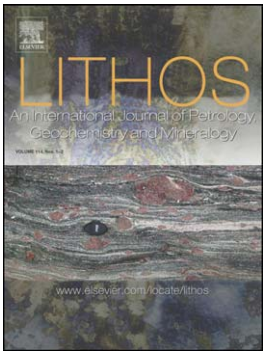

Estimation of crystallization pressure of granite intrusions

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Estimation of crystallization pressure of granite intrusions

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Abstract

A numerical method is presented to estimate the crystallization pressure of granite intrusions based on two polynomial equations obtained by an analysis of the existing haplogranite ternary phase diagram and associated dataset. The results indicate that the pressure is correlated respectively with normative quartz (Qtz) content and with normative albite (Ab) plus orthoclase (Or) contents of granitic rocks as follows.

$$P = -0.2426 \times (Qtz)^3 + 126.392 \times (Qtz)^2 - 980.74 \times (Qtz) + 12563 \quad (1)$$

$$P = 0.2426 \times (Ab + Or)^3 - 46.397 \times (Ab + Or)^2 + 2981.3 \times (Ab + Or) - 64224 \quad (2)$$

($R^2 = 0.9943$)

where P is pressure in MPa, and R denotes correlation coefficient. It is noted that the procedure of normalizing the sum of CIPW norm (quartz, albite, orthoclase) contents to 100% is required before using equations 1 and 2. The difference in pressure calculations between these two equations is ≤16 MPa for the range of normative quartz contents from 15 to 40 wt%. An example of how to use these equations to estimate the crystallization pressure of a granite intrusion is also provided to show the validity and convenience of this method. The uncertainty of such pressure estimation is not well known, although it must fall into the uncertainty range of the existing experimental work on pressure constraints.

The simplicity of this empirical method is appreciable, although its applicability to natural granitoids needs further test. More experimental work is required to constrain the effects of components, such as CaO, FeO, MgO, F, Cl, CO_2, on the granite phase equilibria. These equations, however, can be used for estimating crystallization pressures of water- and quartz-oversaturated granitic systems.

Keywords: CIPW normative quartz, albite, orthoclase; crystallization pressure; emplacement depth; granite