CRYSTALLIZATION CONDITIONS OF TERPUK AREAL BASALTS (SREDINNY RIDGE, KAMCHATKA)

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The study of the products of the Holocene areal volcanism of the northern part of the middle ridge of Kamchatka is interesting in that the Holocene volcanism of this zone cannot be unambiguously interpreted neither as the reflection of the conditions of the rear unit of the contemporary island arc nor as the relict volcanism of earlier than the existed on Sredinny Ridge island arc.From this point of view, are most interesting the basaltic flows of the region of g.Terpuk, which are located to northwest from Shiveluch, northern active volcano of Kamchatka island arc.For determining the specific character of melts, evaluation of the compositions of the primordial melts and parameters of their existence were studied the large (50-100 mkm) melt inclusions in olivine phenocrysts ($Fo_{82.7-85.2}$).Using melt inclusion compositions, the results of calculations in COMAGMAT software and data of spinel/melt equilibrium, are obtained the estimations of the intensive parameters at the crystallization of the magmas of the northern part of the middle ridge in central Kamchatka.

Melt inclusions were reheated to the temperature 1250 C with the controlled oxygen fugacity at the level CCO buffer, they were sustained at this temperature during 6-10 min. and, then they were quenched. The studied grains of olivine had a composition $Fo_{82.7-85.2}$. The inclusions, which exceed with the sizes of 25 mkm, were analyzed by EPMA (EDS) employing routine procedure [e.g. Gramenitskiy et al.., 2001]. All compositions are the high-alumina melts, which in the content K2O are subdivided into two groups: low-K (K2O ~ 0.25-0.35) and middle-K (K2O ~ 0.5-0.9). The compositions of melts are represented in tab. 1. The compositions of the coexisting olivine are actually equal for the compositions of inclusions of different groups.

Sample	SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cr_2O_3	Fo#
02/20 - 1	47.98	0.37	20.14	10.05	0.06	7.34	8.87	4.88	0.22	0.02	0.10	83.63
02/20 - 2	45.76	1.87	17.52	10.10	0.28	7.56	11.97	4.00	0.55	0.33	0.06	84.29
02/20 - 3	46.31	1.69	17.99	10.07	0.20	7.86	11.41	3.63	0.44	0.41	0.00	84.47
02/20 - 4	48.12	0.78	20.05	10.04	0.17	7.19	9.43	3.75	0.34	0.13	0.04	82.69
02/20 - 7	47.47	1.57	17.59	10.03	0.34	7.79	9.95	3.92	0.84	0.51	0.00	84.32
02/27 - 12	47.42	1.51	17.11	10.03	0.20	8.49	10.67	3.20	0.83	0.47	0.06	85.18
02/27 - 13	47.98	1.73	17.33	10.03	0.22	7.21	10.45	3.49	0.99	0.54	0.07	82.89

Table 1. Melt compositions of Terpuk areal basalts. These compositions were calculated from melt inclusions compositions by reverse crystallization of host mineral. Fe-loss effect was took into ccount.
* total FeO is taken as FeO in whole rocks.

Calculations with COMAGMATE software (P= 1 atm) shows that both groups can be considered as the cotectic systems (Ol+Pl) with temperatures of liquidus curve near 1230 C for low-K melts and 1200 C for middle-K group.One group of melts corresponds to low-potassium tholeiits, which common in frontal parts of the island arcs, and another group of melts corresponds to middle-K high-titanium basalts.The mixing of such different melts with the formation of areal basalts makes it possible to speak about the multilevel processes of magma generation for the Holocene volcanism of middle ridge.

For the olivines, which contain only middle-K melt inclusions, is characteristic the abundance of the chromspinel inclusions, which form groups and chains. Combining data by the spinel compositions with the results of the simulation of the initial stages of crystallization and equilibrium calculations

spinel/melt (Poustovetov, Royeder, 2001), it was possible to estimate pressure and oxygen fugacity conditions.

The procedure of calculation (fig. 1) consisted in the fact that with the assigned composition of melt and oxygen fugacity by the model COMAGMATE 3.52 were determined the values of the temperature of crystallization and liquid-water content in the system. Further, taking into account the obtained temperature, were performed uses according to the model spinel/melt (Poustovetov, Royeder, 2001) for determining the pressure. The pressure value was selected in such a way that at this pressure the calculated composition of spinel would most correspond precisely to the measured composition. With the following step we again returned to the users according to the model COMAGMATE 3.52, but already taking into account the obtained pressure. Thus, it was determined the new calculated temperature, taking into account which again were performed the uses of pressure according to equilibrium model spinel/melt. As a result, after several similar iterations, the values of pressure and temperature converged to the specific values: the temperature of 1195 C and pressure 1,3 kbar.

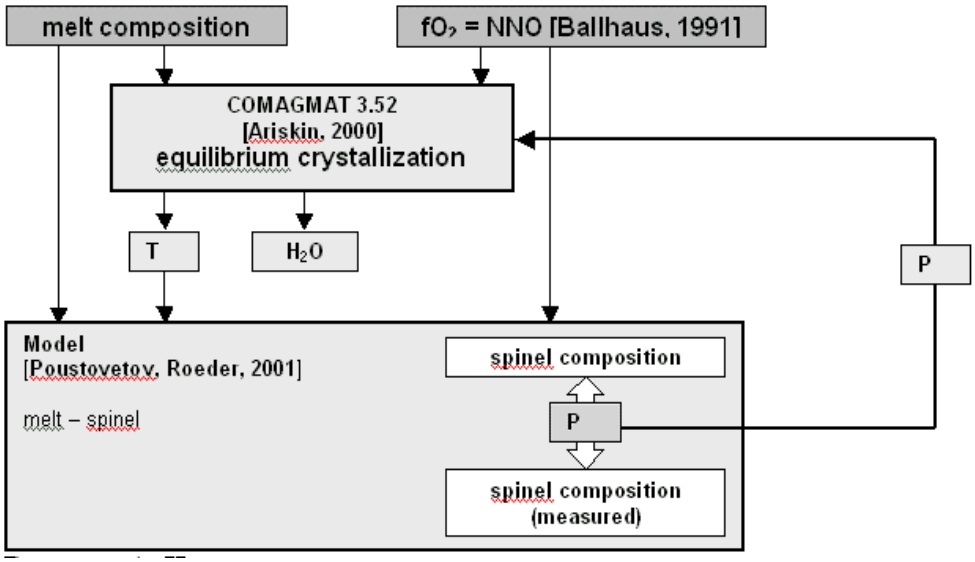

Fig. 1. Scheme of iteration calculations, which was used for determinaton of temperature, pressure, water content and oxygen fugacity of crystallization.

Thus, the physical chemistry conditions of crystallizing basalts had the H_2O contents near 0.2 mass %, the pressure 1.3 kbar and temperature near 1195 C. The oxygen fugacity, evaluated at this temperature on Ol-Sp oxygen barometer [Ballhaus et al,1991], corresponds to buffer equilibrium nickel-bunsenite (NNO).

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Reference:

1. Explanatory note to the geological map of USSR 1:200000, a series Western- Kamchatka, sheet O - 57-XXVIII, 1971
2. Ballhaus, C., Berry R. F., et al. (1991). “High pressure experimental calibration of the olivine-orthopyroxene-spinel oxygen geobarometer: implications for the oxidation state of the upper mantle.” Contributions to Mineralogy and Petrology 107: 27-40.
3. Gramenitskiy YE.N., Kotelnikov A.R., Batanova A.M., Shchekina T.I., Pletchov P.Yu.(2000) "Experimental and technical petrology", Moscow, Nauchniy Mir, 415 pp.

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