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The effect of water activity on the eutectic point in natural granitic system

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The water activity except for pressure is known to be the most important parameter affecting the eutectic point in granitic systems. Water saturated magmas have lower solidus temperatures than water undersaturated magmas (Johannes, Holtz 1996). Water activity influences also Ab-Or relation in granitic systems (Holtz et al. 1992). Mineral phases present in water saturated conditions differ from those present in water poor conditions (Dall'Agnol et al. 1999).

This effect of water activity on the granitic system has so far been analyzed on synthetic materials. Other parameters which would affect the eutectic point might exist in a natural granitic system. Therefore, two natural samples of Wangrah granites from Australia were taken to analyze their crystallization path. They were chosen so they had very similar composition in terms of Qz-Ab-Or, but different in terms of Ca and Fe contents. The homogenous glass powder was used as a starting material. The water was added to reach water saturated conditions. The water and silver oxalate were added to reach water undersaturated conditions. Crystallization experiments with both samples were performed in cold seal pressure vessel (CSPV) in the temperature range of 680-720ºC for water saturated conditions and 765-815ºC for water undersaturated conditions. The pressure of 2 kbar and oxygen buffer NNO were established for 15 days. The phases were identified and glass composition was determined by an electron microprobe. The water content of glass was measured with the use of near infrared spectroscopy.

The results were plotted on the Qz-Ab-Or diagram with application of Blundy and Cashman corrections (Blundy, Cashman 2001) for the An content. Two very similar compositions in terms of Qz-Ab-Or show a different position of their cotectic lines for water saturated conditions. One possible explanation of this fact is that the projection of Blundy and Cashman does not account accurately for the effect of Ca. The alternative explanation is that there must be other parameters controlling the position of the cotectic line, one of them may be Fe. In any case, one cannot simply project natural granite or rhyolites on the Qz-Ab-Or diagram to extract quantitative information on pressure or water activity of granites or rhyolites. A new set of experiments should be performed to clarify this problem.

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