SMALL BUT IMPORTANT: NEW DATA ABOUT ACTIVITY AND COMPOSITION OF ZARECHNY VOLCANO (CENTRAL KAMCHATKA DEPRESSION)

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Inactive Zarechny volcano is located in the northern part of the Central Kamchatka depression (CKD) and is bounded by the Kliuchevskoi volcanic group in the south and Shiveluch volcano in the north (Fig. 1a, b). The whole area is spatially related to the Kuril-Kamchatka - Aleutian junction (Fig. 1, inset). Zarechny (754 m) and neighboring Kharchinsky (1410 m) volcanoes form an "island" half-buried in the sediments and surrounded by marshes, lakes and channels of the Kamchatka River valley. These relatively small volcanoes are unique among other Kamchatka vents as their rocks are dominated by high-Mg basalts (Volynets et al., 1998, 1999). In addition, Zarechny erupted products include Mg andesites although the compositional data on those remain scarce (Volynets et al., 1999).

Zarechny edifice consists of a large cone destroyed by a ~3.5 km horseshoe-shaped crater, which hosts an inner cone with a crater filled with the fragments of a younger lava dome. Considering the fact that the lower 100-200 m of the Zarechny slope are buried under the glacial and alluvial sediments, the original height of the pre-collapse Zarechny cone might have reached 1650-1750 m. Zarechny larger crater is twice as large as the 1956 Bezymianny or 1964 Shiveluch craters formed by sector collapses and subsequent plinian eruptions. Volynets et al. (1998) suggested that the main Zarechny edifice formed before the Last Glacial Maximum (23-24 ka BP) whereas the activity from its inner cone continued into the glacial times. However, the exact timing of Zarechny activity was not known. The volcano is covered by forest, which hampers the sampling of its rocks.

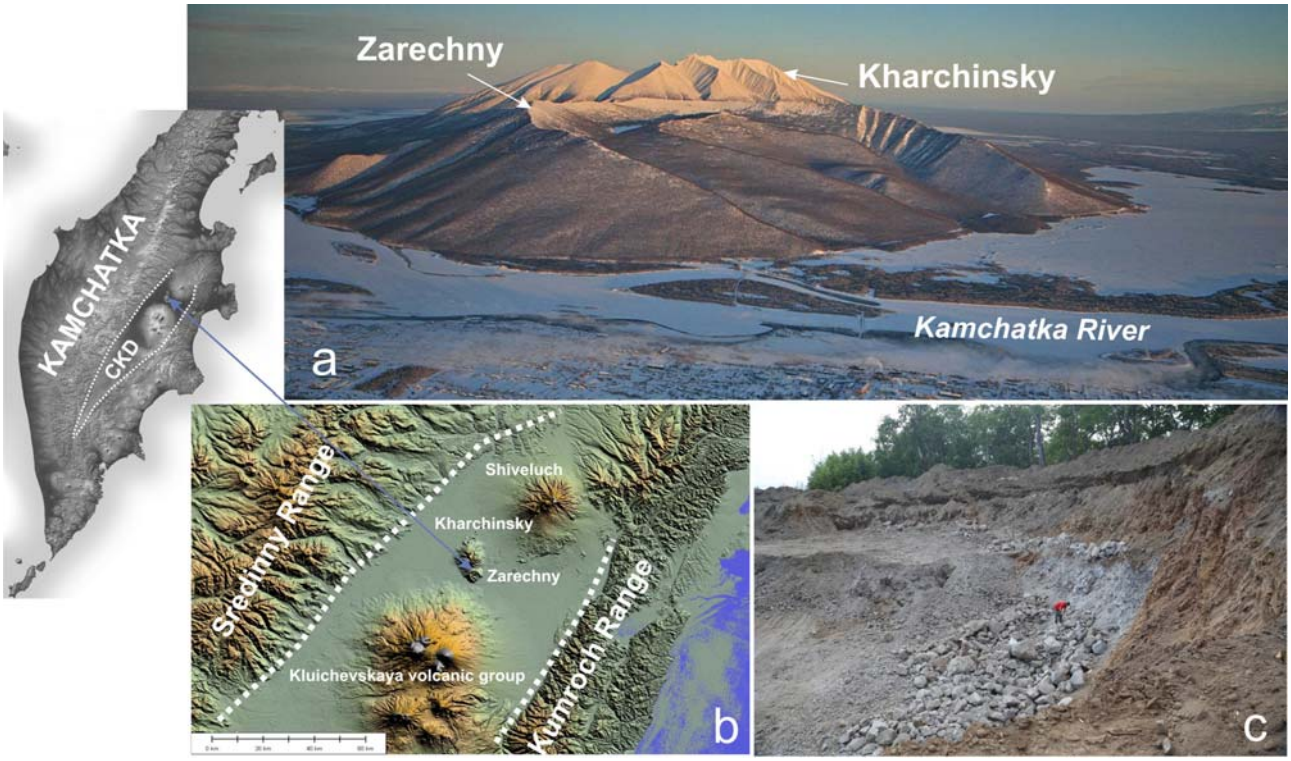

Fig. 1. Zarechny volcano (a) with its regional position (b) and deposits (c). Photo by Yuri Demyanchuk (a) and Anastasiya Plechova (c).

Here we present the results of our 2013-2015 fieldwork, when we were lucky to sample Zarechny andesites unearthed by a new quarry (Fig. 1c) as well as the pyroclastic flow deposits opened by a road cut at

the Zarechny slope. In addition, we measured and ^{14}C-dated a late Pleistocene tephra sequence located across the Kamchatka River from Zarechny, where some of the tephras were likely erupted from Zarechny during its andesitic stage.

Tephra sequence across the river from the Zarechny volcano dates to the last 29 ka and contains 48 pre-Holocene visible ash layers. Comparison of the electron microprobe data for the glasses from these ash layers to those for the Shiveluch and Zarechny proximal tephra reveals that at least 14 tephras have been likely derived from Zarechny. The glasses have dacite-rhyolite medium-K compositions and form trends between 65 and 75% SiO_2. The radiocarbon dates for the enclosing lacustrine deposits suggest that all these tephras form a cluster between 21.5 and 17.5 ka BP and likely correspond to the andesitic eruptive stage of the Zarechny inner cone/dome.

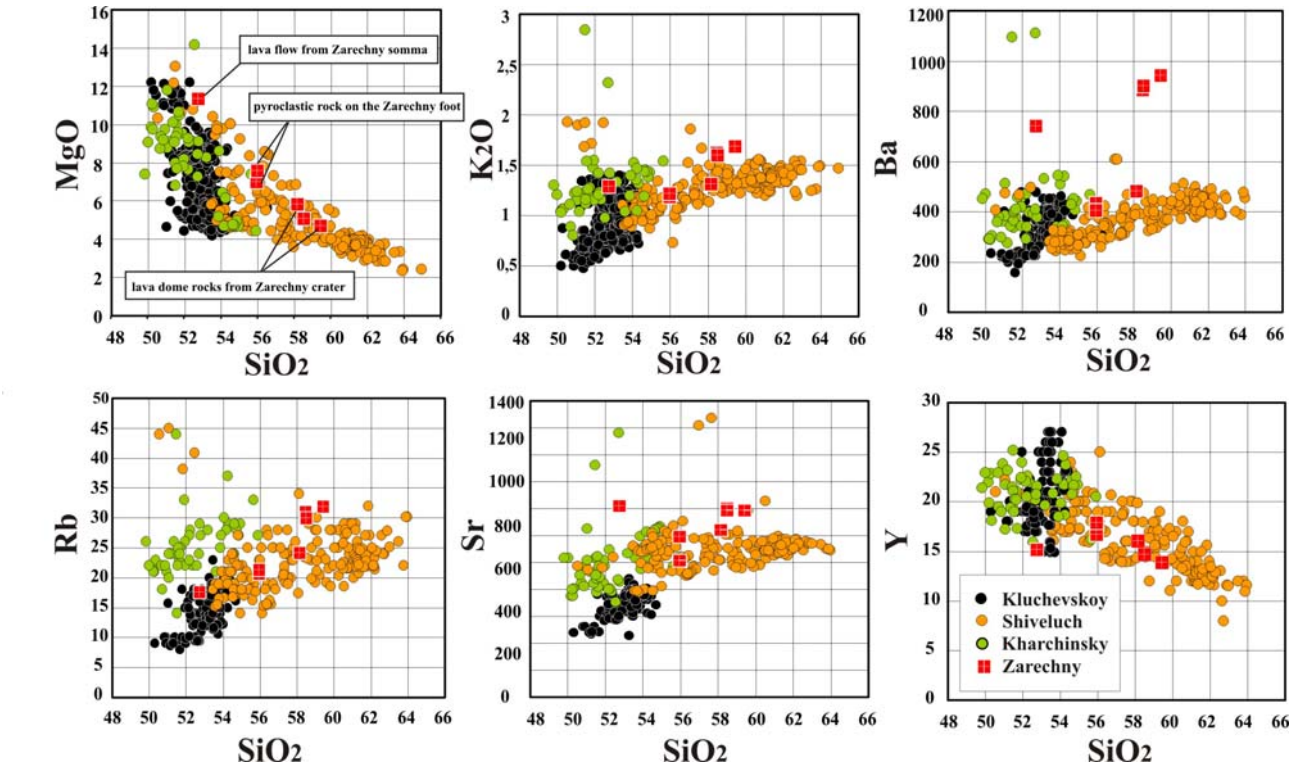

Fig. 2. Selected major (Mg, K) and trace (Ba, Rb, Sr, Y) elements composition of Zarechny volcano rocks compared with the neighboring CKD volcanoes. The composition of Kliuchevskoi rocks from Portnyagin et al. (2007); Shiveluch – from Gorbach and Portnyagin (2011) and Gorbach et al. (2013), and Kharchinsky volcano from our unpublished data.

The rocks of a lava dome (SiO_2=58.45-59.40, Mg#=0.61) are light-gray highly crystallized amphibole-phyric andesites with ~40 vol. % of pargasitic amphibole and minor amount (≥ 5 vol. %) of plagioclase phenocrysts. The rocks from the pyroclastic flow deposits are sub-aphyric highly vesiculated dark-gray with greenish shade basaltic andesite-andesites (SiO_2=55.92-58.13, Mg#=0.61-0.67). Rare phenocrysts (~5-7 vol. %) are mainly amphiboles accompanied with sporadic olivine and ortopyroxene crystals. Plagioclase is present only as groundmass microlites. The rock contains microxenolites of amphibolites and amphibolized pyroxenite and resorbed ortopyroxene fragments (likely xenocrysts). Pre-eruptive crystallization conditions (P≥400 MPa, T~955±16°C, n=20) preliminary estimated from the amphibole composition using approach by Ridolfi et al. (2010) correspond to low-middle crust.

Major and trace elements abundances in Zarechny lava dome and pyroclastic rocks are very close to Shiveluch Mg andesites (Fig. 2) but slightly enriched in K, Rb, Sr and, especially, in Ba. As well as Shiveluch andesite, Zarechny rocks are depleted in Y (Fig. 2) and HREE, which indicates extensive amphibole fractionation.

The data on the Zarechny Mg andesites are important for our understanding of the conditions of magma origin and differentiation in the northern part of the CKD. For instance, the mixing of primitive and evolved magma play significant role in the origin of Mg andesites dominated at Shiveluch volcano (Gorbach and Portnyagin, 2011). However, such an explanation is not appropriate for the origin of the Mg andesite from Zarechny volcano, because its small magmatic system unlikely could provide conditions for magma

mixing. We discuss two possible models of the Zarechny magma origin. The first model suggests that sub-aphyric plagioclase-free Mg basaltic andesite-andesite from Zarechny volcano may derivate from separate primitive high-H_2O magma. The second model addresses the fraction crystallization of high-Mg basalts in low-to-middle crust accompanied by process of crustal rocks assimilation.

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