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MELT SOURCES OF WUDALIANCHI VOLCANOES, NORTHEAST CHINA, AND THEIR ROLE IN THE ERUPTIONS OF 1720–1776

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On the Wudalianchi volcanic field, lava flows and pyroclastic cones show rocks of potassic series. In terms of spatial-temporal distribution, volcanism is subdivided into three stages: 1) 2.5–2.0 Ma, 2) 1.33–0.8 Ma, and 3) <0.6 Ma. In the central group of volcanic edifices, eruptions shifted northeastwards from Laoshantou flow, through Weishan and Bijiashan volcanoes to Laoheishan and Huoshashan ones (Rasskazov et al., 2016). The last two volcanoes erupted about 97 Ka and in 1720–1776 (Wei et al., 2003; Liu, Taniguchi, 2001).

In terms of major oxide, trace element concentrations and Sr–Pb isotope ratios, the volcanoes show 5 sources: Laoshantou, Gelaqiu, Molabu, Wohu, and Huo. The first three were spatially individualized. The Laoshantou one exhibits a material of 1.884 Gyr erupted by trachyandesite flow about 2.5 Myr ago. The Gelaqiu source had a material of the same age erupted by low-Mg tephrite flow about 2.0 Myr ago. The Molabu source that shows no amenable age estimate erupted by moderate-Mg tephrite since about 0.6 Ma. The Wohu source originated through modification of a material from the Gelaqiu one at about 150 Ma was erupted between 1.3 and 0.4 Myr ago. The Huo source contained material the similar of Molabu and partly modified about 100 Ma.

The eruption of ca. 97 Ka on Laoheishan volcano was dated by K–Ar method (Wei et al., 2003). Accumulated cinder and volcanic bombs into a cone was followed with a lava flowed downstream the Beihe river. In low-Mg rocks, the material was combined from Laoshantou, Gelaqiu, and Molabu sources. During the rejuvenation of eruptions on Laoheishan volcano within the older crater in 1720–1721, the new edifice was formed with a new crater as deep as 145 m. After the Laoheishan volcano extinction, Huoshaoshan volcano began erupting 3.5 km to the north-east of the Laoheishan cone in a half year. Laoheishan volcano reactivated again in 1776 by eruptions of moderate-Mg liquids. Unlike low-Mg products of Laoheishan eruptions, the moderate-Mg ones were derived from the Gelaqiu and Molabu sources only.

For recording the latest eruption, the tephra layer was studied in bottom sediments of Nananelaqiushan Lake located in the summit crater of South Gelaqiushan volcano. Diameter of the lake is about 400 m. Two columns were sampled in the lake and the similar layers were observed and identified through deceasing loss of ignition and increasing magnetic susceptibility. In this tephra material, the contents of Na, Mg, Al, Si, P, K, Ca, Ti, Mn, and Fe were determined and compared with ones of the Laoheishan tephra. The defined heterogeneous compositions (tephriphonolitic and trachyandesitic) of the 1776 tephra were characteristic of volcanic glasses from Laoheishan and Huoshaoshan eruptions in 1720–1721 (Sun et al., in press).

Earlier, it was inferred that melts erupted on Laoheishan in 1720–1721 were derived from the enriched mantle sources that were similar to those of the previous eruptions in the Wudalianchi volcanic field, and melts erupted on Huoshaoshan afterwards (i.e. in 1721) with

melts from a new less enriched mantle source that is not characteristic of the previous Quaternary eruptions of this field (Chuvashova et al., 2007). It was proposed that during the Laoheishan and Huoshaoshan eruptions, lasted about one year and five months, there was a drastic change of sources under Wudalianchi similar to the transition from the lithospheric source to the asthenospheric one under the Lucero uplift in the Rio Grande rift during the long-lasted (millions of years) late Miocene lull of magmatic activity (Chuvashova et al., 2011). The obtained confirmation of the Laoheishan eruption in 1776 leads to the new understanding roles of the Wudalianchi magmatic sources. The Huo source, displayed in the eruption of 1721, was not retained in subsequent products of the 1776 eruption of Laoheishan volcano. After initial eruptions with sharp change of the magmatic sources of Laoheishan and Huoshaoshan volcanoes in 1720–1721, the final eruption of Laoheishan followed in 1776 with moderate-Mg lavas similar to the main moderate-Mg series of the Wudalianchi field. As a result, the Huo source did not show a comprehensive change of sources beneath the Wudalianchi volcanic field, but rather reflected an impulse crack propagation that caused decompression melting in heterogeneous viscous mantle of the anomalous Huo source.

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