Time scales of magma reservoir processes from U-series dating of crystals

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Recent advances in analytical techniques, for example, measuring trace elements at small spatial scales, have resulted in advances in a wide variety of approaches to extracting information about magma dynamics from crystal records [e.g., 1]. U-series disequilibrium offers one of the only ways to obtain absolute ages of crystals over time scales relevant to dynamics of crustal magmatic systems (10's of yr to 100's of kyr) and therefore provides a key element to studies of crustal magma dynamics, particularly when combined with other types of crystal-scale information.

In the past decade, new techniques were developed to analyze U-Th *in situ* in accessory phases [2] and to account for the effects of Ra-Ba fractionation when calculating Th-Ra ages [3]. Application of these techniques has prompted new views of magmatic processes, for example: 1) zircon ages typically pre-date eruption by tens to hundreds of thousands of years, spurring discussion over what physical form (liquid vs. mush vs. solid) magmas typically have during storage; 2) recycling of crystals (antecrysts) within a magmatic system is common and dating can be one of the most effective ways to recognize these crystals; 3) timescales of crystal storage can vary widely between different systems [4 and references therein].

New frontiers in application of U-series crystal dating to understanding magma reservoir processes are focused around combining U-series ages with other crystal-scale information to provide direct links to chemical and thermal evolution of magma bodies. I will present examples of recent and ongoing work including comparison of zircon and major-phase ages in silicic systems (Tarawera, New Zealand, and South Sister, OR), comparison of oxygen-isotope and U-series data for plagioclase in Iceland, and comparison of diffusion ages, crystal size distributions, and U-series ages of crystals in andesite from Mt. Hood, OR as windows into the timescales of mixing and pre-eruptive storage. The combination of multiple techniques shows great potential for unlocking additional information about crustal magma dynamics.

[1] Putirka & Tepley III (eds) (2008) *Rev. Mineral. Geochem.* **69**. [2] Reid *et al.* (1997) *EPSL* **150**, 27-39. [3] Cooper *et al.* (2001) *EPSL* **184**, 703-718. [4] Cooper & Reid (2008) *Rev. Mineral. Geochem.* **69**, 479-544.

Ultrahigh resolution mass spectrometry of soil porewater DOM

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Mass Spectrometry of DOM

Ultrahigh resolution (UHR) Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) has revolutionized the characterization of dissolved organic matter, providing a level of molecular detail thought impossible just a decade ago [1]. We have reported on the use of this technique to identify the reactive and refractory components of DOM in porewaters from two disticntly different geoforms in the Glacial Lake Agassiz Peatlands in the northern US [2]. This work is a part of a larger study of geomorphic and hydrological controls on carbon sequestration in peats. Recent experiments have also attempted to identify specific molecular forms of black carbon that can be leached from biochars of different origins. This dissolved black carbon may well be responsible for the enhanced productivity associated with combusted soils

Conclusions from the Molecular Characterization of Soil Porewater DOM

The ^{14}C content of respiration products in porewaters from Fen peatlands are similar to high molecular weight DOM, while respiration products in Bog peatlands are more similar to solid phase material. UHR MS confirms that DOM in sphagnum-woody plant dominated FEN peatlands is more reactive than aromatic-rich Bog DOM. We are currently exploring the *enzymatic latch model* as an explanation for this differential reactivity.

We have also been able to verify the presence of individual black carbon molecules in DOM leached from biochars. Black carbon DOM appears to have a molecular signature readily identifiable from UHR mass spectra.

[1] Stenson *et al.* (2003) *Anal. Chem.* **75**, 1275-1284.
[2] Chanton *et al.* (2008) *Global Biogeochem. Cycles* **22**, GB4022.