Melt permeability barriers beneath slow and ultraslow mid-ocean ridges

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The transition from slow to ultraslow spreading at mid-ocean ridges may be related to a change in the efficiency of vertical melt extraction [1]. As spreading rates decrease, some combination of reduced melt volume and thickened lithosphere results in localization of volcanic centers separated by amagmatic segments, as in the highly oblique Southwest Indian Ridge [2]. Deep, low-F melts seem to be redistributed along the axis of ultraslow spreading ridges, maybe following a permeability barrier in the lithosphere [3]. As this permeability barrier is likely associated with the rapid crystallization of plagioclase ± clinopyroxene [4], Montési & Behn [1] adopted a simple depth-dependent relation to address the efficiency of melt extraction in this environment:

$$T_{barrier} = 1240°C + 1.9z, \qquad \text{(Eq.1)}$$

We verify and refine this relation using the thermodynamics software (pH)MELTS [5] in conjunction with 2D numerical models of the mantle flow field and the thermal regime of mid-ocean ridges. We model the evolution of magma batches as they rise through the thermal boundary layer of the ridge and determine at what depth the crystallization rate is maximum as a proxy to the potential permeability barrier.

Eq. 1 appears appropriate for near-axis melt trajectories at slow to fast spreading ridges where there are high aggregate melt fractions (> 15 wt. %) and the lithosphere is thin. However, at ultraslow ridges and off-axis at slow ridges, where the lithosphere is thicker and melt fractions are lower, we observe steadily increasing crystallization along melt trajectories over a wider depth interval controlled by the thick conductive lid. The protracted crystallization history may allow melt to be incorporated into the lithospheric mantle instead of being focused toward the axis, explaining the dearth of volcanism at ultraslow ridges [2, 6]. However, the potential absence of a strong permeability barrier calls for a revision of melt focusing scenarios.

[1] Montési & Behn (2007) *GRL* **34**, L24307, doi:10.1029/2007GL031067. [2] Dick, Lin, & Schouten (2003) *Nature* **426**, 405-412. [3] Standish *et al*. (2008) *G-cubed* **9**, Q05004, doi:10.1029/2008GC001959. [4] Korenaga & Kelemen (1997) *JGR* **102**, 27729-27749. [5] Smith & Asimow (2005) G^3 **6**, Q02004, doi:10.1029/2004GC000816. [6] Cannat et al. (2008) G^3 **9**, Q04002, doi: 10.1029/2007GC001676.

Ion chromatography of inositol phosphates with high resolution mass spectrometric detection

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Inositol phosphates are a class of organic phosphorus compounds that are found widely in the environment. They are the family of phosphoric monoesters of hexahydroxycyclohexane (inositol) containing 1-6 phosphate groups. Synthesized by plants and strongly complexed by metals (principally iron) in soils, inositol phosphates represent the dominant form of identifiable organic phosphorus in soils. They are also prevalent in aquatic environments, especially aquatic sediments. Inositol hexa*kis*phosphate, commonly referred to as phytic acid, is by far the most prevalent of these compounds. Despite their significant presence in the environment, the role of inositol phosphates in the phosphorus cycle remains poorly understood. The primary reason for this is a lack of methods available for their analysis.

Anion exchange chromatography coupled to electrospray ionization-time of flight mass spectrometry with ion suppression has been used to develop a fast analytical method for the determination of phytic acid. Using a strong hydroxide mobile phase, phytic acid could be eluted in less than six minutes. Detection of phytic acid was achieved by monitoring an extracted ion mass chromatogram at *m/z* =659, the molecular ion peak of the compound (Figure 1). This method has been applied to detect and quantify phytic acid in soil extracts from the Florida Everglades and the United Kingdom.

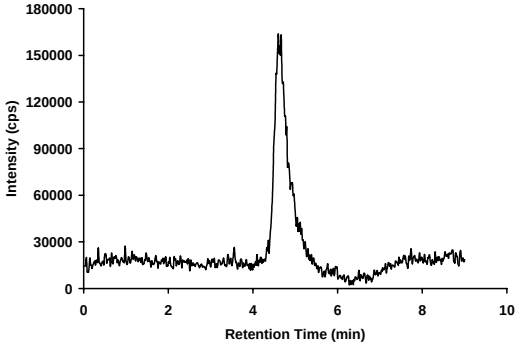

Figure 1: Extracted ion mass chromatogram at *m/z* = 659 of a United Kingdom pasture soil extract.