HIGH-MAGNESIA BASALTS – SOURCE OF CALC-ALKALINE SERIES OF GORELY VOLCANO (KAMCHATKA).

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Gorely volcano is large, long-lived shield-type volcano (South Kamchatka) that is currently in an eruptive phase (prior eruptions occurred in 1980-81 and 1984-86). The volcano has a complicated structure. Its structure has a number of complexes, but in general the structure of the volcano Gorely consists of two edifices - ancient and modern. The ancient edifice (Pra-Gorely) has shield-shaped form. Caldera (13x12 km) is located in its center. The modern edifice (Young Gorely) occupies the central part of caldera, represented by three fused cones, which form the ridge which stretch out in the North-West direction. The absolute height of the central cone is 1829 m. At the top there is a 11 craters superimposed on each other, and on the slopes there are about 40 cinder cones with lava flows of varying lengths.

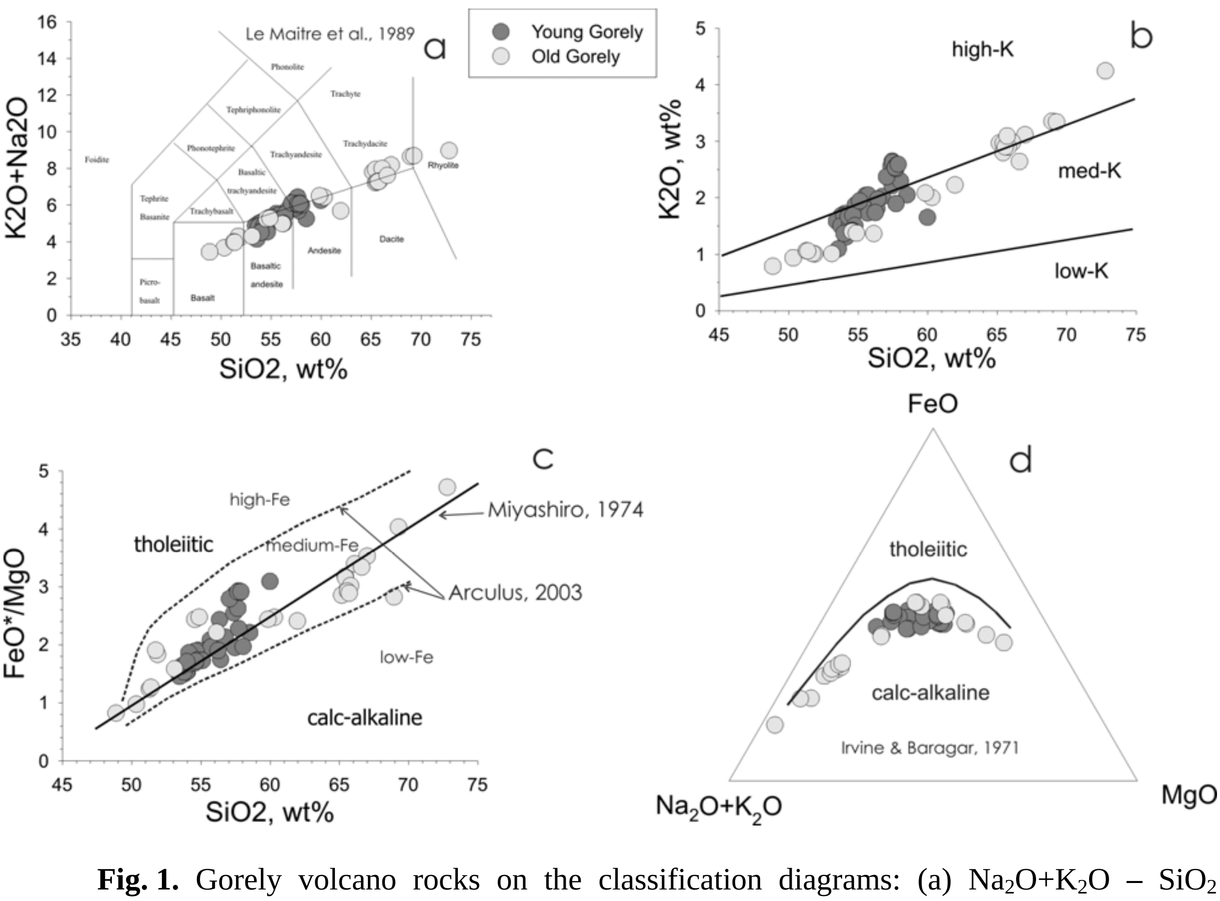

Fig. 1. Gorely volcano rocks on the classification diagrams: (a) Na_2O+K_2O – SiO_2 (TAS-diagram [Le Maitre et al., 1989]); (b) diagram K_2O-SiO_2; (c) FeO*/MgO–SiO_2 [Miyashiro, 1974; Arculus, 2003] and (d) AFM-diagram [Irvine and Baragar, 1971].

After geochemical analysis two evolution series were found. First, Pra-Gorely volcano is represented by a suite of compositions ranging from basalt to rhyolite, with in this series, high-Mg basalts (MgO – 11 wt %) were discovered. Second, Young Gorely edifice is composed of only basalt, andesite and dacite. The reconstruction of chemical evolution trends shows that both volcanic series of Gorely volcano share the same genetic history with similar evolutionary stages. We suggest fractionation of an upper mantle peridotite as a common means to produce both volcanic series as a result of which the evolution of all rocks (from basic to acidic) was generated. It is necessary to add, that the discovery of high-Mg basalts at Gorely volcano demonstrates that eruptive centers of Southern Kamchatka are being feed by a mantle source like those of Central Kamchatka.

The magmatic series of Pra-Gorely and Young Gorely volcanoes were formed under different geodynamic conditions. Between these two series was a powerful stage of caldera formation, during which 100 km^3 of ignimbrites were emplaced. The 12-km diameter caldera collapse was the catalyst for a large-scale reorganization of the volcanic feeding system. Following caldera collapse, Young Gorely volcano was formed by activity inside the caldera and shows very similar evolutionary trends to that of Pra-Gorely volcano. Therefore, it can be confidently stated that crustal components are practically absent in the evolution of the series, and the compositional range is attributed directly to the evolution of the magmatic melts of Gorely volcano.

Microprobe analyses conducted on olivine and pyroxene phenocrysts of Gorely volcano lavas, show that there were at least two stages of crystallization during the evolution of magmatic melt. The first stage corresponds to a crystallization of high-Mg and middle-Mg olivines, Mg# 88-77. The second crystallization stage is characterized by pyroxene phenocrysts with core compositions of Mg# 73-67.

The two-stage character of initial magmatic melt evolution is confirmed by results of the computer simulation (COMAGMAT software, by A. Ariskin). The first stage is characterized by comparatively high pressures (6-8 kbar), which corresponds to formation at depth and low rates of oxygen fugacity (1% part of Fe^3+ in total Fe). In contrast, the magmatic evolution of the second stage occurred in near-surface conditions (1-1.5 kbar) with high rates of oxygen fugacity (Ni-NiO buffer). The existing of this stage of crystallization testifies to shallow magmatic chamber presence which is responsible for generation of caldera and thick ignimbrite complex.

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