

Thermochemical modelling of boron incorporation in evolving oceanic crust: Insights into subarc budgets

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I have implemented a two-dimensional explicit finite-difference technique to model the thermal structure of oceanic crust cooled by conductive and advective heat transport, the latter of which is approximated by scaling thermal diffusivity, K . Effective K is related to porosity which controls fluid flow as a function of pressure (P), temperature (T), lithology, and rock closure by alteration. Also, sediment cover is studied which can strongly influence T and fluid circulation in the basement section. T at depth limits fluid penetration to the thermal cracking front and controls the circulation rate. Rock closure is controlled by defining an arbitrary sealing age, or as a function of the degree of alteration.

Recent efforts to model the incorporation of B, a highly fluid-mobile element (FME), into ocean crust have employed simple conduction equations [1] which fail to describe the T structure of crust by ignoring non-trivial advective processes. In the present model, B incorporation is simulated with T -dependent partitioning ($D_B^{\text{Solid/Fluid}}$) and various functions of fluid flow. Since experimental data for B exchange between basalts and seawater are limited, I determine D_B values analytically and use empirical data for qualitative constraints.

Issues of interest are correlations with heat flow and age to constrain thermal models of evolving ocean lithosphere [2] and constraining the FME budgets of ocean crust prior to subduction. Dehydration fluxes off downgoing slabs are the primary sources of FME signatures in arc volcanic rocks and must necessarily be influenced by variations in crustal FME budgets [3, 4]. Constraining FME budgets in ocean crust may be a valuable source of data from which to identify the effects of age and T structure on arc rock chemistry.

Initial modelling results suggest that various properties and processes affecting heat and fluid transfer will influence the magnitude of B incorporation in ocean crust. The robustness of this model will be studied through parametric sensitivity analyses and comparisons to ocean drilling data. Future work should include partitioning and isotopic fractionation for B and other FME such as As, Sb, Pb, and Li.

[1] Simon *et al.* (2006) *Chem. Geol.* **255**, 61-76. [2] Grose (2008) *in prep.* for Joint Assembly. [3] Tomascak *et al.* (2002) *Geochim. Cosmochim. Acta* **196**, 227-238. [4] Hochstaeder *et al.* (1996) *Geochim. Cosmochim. Acta* **60**, 613-628.

Spectroscopic investigation of Tellurium in Chloride brines

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The numerous oxidation states available for tellurium lead to its complex chemistry. The thermodynamic properties for the different Te-species required to build accurate models of tellurium transport and deposition in hydrothermal fluids are not currently available, making it difficult to understand, for example, the link between gold and tellurium characteristic of many gold deposits.

Previous studies focusing mainly on the lower oxidation states of tellurium, as found in most hypogene tellurium bearing minerals, failed to predict solubilities of tellurium agreeing with observations [1, 2].

This indicates that an important feature escaped the attention of previous investigators. By reassessing the stability fields of the different tellurium species in the pH- $f(\text{O}_2)$ space we noted that the stability of aqueous Te(IV) species vs. Te(-II) species increases with temperature and thus the stability domain of Te(IV) at 300°C may be much closer to the hematite/magnetite buffer than currently believed [1].

To verify these predictions, the chemistry of the Te(IV)-Cl-H₂O system was investigated over a wide range of chloride and acid concentrations, and up to 95°C, using a combination of UV-Vis spectrophotometry, ¹²⁵Te NMR spectroscopy and XAS. This combined information provides the first insight into the geochemistry of Te(IV) under mild hydrothermal conditions.

[1] McPhail (1995) *Geochim. Cosmochim. Acta* **59**, 851-866.

[2] Wallier *et al.* (2006) *Economic Geology* **101**, 923-954.