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Reactionary Phenomena at the Phase Boundary of Granitic Melt and Basic Rocks

Tatyana I. Shchekina (tishchek@geol.msu.ru), **Eugeniy N. Gramenitskiy** (engramen@geol.msu.ru), **Anna M. Batanova** & **Tatyana A. Kurbyko**

Department of Petrology, Faculty of Geology, Moscow State University, Vorobyovy Gory, Moscow, 119899, Russia

A series of experiments has been carried out to simulate the interaction process of the model granite melt with the common igneous rocks (olivine pyroxenite and quartz-normative dolerite). Trace elements Ga and Ge were introduced to the granite glass as oxide in amount of 4 and 3 wt.%, respectively. It was demonstrated, that in "dry" (1150ºC - 1200ºC, 1 atm) and in hydrothermal (800ºC, 1000 bar) conditions, the interaction leads to the initiation of the reactionary zoning. As distinguished from similar metasomatic columns, in this case zones are built not only of the crystalline phases but of the melt too. The substitution of the crystalline phases by the melt is similar in morphology to the mineral pseudomorph development at metasomatism. In all cases the homogeneous melt formation is proved in back parts of the columns. This melt grade into granite one, contaminated by the rock components. The diffusion transference of the substance realises through both a fluid and a melt. By the relative role of these mediums next types are evident: 1. Initial rock and reactionary zones remain in crystalline state. Diffusion is effected mainly through a fluid. An example is hydrothermal run (800ºC, 1000 bar) on monolithic sample of pyroxenite. At 200 mkm distance from the phase boundary of rock and granitic melt reactionary edging is produced between olivine and plagioclase in pyroxenite: i)Opx; ii)Cpx+Phl; iii)Am. It was derived from reaction of olivine with plagioclase in SiO_2 and K_2O diffusion from the granitic melt. Away from the original contact this reactionary edging is not observed. Just before the contact olivine is replaced by orthopyroxene, plagioclase - by the glass, clinopyroxene and amphibole disappears. Orthopyroxene is separated from the granite glass by phlogopite edging. 2. In reactionary zone the new formation of the melt occurs by the replacement of crystalline phases one after another in succession. The column with monolithic pyroxenite in "dry" (1150ºC) and grinding pyroxenite in hydrothermal (800ºC) conditions fall in to this type. In the "dry" run lamellae of clinopyroxene in orthopyroxene are replaced completely by aggregate of glass and $MgFe_2O_4$ close to the contact with granitic melt. In this case the orthopyroxene grains shapes and the clinopyroxene lamellae contours are fully conserved. In the back zone Mg-rich orthopyroxene is keyed to glass. Diffusion is effected mainly through the melt and solid phases. At interaction zone of pyroxenite and granitic melt (hydrothermal run, at 200 mkm from the contact) orthopyroxene and plagioclase are replaced by aggregate of glass and phlogopite, according to the reaction: reactants and products should be searated by Opx + Pl + (K_2O) (r) Phl + L + (FeO + CaO + Na_2O). The reaction is followed by addition of K from granitic melt and removal of Fe and Ca from pyroxenite to the melt. Ga (3,6%), Ge (0,64%) also enter into the composition of phlogopite. In this case diffusion is effected mainly through the melt zones close to initial contact (200 mkm) and a fluid - away from it. 3. In reactionary zone granitic melt interact with the rock, which exhibits partial melting under experimental P-T conditions even without granite melt. Diffusion of the components is effected both through an inter-grain melt and a fluid across the column. The columns with dolerite at (1150ºC, 1 atm) and (800ºC, 1000 bar) conditions and with pyroxenite (1200ºC, 1 atm) fall in to this type. Reaction of anatectic melting in pyroxenite is the result of local diffusion interaction between orthopyroxene and plagioclase: Opx14 + An60 = Opx7 + An73 + Ol4 + $MgFe_2O_4$ + L (andesitic - basaltic melt). The intensive diffusion of Ga and Ge is observed for a distance more than 200 mkm in the contact of anatectic and granitic melts whereas in the crystal phases it is no more than 30 mkm. On coming in contact with granitic melt (800ºC, 1000 bar), only plagioclase, orthopyroxene and glass remain in zone of dolerite (300 mkm). In this zone trace elements enter into the composition of minerals and coexisting glass: 1.2% Ga and 0.2% Ge into plagioclase, 1% Ga and 0.3% Ge into orthopyroxene, 1.64% Ga and 0.7% into glass. At the end of column (18000 mkm) the content of Ga is less than limit of determination, Ge - 0.1 - 0.2%. Pyroxene, amphibole and plagioclase are corroded by melt and fluid, change their composition, but are conserved in zones far removed from contact. Effects of diffusion rate difference in the melt for distinct components are detected. The alkaline metals contents level off in some zones of the column, hence their fully mobile behaviour is simulated. These runs model directly the assimilation and anatexis processes. The experimental results apply to description of the infiltration magmatic substitution according to mineral compositions of column zones and replacement mechanisms. At the same time the direction of established reactions, changes of mineral compositions, as well as complementary changes of melt and rock compositions is opposite in many cases to that ones, which are observed in granitisation areas. These facts base the distinction criteria of processes being considered.