THE FORMATION OF K-RICH LAVAS OF VOLCANO VESUVIUS (ACCORDING TO THE PARAGENETIC ANALYSIS AND SOME EXPERIMENTAL DATA)

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The Somma-Vesuvius volcanic complex, located east of Naples in Italy, is a part of Roman volcanic province. It is characterized by association of silica undersaturated and potassium rich rocks. In this work we consider a part of these volcanic products, presented by tephrites, basanites and ultrabasic nodules.

The study of morphological features and chemical compositions of minerals, composing products of volcanic activity of Vesuvius (ultrabasic inclusions, tephrites, basanites) revealed several paragenesises of minerals. The following paragenesises of nodules were studied: olivine + clinopyroxene + shpine; clinopyroxene + phlogopite + titanian magnetite; clinopyroxene + phlogopite + titaniferous magnetite + apatite. In lavas we investigated the paragenesises of olivine + clinopyroxene + titaniferous magnetite; clinopyroxene + leucite + plagioclase + titaniferous magnetite; olivine + clinopyroxene + leucite + plagioclase + titaniferous magnetite + apatite. The identity of chemical compositions each of minerals of early paragenesises of nodules and lavas proves the formation of these paragenesises from common magmatic melt. In the evidence of oxygen fugacity increasing one can consider a changing of accessories from spinel to titanian magnetite in this rocks.

The evolution of mineral compositions and the cause of a variety of paragenesises in volcanic products were determined. The occurrence of phlogopite and leucite in volcanic products proves the extended magmatic evolution with the potassium accumulation. Increasing of calcium content in pyroxenes from the ultrabasic nodules and the constant of it content in pyroxenes from lavas (with co-existing plagioclase) proves the calcium enrichment of magma. The increasing of calcium content in magmatic melt is verified by the comparison of calcium content in lavas of recent and previous periods of Vesuvius activity. Lavas from recent period of activity contain more calcium, than lavas from previous period. Occurrence of diopside on the early stages of magma crystallization proves the alkali enrichment of primary magma. According to the Korzhinsky's theory, the increasing of activity of one basic component in magma increases the activity of another basic component. So, we can explain described evolution of melt by the consecutive assimilation of crustal components, consists of mica shales and dolomites. Increasing of calcium content in magma makes potassium more active. As a result the occurrence of potassium minerals leucite and phlogopite is observed. The data of paragenesis analysis confirms by the results of determination of $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios and other isotopic characteristics [1]. The rocks of Vesuvius are enriched by LREE – elements and large-ion elements of K-group. This fact is explained by assimilation of crustal material and enriched mantle source of magma. Presence of phlogopite in nodules and leucite in lavas suggests different fluid conditions of the rock formation.

Experimental studies of fluid inclusions in different minerals [2] prove changing of fluid conditions during crystallization. It is supposed, that mineral variety in nodules and lavas causes by different composition of fluid. The results of study of fluid inclusions allow to estimate the compositions of fluid during the nodules and lavas formation as: for nodules - H_2O (~70%), CO_2 (~25%) and other components (~5%); for lavas - H_2O (~20%), CO_2 (~75%), SO_3 and other components (~5%). Since the fluid composition determine the mineral composition of rocks, high concentration of H_2O in fluid contributes the crystallization of phlogopite and low H_2O content in fluid contributes the formation of leucite. Changing of fluid composition can be explained by the follow reaction, in which fluid is enriched by CO_2:

$$CaMg(CO_3)_2\,(Dol) + 2SiO_2(melt) = CaMgSi_2O_6\,(Di) + 2CO_2\uparrow$$

The estimation of formation temperature of the early paragenesis in lavas (basanites) and ultrabasic nodules was conducted using Loucks olivine – clinopyroxene thermometer [3]. The accuracy of this thermometer is ±50°C. The formation temperature of the first paragenesis on our data is 1150–1250°C, which is close to results of [4] on silica-melt inclusions investigations - 1220 ± 50°C. The pressure of formation of this paragenesis on data of Vagelli et al. (1993) is equal 4.5 kbar, that correspond the formation in the depth of 10 – 15 km.

The volcanism of Roman alkaline province reflects the enrichment of mantle source. The regularity of mineral evolution of products of Vesuvius depends on potassium activity in the magmatic melt. The successive variations of mineral compositions of Vesuvius volcanic products depends on several processes during the magmatic evolution: 1) the increasing of calcium, aluminium, potassium contents in magmatic melt; 2) the increasing of activity of potassium in melt; 3) the changing of composition and fugacity of fluid, which depends on the crustal material assimilation.

References

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