Modeling heat transfer from convecting, crystallizing, replenished andesitic magmas at oceanic spreading centers

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Although most hydrothermal systems at oceanic spreading centers are driven by basaltic sub-axial magma chambers, some hydrothermal fields (e.g. at the 9°N overlapper on the EPR and at Eastern Lau Spreading Center and Manus Basin) are underlain by high-silica andesite and dacite magmas. The kinematic viscosity of these magmas differ significantly from one another. Mid-ocean ridge basalt magmas are very dry, hence viscosity depends mainly on the crystal content and to a lesser degree on temperature whereas the viscosity of high-silica magmas is also affected by water content. As a result of their higher silica content and lower liquidus and solidus temperatures, these magmas have a greater viscosity than basaltic magmas.

We have incorporated an equation for the viscosity of andesitic magma [1] as a function of temperature, crystallinity and water content into our earlier model of magma convection [2] in order to determine the convective heat flux magmas having a range of silica and H_2O contents.. Simulations comparing dry basalt, 0.1 wt.% H_2O andesite and 3 wt.% H_2O andesite show that higher viscosity andesitic magmas convect less vigorously than their basaltic counterparts, which results in both lower initial heat flux and in a slower rate of decline of the heat flux. Heat flux data are not available for hydrothermal systems driven by andesitic magmas at oceanic spreading centers, but the initial simulated heat flux of ~ 100 W/m^2 is still likely to be sufficient to drive observed hydrothermal venting. The slower rate of decay suggests that hydrothermal systems driven by andesite could have longer lifetimes than those driven by basalt. Because magma replenishment is needed to maintain hydrothermal temperatures, however, the higher viscosity, andesitic magmas may undergo slower rates of replenishment. Hydrothermal activity of andesite-hosted systems may exhibit greater temporal variability related to magmatic heat flux than those underlain by basaltic magma.

[1] Vetere *et al*. (2006) *Chem. Geol*. **228**, 233–245. [2] Liu & Lowell (2009) *J. Geophys. Res*. **114**, B02102.

Dating of multi-stage metamorphism events: Constraints on episodic zircon growth from retrograded eclogites of the South Altyn Tagh, China

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The South Altyn Tagh is an ~ 250 km HP-UHP metamorphic belt in the northwestern of China. In the Jianggalesayi, the western of the South Altyn Tagh, coesite pseudomorphs in garnet and omphacite and abundant exsolution needles of quartz in omphacite are founded [1]. Recently, Liu *et al*. [2] discovered evidence of former stishovite in metamorphosed sediments, and the minimum metamorphic pressure was estimated to exceed 12 GPa.

Although many U–Pb zircon age studies have been performed on these HP/UHP rocks, the geochronological of peak or retrograde metamorphism is still oversimplified. Based on mineral inclusion, cathodoluminescencent (CL) images, trace element analyses, and high precise U–Pb age obtained from distinct zircon domains of the Jianggalesayi retrograded eclogites, three discrete and meaningful age groups have been identified. Proterozoic ages of 727 and 715 Ma for dusty inherited zircon cores indicate that the protolith age of eclogite. The group of 499±5 Ma ages for grey-white luminescent zircon mantles is consistent the timing of a UHP metamorphic event studied by previous [3, 4]. The weighted means of 451 ± 4 Ma obtained from dark grey luminescent overgrowth rims represents the age of retrograde eclogite-facies metamorphism. These multi-stage metamorphism age records the information of zircon overgrowth during subduction and exhumation of the South Altyn Tagh UHP terrane, and provide the clue to constraint the exhumation rate.

[1] Zhang *et al*. (2002) *CSB* **47**, 751–755. [2] Liu *et al*. (2007) *EPSl*, **263**, 180–191. [3] Zhang *et al*. (1999) *CSB* **44**, 1109–1112. [4] Liu *et al*. (2004) *JAES* **35**, 232–244.