CHEMICAL COMPOSITION, VOLATILE, AND TRACE ELEMENTS OF MAGMAS FROM KAMCHATKA VOLCANOES: EVIDENCE FROM MELT INCLUSIONS.

TOLSTYKH, M. L.[1], NAUMOV, V. B.[1], BABANSKI, A. D.[2]
[1] Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, ul. Kosygina, 19, Moscow, 117975, Russia.
[2] Institute of Geology of Ore Deposites, Petrography, Mineralogy and Geochemistry, Russian Academy of Sciences, Staromonetnyi per., 35, Moscow, 109017, Russia.
E-mail: Mashtol@museum.ru

The origin of andesites is known as one of most important petrological problems. Now it is established that the chemical composition of the continental crust is near to that of andesites (Ronov et al., 1990; Taylor, McLenman, 1985). The association of andesitic volcanism with the island-arc regions, being formed in the peculiar tectonic conditions, is also well known. The Kuril-Kamchatka island-arc system is considered as unique region in Russia for the reconstruction of andesitic volcanism geological events so that the data on the broad compositional range of andesitic melts as well as on their genesis could be obtained.

The set of andesitic formation models is various and claimed by a number of authors. It can be concluded that andesites are formed in a multistage process, including the mixing of melts having different basicity, the processes of wall-rock contamination and, perhaps, the incomplete fractionation of crystals (cumulative process). Here we discuss this problem in terms of melt inclusion data in minerals of some Kuril-Kamchatka volcanoes.

More than 200 melt inclusions in andesitic basalts and andesites were studies. The volcanoes in question are located in the Central Kamchatka depression (Sheveluch, Bezymyanny volcanoes), East Kamchatka volcanic belt (Avachinsky, Karymsky volcanoes) and Dikiy Greben dacitic volcano (Southern Kamchatka). The melt inclusions were homogenized and their composition was determined in correspondent quenched glasses by electron and ion microprobe analysis.

It was found that the chemical composition of melt inclusions from andesitic phenocrysts is highly variable in basicity: SiO_2 content is corresponding to 56 - 80 wt % range with the regular decrease of Al_2O_3, FeO, MgO and CaO content along with alkalies increase (Na_2O, K_2O). About 80 % of studied glass samples show the dacitic and rhyolitic chemical composition, but the samples of acidic composition (SiO_2 > 65 wt %) are sufficiently different from the dacitic and rhyolitic ones in TiO_2, FeO, MgO, CaO and K_2O content. Melt inclusions with high potassic melts (K_2O = 3.8 - 6.8 wt %) were found in all volcanoes studied, having no correlation with SiO_2 content (51.4 - 77.2 wt %). This fact is indicating the contribution of some potassic enriched fraction in the the process of magma generation of the Kuril-Kamchatka region. Firstly the great differency of chemical composition of melt inclusions in the same plagioclase phenocrysts from Bezymyanny volcano was established indicating the multistage history of such phenocryst formation corresponding to complicated melt evolutionary trend.

The melts of different volcanoes are markedly variable in their volatile content. The greatest H_2O content was found in Sheveluch melts (3.0 - 7.2 wt %, 4.7 wt % as an average) and Avachinsky melts (4.7 - 4.8 wt %), whereas Dikiy Greben and Bezymyanny melts show low H_2O content (0.4 - 1.8 wt % and < 1 wt % correspondingly). Chlorine content is also variable: from 0.09 wt % (average) in Bezymyanny volcano melt inclusion up to 0.26 wt % (average) in Karymsky samples. Intermediate chlorine contents (0.13 - 0.20 wt %) were found in melt inclusions of phenocrysts from Avachinsky, Dikiy Greben and Scheveluch volcanoes. CO_2 fluid inclusions in andesitic plagioclase samples of Sheveluch volcano were also studied. It was found that the pressure of its formation could be estimated as 350-1600 bar corresponding to 1.5 - 6.0 км of magmatic camera depth.

17 trace element contents were determined in melt inclusion glasses in plagioclase samples from 4 volcanoes (Avachinsky, Bezymyanny, Dikiy Greben, Sheveluch). All the melts studied are rather near in the distribution pattern of trace elements: they are characterised by the relative minimum of Nb and Ti content, maxima of B, K, Be, Li and heavy REE depletion, all these peculiarities being typical for the island-arc magmatic calc-alcaline series. In terms of Sr/Y, La/Yb, K/Ti and Ca/Sr ratios our melts are similar to island-arc typical magmas with subordinate regional geochemical differences. REE distribution curves indicate the different stages of melt differentiation, the most advanced members are supposedly the Sheveluch volcanic melts.

References

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