Experimental determination of liquidus H_2O contents of simple granites at deep crustal conditions

A.R. MAKHLUF, R.C. NEWTON, C.E. MANNING

Department of Earth, Planetary, and Space Sciences University of California, Los Angeles, CA, USA

The liquidus water content of a granitic melt at high pressure (P) and temperature (T) is important because it constrains the volume of granite that could be produced by melting of the deep crust. Previous estimates based on melting experiments at low P (≤0.5 GPa) show substantial scatter when extrapolated to deep crustal P and T (700-1000°C, 0.6-1.5 GPa). To improve the high-P constraints on water concentration at the granite liquidus, we preformed experiments in piston-cylinder apparatus at 1 GPa using a range of granite compositions consisting of albite, orthoclase and quartz. In each experiment, granite glass + H_2O was homogenized well above the liquidus T, then T was lowered by increments until quartz and alkali feldspar crystalized from the liquid. To establish reversed equilibrium, we crystallized the homogenized melt at the lower T, then raised the T until we found that the crystalline phases were resorbed into the liquid. The reversed liquidus temperatures at 2.97, 4.15, 5.82, 7.92, and 12.00 wt% water are respectively 950-985, 875-910, 800-850, 750-775, and 650-675°C. Our results plot on the extreme end of the extrapolated water contents at the liquidus when compared to all other previous determinations, and, as a result, give significantly higher water contents than used by most dehydration melting models. This presents a challenge for producing voluminous amounts of metaluminous granites from lower crustal biotite-amphibole gneisses by dehydration melting. For example, a deep-crustal tonalitic gneiss with 0.6-0.8 wt% H_2O would yield less than 20 vol% granitic liquid for complete dehydration and perfect extractability, neither of which are likely to be realized in deep crustal melting.