozoic Dynamics of a Melting Anomaly beneath Central Mongolia: magmatic and tectonic Evidence

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Spatial–temporal pattern of Late Cenozoic volcanic activity in Central Mongolia has been interpreted as surface expression of melting zones temporally transformed to melting lenses. The former are exhibited by loci of coeval volcanic fields extended up to 500 km, the latter are marked by isometric volcanic areas with diameter up to 200 km. Activity of the melting zones is constrained in time intervals of 23.4–9.7, 9.6–2.6 and $<$1.9 Ma respectively activity of the melting lenses is recognized at two latter time intervals. Based on seismic images, the magmatic processes are attributed to depth 80–200 km. Correlation of volcanic events in Central Mongolia and Tibetan Plateau demonstrates a common connection of mantle processes beneath both areas with tectonic stress derived from Indo-Asian collision zone (Rasskazov et al., 2007, in press).

In this presentation, the model is developed on basis of new geochronological and geochemical evidence on spatial–temporal change of mantle magmatic sources beneath Central Mongolia. Volcanic rocks from this area are alkaline basalts with K- and K-Na affinities. In terms of Sr and Nd isotope compositions, we distinguish three end-members of mantle sources for volcanic rocks: 1) slightly enriched (EM', ^{87}Sr/^{86}Sr $\sim$0.7047, ^{143}Nd/^{144}Nd $\sim$0.51229), 2) depleted (DM, ^{87}Sr/^{86}Sr $\sim$0.7039, ^{143}Nd/^{144}Nd $\sim$0.51259), and 3) more enriched (EM, ^{87}Sr/^{86}Sr 0.7049–0.7059, ^{143}Nd/^{144}Nd 0.51207–0.51232). In time interval of 23–10 Ma, K-rich and K-Na series were produced by separate mantle sources dominated by the first and second components, respectively. Subsequent K-rich liquids were produced from the DM source and mixed with K-Na ones, derived from the EM' source. Eruptions of liquids with the EM signature marked structural reorganizations and temporally changed to those with the EM' characteristics (Chuvashova et al., 2007).

High activity of potassium in the mantle is defined by occurrence of K-bearing clinopyroxenes in the deep mantle at pressures of 5–7 GPa (Tsuruta & Takahashi, 1998; Safonov et al., 2005), i.e. at depth of 120–180 km. Decreasing potassium activity in the shallow mantle presumes transition from K-rich to K-Na liquids. The sources of K-rich lavas are referred to depth 120–200 km and K-Na ones to the relatively shallow mantle. K-rich liquids indicate strongly mobile high temperature mantle loci where the melts are generated due to adiabatic decompression and are capable to escape to surface from relatively deep level, K-Na compositions show shallow melting processes, required less heat, and exhibit spatial transition to an energetically weaker part of a melting zone or lens.

Local eruptions of K-Na lavas at 23.0–15.5 Ma demonstrated exclusively shallow initial melting. Subsequent K-rich lavas were indicative for pronounced collision-derived stress, resulted in sin-kinematical decompressional melting of the deep mantle. Firstly, at 15.5–14.3 Ma, a locus of volcanic rocks with K-affinity was stretched north-northeast, at direction of collision-caused compression, and spatially coincided with the eastern boundary of East Hangay. Afterwards, at 14.3–10.4 Ma, eruptions K-rich lavas were aligned west-north-westerly, in orthogonal direction. Structural reorganization at ca. 10 Ma was expressed by concentration of tectonic stress and related K-rich and K-Na magmatism along the eastern boundary of Central Hangay.

Magmatic evolution beneath Central Mongolia showed transition from spatially separated deep and shallow mantle sources in a lattice of melting zones operated between 23 and 10 Ma to partly coalescent ones occurred after the major structural reorganization responsible for origin of the new magmatic pattern during the past 10 Ma.

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