Using transmission X-ray microscopy, XAS, and μ-XRF to study Hg accumulation and transformation in *Spartina foliosa* and *Medicago sativa*

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Visualization of Hg accumulation within cordgrass roots (*Spartina foliosa*) and alfalfa (*Medicago sativa*) grown hydroponically in Hg (II) was accomplished using micro X-ray fluorescence (u-XRF; beam line 2-3) and full-field transmission x-ray microscopy (TXM; BL 6-2) at the Stanford Synchrotron Radiation Lightsource (SSRL, USA). The TXM has been designed to operate in the photon energy range from 5-15 keV in absorption contrast, and at 8 keV and 5 keV in Zernike phase contrast with resolution as high as 30 nm. Micro-XRF, and TXM with 2D absorption contrast images and 3D nano-tomography have revealed microorganisms within the rhizosphere of *S. foliosa*, presumably sulfate reducing bacteria, with Hg bound to the surface. Speciation of plant roots using X-ray absorption spectroscopy (XAS; BL 9-3) as well as micro-XAS (Hg L_3 XANES) revealed Hg transformation from $HgCl_2$ to thiol-bound Hg, methylmercury and metacinnabar compounds, consistent with a view of Hg methlylation in progress. Imaging and speciation/ transformation results will be presented for Hg in alfalfa as well.

Oxygen and strontium isotope zonation in shear zone garnet: Evidence for open system exchange

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Sm-Nd geochronology of a large garnet from a shear zone in the Tauern Window, Austria has revealed within its 8Myr growth history two pulses of accelerated garnet growth [1]. We have measured O and Sr isotopic zonation in the same garnet to test the hypothesis that fluid infiltration acted as a catalyst for garnet growth during these pulses.

Crushed cleaned samples (~2mg/ea) were taken from 12 chemically contoured concentric growth zones within the garnet from core to rim for oxygen and Rb/Sr isotopic analysis. From core to rim of the garnet $\delta^{18}O$ values increased from 4.8 to 5.6‰ over ~2.5 cm along a roughly linear radial trend (r^2= 0.84). Within the resolution of the oxygen isotope data (±0.1‰) no deviations from the linear trend were found to correlate with the growth pulses, though the possibility of more subtle correlations is not precluded by the data.

Calculations based on the mineralogy of the sample (garnet, biotite and chlorite with rare chloritoid inclusions in garnet) and the estimated temperature range during which garnet grew (peak temperature of 540-575°C, with core-to-rim temperature change less than 10°C [2]) reveal that neither temperature nor assemblage changes are likely to have produced the observed increase in $\delta^{18}O$. Instead, an open-system interaction with a higher $\delta^{18}O$ fluid is required.

$^{87}Sr/^{86}Sr$ data (age corrected to initial values at ages of growth from Sm/Nd geochronology [1]) also show prounounced zonation from 0.711 near the core to 0.713 near the rim. The relationship of initial Sr isotopic variations to growth age shows large deviations from linear radiogenic increase, indicating that open system exchange of Sr and/or Rb must also have occurred during garnet growth.

Previous work showed evidence for metasomatising fluid flow before garnet growth [2], the effects of which included a decrease in $\delta^{18}O$ [3]. Our data suggest exchange with a different fluid source, which altered both $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ in the shear zone during garnet growth, the effects of which may have included catalysis of the garnet-forming reaction.

[1] Pollington & Baxter (2009) *GCA* **73**, A1038.
[2] Selverstone *et al.* (1991) *J. Met. Geol.* **9**, 419–431.
[3] Barnes *et al.* (2004) *J. Met. Geol.* **22**, 283–300.