Assimilation and diffusion during xenolith-magma interaction

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Magmatic enclaves from the Rudolfov quarry near Liberec (Czech Republic) are interpreted to represent remnants of lamprophyric melt that intruded the Karkonosze granite at a stage at which the granite was not fully solidified. Based on the observation that larger enclaves are generally more circular than the smaller ones, we conclude that bigger blobs of mafic magma became more spherical during flow in the gravity field (sink or float). This flow is also interpreted to be responsible for the incorporation of mineral grains into the enclaves and may have facilitated the assimilation of granitic melt. Linear mixing trends on Harker diagrams for most network-forming and mainly slow-diffusing or fluid-immobile elements indicate such an assimilation process between granite and lamprophyre. In contrast, all fast-diffusing or fluid-mobile elements display scattered element distributions, implying that chemical diffusion also played a role. Pressure and temperature for this late magmatic stage are estimated at around 1 kbar and 500ºC. These results suggest that two processes modified the composition of the enclaves in the Karkonosze granite: (1) assimilation (mechanical mixing) of granitic melt during the injection of the lamprophyric melt and the subsequent flow of the forming enclaves in the gravity field (responsible for the linear mixing trends) and (2) diffusion-controlled redistribution of elements between both solidifying rock types at the magmatic stage and/or due to late-stage magmatic fluids (responsible for the scattering and deviation from the linear mixing trends).