

## Potential temperatures of convecting mantle based on Al partitioning between olivine and spinel

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Knowledge of potential temperatures of convecting mantle is required for the understanding the global processes on the Earth [1]. The common way to estimate these is the reconstruction of primary melt compositions and liquidus temperatures based on the Fe-Mg partitioning between olivine and melt. This approach requires knowledge of the compositions of primitive melts in equilibrium with olivine alone as well as composition of olivine equilibrium with primary melts. This information is in most cases unavailable or of questionable quality. Here we report a new approach to obtain crystallization temperatures of primary melts based on the olivine-spinel Al-Cr geothermometer [2]. The advantages of this approach are: (1) common presence of spinel in assemblage with high-Mg olivine and (2) low rate of diffusion of Al in the olivine, which promises to preserve high magmatic temperatures.

We analysed over one thousand spinel inclusions and high-Mg host olivines from different MORB, OIB and Archean komatiites on the JXA-8230 EPMA at ISTerre, Grenoble, France. Concentrations of Al, Ti, Na, P, Zn, Cr, Mn, Ca, Co, Ni were determined with a precision of 10 ppm (2 standard errors) using a newly developed protocol [3]. When available, we also analysed matrix glass and glass inclusions in olivine and found that temperature estimations from olivine-spinel (Al-Cr) and olivine-melt (Fe-Mg)[4] equilibrium match within (+/-30 degree C).

The results show contrasting crystallization temperatures of Mg-rich olivine of the same Fo content from different types of mantle-derived magmas, from the lowest (down to 1220 degree C) for MORB to the highest (up to 1500 degree C) for komatiites. These results match predictions from Fe-Mg olivine-melt equilibrium and confirm the relatively low temperature of the convecting mantle source of MORB and higher temperatures in the mantle plumes that produce the OIB of Iceland, Hawaii, Gorgona, and Archean komatiites.

[1] McKenzie & Bickle, 1988, *J. Petr.* 29, p 625-679. [2] Wan et al, 2008, *Am. Min.* 93, p1142-1147. [3] Batanova & Sobolev, 2013, *Min. Mag.* (this issue). [4] Ford et al, 1983, *J. Petr.* 24, p 256-265.

## Crystallization of P-rich minerals from the high phosphorus rare-metal magma of East-Kalguty dyke belt (S.Altay, Russia)

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High phosphorus content is an important feature of some highly evolved peraluminous Ca-poor granitoids, associated with ore deposits. East-Kalguty dyke belt (South Altai, Russia) is one of the few representatives of rare-metal rich felsic high-phosphorus rocks (avg 0.39 wt % P<sub>2</sub>O<sub>5</sub> and ASI=1.23). In this case alkali feldspars (Af) represent significant reservoir of phosphorus, containing 0.14 wt % P<sub>2</sub>O<sub>5</sub> in average. Incorporation of P into feldspars involves the substitution  $2\text{Si}^{4+} = \text{Al}^{3+} + \text{P}^{5+}$ [1].

Average P-content 0.27 wt % of P<sub>2</sub>O<sub>5</sub> in the melt equilibrated with Af phenocrysts from dyke rocks was calculated from dependence  $\text{ASI} = 0.7273 * \text{D}[\text{P}]/\text{Af}/\text{melt} + 0.7818$  derived by D.London on the basis of experimental data [1].

Direct measurement of P<sub>2</sub>O<sub>5</sub> by EMPA in melt inclusions in quartz phenocrysts showed 0.29 wt %, which is in good agreement with the calculated value. This means that Af crystallized from the same melt with quartz phenocrysts.

Comparison of Ca and P content, and Ca/P ratio in the melt inclusions and rocks shows that apatite crystallized before entrapment of the melt inclusions in quartz. Low Ca content results in excess of phosphorus in the evolved melts, which was later incorporated into feldspars and ambligonite LiAl[PO<sub>4</sub>](OH). Main intrusive phase of the Kalguty granite massif, preceding to rare-metal dykes, have P-content close to the clark of felsic rocks [2]. The increase of P in latest dykes, which reaches a maximum in the rare-metal rich dykes is explained by introduction of phosphorus by external fluids into magmatic system with subsequent its accumulation in the course of magma differentiation.

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[1] London (1992), *American Mineralogist* 77, 126-145. [2] Vinogradov (1962), *Geochemistry* 7, 555-565