

Understanding dehydration melting of a nominally anhydrous mantle: The primacy of partitioning

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Despite advances in experimental determinations of the H₂O storage capacities in mantle minerals, the H₂O concentration required to produce dehydration melting at a given depth along mantle geotherms remains poorly known. Uncertainty persists because H₂O storage capacity measurements do not constrain the concentration or the activity of H₂O in near-solidus dehydration partial melts. Experimental determinations of mineral/melt partition coefficients for H₂O, D_H , allow estimation of the H₂O concentration in near-solidus partial melts, which, combined with thermodynamic or empirical constraints on the influence of H₂O on activities of silicate components, allow estimation of dehydration solidi. Recent experimental determinations of D_H for olivine, opx, cpx, and garnet show that in the upper 200 km of the mantle, near-solidus melts of sources with 100 ppm H₂O can have no greater than 2 wt.% H₂O. Combined with constraints on the influence of H₂O on liquidus temperature, this indicates that the solidus for mantle with 100 ppm H₂O is no more than 50 °C cooler than the dry solidus and that dehydration melting along a normal ridge geotherm begins at ≤ 80 km. Consequently, dehydration melting is not a viable explanation for the low velocity zone.

Geomicrobiology with soft X-ray scanning transmission microscopy

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Synchrotron based soft X-ray scanning transmission microscopy (STXM) is a powerful tool for spatially resolved chemical analysis. It provides speciation, quantitative chemical mapping, orientation and magnetic characterization of biochemical and non-biological components (metallic species, minerals, etc) at high spatial resolution (~30 nm) on samples that can be fully hydrated, and thus close to their natural state [1]. The principles of chemical mapping by STXM will be presented. Speciation and mapping of biofilms by correlative STXM, confocal laser scanning microscopy, and transmission electron microscopy [2] will be outlined. The capabilities of STXMs at the Advanced Light Source (Berkeley) and the Canadian Light Source (Saskatoon) will be described. Contributions of STXM to geomicrobiology will be illustrated with our recent results, as well as some from the literature. Examples will include:

- speciation and quantitative mapping of metals in natural riverine biofilms [3]
- studies of cation exchange on clays [4]
- biomineralization of calcium carbonates [5-7].

While these studies have a variety of specific goals, in total, they well illustrate the power and potential of STXM to contribute to geomicrobiological studies.

We thank D. Kilcoyne, T. Tyliszczak (ALS); K. Kaznatcheev, C. Karunakaran, D. Bertwistle (CLS-SM). Study supported by NSERC, Canada Research Chair. ALS supported by DoE-BES. CLS supported by NSERC, CIHR, NRC and the University of Saskatchewan.

- [1] Hitchcock *et al.* (2005) *J. Electron Spectr.* **144**, 259-269.
 [2] Lawrence *et al.* (2003) *App. Env. Microbio.*, **69**, 5543-5554. [3] Dynes *et al.* (2005) *Env. Sci. Tech.*, **40**, 1556-1565.
 [4] Gates, W.P. (2008, submitted) *Clays & Clay Minerals*.
 [5] Benzerera *et al.* (2004) *Geobiology* **2**, 249-259 [6] Metzler *et al.* (2007) *Phys. Rev. Lett.* **98**, 268102. [7] Obst *et al.* (2008, in preparation).