Locating the granitic composition water-saturated solidus

The accepted water-saturated solidus for granitic compositions (granitic water-saturated solidus, G-WSS) was largely determined >60 years ago. Significant experimental resources using modern approaches have been allocated to defining, refining, and parameterizing the solidus positions for other rock compositions, but limited work has been performed to accurately define G-WSS. Modern experimental and analytical techniques afford the opportunity to re-investigate the position of the G-WSS. Various thermobarometric applications to many granitic and rhyolitic composition rocks commonly return temperature estimates significantly lower than the widely accepted G-WSS determined largely by Tuttle and Bowen (1958). To evaluate the apparent discrepancies and help distinguish igneous from metamorphic processes recorded in granitic mineral assemblages, we performed experiments at temperatures ranging from 575 to 900°C and 0.5 to 10 kbar on 12 granitoid compositions composed of natural and synthetic starting materials. Most starting materials were melted in the presence of water at 10 kbar and 900°C in piston cylinders and quenched to room temperature in under one minute to produce water-saturated glasses for usage in subsequent crystallization experiments. The results of experiments on glass compositions were further validated in several runs using finely-ground crystalline starting materials. We ran crystallization experiments at P-T conditions spanning the accepted G-WSS. Decreasing experimental temperatures along each isobar caused systematic decreases in melt percentages until achieving complete crystallization at solidus conditions. A time-series of experiments at P-T conditions with ~20% melt did not reveal any kinetic effects on melt crystallization. All compositions investigated contained melt to temperatures ~75 to 100°C below the accepted G-WSS. Experimental results demonstrating that the G-WSS is significantly lower than unanimously accepted estimates will help us to better understand the storage conditions and evolution of silicic magmatic systems.

Tuttle O, Bowen N (1958) Origin of Granite in the Light of Experimental Studies in the System NaAlSi3O8–KAlSi3O8–SiO2–H2O. Geological Society of America

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