High-resolution paleoclimate records from soils using SIMS approaches

K. MAHER[1,2], J. HARDEN[2], J. STOCK[2] AND M. REHEIS[3]

[1]Department of Geol. and Env. Science, Stanford University, Stanford, CA 94501 (kmaher@stanford.edu)
[2]U.S. Geological Survey, Menlo Park, CA 94025
[3]U.S. Geological Survey, Denver, CO 94025

Soils are dynamic chemical systems that actively record climatic variations through the precipitation of secondary minerals in the soil, including opaline silica, carbonate and clays. The maximum age of a soil reflects the stabilization of an erosional surface, providing additional information about past climates and their effects. *In situ* dating of secondary minerals provides a means of determining the maximum age of a particular deposit (shoreline, terrace or alluvial fan) and can also provide long-term records that reflect local paleoclimate variations and provide genetic information pertaining to the formation of younger surfaces.

In situ dating approaches are necessary for developing long-term climate records from soils using pedogenic carbonate and silica because of the slow growth rates (ca. u/kyr), the possibility of episodic growth, and the complex mixtures of minerals and detrital contaminants that are often incorporated into pedogenic deposits. Using the ion microprobe (SHRIMP-RG) we have developed ^{230}Th-U and U-Pb dating approaches that enable us to determine maximum soil ages and the age of different zones within the soil precipitate. Our approach uses opaline silica from soils because the extremely high U concentrations (ca. 100's of ppm U) and apparent long-term stability of opal make it the most favorable target for in ion microprobe analysis.

We have focused on three sites in western N. America that represent gradients in age, climate and geomorphic properties. Analyses of opal from different soil depths, modern soil waters, bulk soils and dust suggest that variations in initial (^{234}U/^{238}U) values and trace element concentrations in soil opal are driven by changes in the moisture flux through the soil. These variations are generally correlated with global and local climate records, with several differences in timing and magnitude of response between the sites that may reflect differential changes in atmospheric circulation in response to the advance and retreat of the ice sheet. Records also suggest that vegetation may play a role in stabilizing erosional surfaces. In comparison to regional speleothem records, soils show an enhanced sensitivity to climate shifts and, given their ubiquity, may provide a new means of studying terrestrial paleoclimate.

C-isotope variability in the Delhi Supergroup, NW India: Implications for Meso-Neoproterozoic transition

A. MAHESHWARI[1]*, A.N. SIAL[2] AND V.P. FERREIRA[2]

[1]Geology Dept., University of Rajasthan, Jaipur-4, India (*correspondence: anilm@datainfosys.net)
[2]NEG-LABISE, Geology Dept., UFPE, Recife, PE, 50670-000 Brazil (ans@ufpe.br, valderez@ufpe.br)

The late Mesoproterozoic to early Neoproterozoic successions (1.3-0.85 Ga) from different parts of world have been studied for their isotope stratigraphy. In recent past new data set have been provided from successions worldwide and our understanding of Mesoproterozoic seawater evolution improves. The studies indicate that the late Mesoproterozoic to early Neoproterozoic successions (1.3-0.85Ga) exhibit moderately positive average δ^{13}C values. The transition from a characteristically late Mesoproterozoic record of little δ^{13}C change to the moderate variability noted in the early Neoproterozoic has not been reported frequently from any single succession.

Marine carbonate rocks from the Delhi Supergroup of Northwestern India show little deviation in whole rock δ^{13}Ccarb values, which is generally around 0 ‰. This narrow range and almost constant δ^{13}Ccarb values persist despite close sampling and through long sections. The data suggest that the global rate of organic carbon burial was probably constant during deposition of Delhi Supergroup. The nearly invariant C isotopic profile of the Delhi Supergroup is similar to C isotopic profiles of Mesoproterozoic carbonates older than ca. 1.3 Ga as reported from different parts of world. The carbonates occurring on the western margin of Delhi Supergroup however, have on average, moderately positive δ^{13}C values (from 2 ‰ to + 4.96 ‰). These high δ^{13}C carbonates may represent the Mesoproterozoic-Neoproterozoic transition (~ 1.25 to ~ 0.85 Ga), a period characterized by such high positive δ^{13}C values globally.