Zhmodik A.S. Rates of the basalt magma eruptions in the Cleft sector of the mid ocean Juan-de-Fuka ridge on the results of mathematic modeling..

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key words: [basalt magmatism, eruption rates, mid-ocean ridges, ferrobasalts, numeric modeling]

Based on numeric modeling of non-stationary non-isothermic flow dynamics of basalt liquids in regular dike channels the feeding regimes of the fracture eruptions in the axis rift of the Juan-De-Fuka valley parts were estimated. The feeding parameters are estimated for such structures as: 1) lava flows; 2) pillow lava structures.

To state the task the following data were used: 1) Geophysical data confirming that the low depth magmatic chambers (2-4 km deep) are the magma sources within the ridge (Embley & Chadwick, 1994); 2) Data on the contents and composition of gabbroid xenoliths in basalts and basaltic glass that confirm geophysical data on the magmatic chamber location (depth) in the eruption area (Dixon et al., 1986); 3) Structural data on erupted basalt lavas within the ridge that allow estimating the volumes of the erupted lavas (Embley & Chadwick, 1994); 4) average compositions of the most magnesium (primitive) basalt and ferrobasalt varieties were taken as standard (Sharapov and Zhmodik, 2000); 5) PK KOMAGMAT (Ariskin and Barmina, 2000) and PK KANAL were used for a state diagram plotting and for the intrusion dynamic calculation (Sharapov et al., 2000), respectively.

The calculation procedure was as follows: 1) the state diagram for the average real composition was plotted by KOMAGMAT, and the diagrams of the quantity and composition of minerals formed during crystallization were plotted; 2) The data were entered to PK KANAL iteration cycles for calculation phase transition dynamics in the melt flow channels of 0.5-3 m in thickness (statistical data of cross section sizes of the dikes in the spreading zones (Island, Hawaii)); the channel height was 2-4 km; the flow rate at the channel mouth varied from 0.5 m/s to 0.05 m/s. A full spectrum of various time “sections” of temperature distribution in the channel for the various magma flow regimes was investigated.

The obtained results on composition and volume fraction of solid phase at the fracture mouth were compared with the observed values at Juan-de-Fuka neovolcanic basalts. “Controlling” were the 5 volume percents of phenocrysts, which corresponds to the most Cleft segment lavas from the Juan-de-Fuka ridge.

Table 1. The obtained rate estimates of the basalt lava flows and pillow lava structure formation at eruption from fractures of 0.5 m in thickness.

Structure type	Formation time at the output rate of 0.3 m/s	Formation time at the output rate of 0.2 m/s
Lava flows	~20 min (individual flow)	“Refreezing” of the channel is observed at these rates
Pillow structures	~55 hours (full structure)	~80 hours (full structure)

The closest to real conditions for eruption of the various basalt flow types in the studied Cleft segment were ascertained by the following way: 1) the closest to real conditions for eruption as of magnesium basalts as of ferrobasalts are as follows: the melt eruption rates are 0.2-0.3 m/s from the channel of 2-4 km in height and 0.5 m in thickness. The calculation compositions and those of phenocrysts from the natural rocks of the ridge show the best coincidence under these rates. 2) The basalt eruption durations for various parts of the Juan-de-Fuka ridge were also estimated. The morphostructural data of the erupted basalt bodies within the ridge were used (Embley & Chadwick, 1994). The following duration estimates of such morphostructure formation were obtained in combination with the estimated rates: a) the duration of the basalt lava individual flow with the average thickness of about 15 cm is 20 minutes, which is close to the observed by the submerging apparatus eruption period of such flows in the analogous structures from the mid-ocean ridges; b) the duration of a relatively large morphosrtucture – hill formation - was considered for pillow lava structures; the approximate duration is 55 hours at 0.3 m/s rate of magma flow from the channel mouth (Table 1).

Thus, feeding of submarine eruptions in the low-depth magmatic source of the Cleft segment is of the same order of magnitude with that in the Eastern rift zone of the Kilauea volcano (Hawaii) where the feeding sources are located approximately at the same depth (Magmatism of Hawaii, 1987).

The work was supported by RFBR (no. 99-05-64599)