In situ immobilization of Pb using a natural Mn oxide by-product amended to contaminated soil

K.L. JOHNSON[1]*, C.M. MCCANN[2], J. TOURNEY[1], R.J. DAVENPORT[2], S.A. ROBERTSON[1], N.C. FINLAY[1], N.D. GREY[2], M. WADE[2] AND K. HUDSON-EDWARDS[3]

[1]School of Engineering and Computing Sciences, Durham Univ., Durham, DH1 3LE, UK (*correspondence Karen.johnson@durham.ac.uk)
[2]School of Civil Engineering and Geosciences, Newcastle Univ. Newcastle, NE1 7RU, UK (clare.mccann@newcastle.ac.uk)
[3]Department of Earth and Planetary Sciences, Birkbeck Univ. London (k.hudson-edwards@bbk.ac.uk)

Natural Mn oxide (NMO)-coated sand byproducts from the water treatment industry were assessed as a potential remediation amendment for in situ immobilization of Pb in contaminated soils. Sorption of Pb by the NMO was found to be pH dependent in aqueous batch experiments and qmax was calculated. The viability of NMO amendment as a remediation strategy was determined through a 10 month outdoor lysimeter trial using naturally Pb contaminated soils mixed with 10 % by weight NMO. After 10 months available pore-water Pb did decrease but bioaccessibility data was equivocal and at odds with other literature e.g. [1],[2].

Our data, the first to explore the use of natural manganese oxides in contaminated soils suggests that it is difficult to establish a statistically significant reduction in available Pb concentrations and we suggest that this is due to the highly heterogeneous nature of Pb contamination in industrially contaminated soils. However, our electron probe X-ray mapping shows Pb immobilization on the Mn oxide coating of the sand grains, which were Pb free prior to their addition to the soils. Amendment of the Pb contaminated soil with NMO had no effect on gross microbial functioning as assessed by respiration, potential denitrification and nitrification rates. In addition, 454 pyrosequencing showed that NMO amendment did not alter soil microbial community structure or diversity. We conclude that NMO byproducts could be used as an effective soil amendment for the treatment of sites contaminated with Pb.

[1] Lee *et al*. (2011) J. Haz. Materials **186**, 2117-2122. [2] Beak *et al*. (2007) EST **42**, 779-785.

North Pacific SST variability and drought in Southwestern North America since 854 AD

K.R. JOHNSON[1*], S. MCCABE-GLYNN[1], C. STRONG[2], M. BERKELHAMMER[3], A. SINHA[4], H. CHENG[5] AND R.L. EDWARDS[5]

[1]Dept. of Earth System Science, Univ. of California, Irvine, CA 92697 (*correspondence: kathleen.johnson@uci.edu)
[2]University of Utah, Salt Lake City, Utah 84112
[3]CIRES/ATOC, University of Colorado, Boulder, CO 80309
[4]California State University, Dominguez Hills, CA 90747
[5]University of Minnesota, Minneapolis, MN 55455

Climate models predict increasing aridity in Southwestern North America (SWNA) as storm tracks intensify and shift poleward under global warming. However, precipitation in SWNA also exhibits significant natural variability, which has been linked to Pacific and Atlantic sea surface temperature (SST) regimes and the associated atmospheric circulation patterns. The North Pacific, in particular, is known to influence decadal precipitation variability in this region over the 20th century, yet little is known about its role in past droughts and pluvials. Here we present a new record of North Pacific SSTs and SWNA drought from 854 to 2007 A.D. derived from stable isotope ($\delta^{18}O$ and $\delta^{13}C$) and trace element (Mg/Ca, Sr/Ca) variations in a stalagmite (CRC-3) from Crystal Cave, located in the southern Sierra Nevada Mountains, CA (36.59°N; 118.82°W; 1,386 m). Crystal Cave drip water reflects the mean $\delta^{18}O$ of precipitation falling over the cave, which is largely controlled by moisture source region and storm track, with lower values reflecting transport from the North Pacific and higher values reflecting transport from the tropical Pacific. Storm tracks are influenced by North Pacific SST patterns and we find that CRC-3 $\delta^{18}O$ values are strongly correlated with SST anomalies in the Kuroshio Extension region in particular and we use this relationship to reconstruct KE SSTs from 854 to 2007 A.D.. A moderate correlation between $\delta^{13}C$, Mg/Ca, and Sr/Ca suggests that these proxies are linked to prior calcite precipitation, which is thought to reflect local effective precipitation. Comparison of the KE SST reconstruction with last millennium tree-ring records indicate only weak coherence between KE SST and SWNA droughts, with only some occurring during periods of warm KE SSTs, as seen in the instrumental record. $\delta^{13}C$, Mg/Ca, and Sr/Ca are, however, significantly correlated with tree ring records of drought. Through this novel multi-proxy approach, we demonstrate how records of large-scale ocean-atmosphere dynamics and local hydroclimate may be obtained from individual speleothem samples.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.10