

## Paleoclimate inferences from the stable isotope composition of paleosols in the Hensel Formation, Texas, USA

L.A. WHITE, D. PAUL AND S.J. BIRNBAUM

Department of Geological Sciences, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249 (leawhite@hotmail.com, Debajyoti.Paul@utsa.edu, Stuart.Birnbaum@utsa.edu)

This study uses the stable carbon ( $\delta^{13}\text{C}$ ) and oxygen ( $\delta^{18}\text{O}$ ) isotope composition of carbonate-rich paleosols to reconstruct climatic conditions that existed during paleopedogenesis. An ~ 12 m thick paleosol unit belonging to the Hensel Formation of Cretaceous age (mid Albian ~ 100 Ma) is exposed in Gillespie and Kimble Counties, Texas. In August 2007, 36 hand specimens were collected at ~ 30 cm intervals from this continuous vertical exposure. Another 14 samples targeting calcite nodules were also collected from the base of the outcrop. Since primary calcites retain their primary isotopic composition, care was taken to select samples with textures characteristic of primary carbonates (e.g. dense micrite size grains, tubular structures, cavities filled with fibrous calcite, calcified roots etc.) in order to accurately estimate paleotemperature variations [1, 2].

Carbon and oxygen isotopic analyses of 30 samples were performed using a Gasbench II sample preparation device (carbonate-phosphoric acid reaction) attached on-line with a DeltaPlus XP Isotope Ratio Mass Spectrometer (IRMS). Isotope data is reported in ‰ VPDB scale.  $\delta^{13}\text{C}$  varies from -4.90 to -6.00‰ from the base to the top of the profile, (13C-depletion with depth) whereas  $\delta^{18}\text{O}$  varies from -4.97 to -4.12‰ (18O-enrichment with depth). The range in  $\delta$ -values is similar to that observed in modern pedogenic carbonates. Using the spatial simultaneous solution  $[-0.49 \text{ T3} + (0.180\text{Ocalcite(SMOW)} + 152.04) \text{ T2} - 2.78 \times 10^6 = 0]$  given by Dworkin *et al.* (2005) [1], we estimated the temperature during primary carbonate formation. Our results suggest a warming trend in the study area, with temperature increasing from 17°C at the base of the profile to ~ 22°C at the top. To determine paleovegetation patterns in the area, carbon isotope composition of soil organic carbon (after removal of inorganic soil carbonate by reacting sample with dilute HCl) is currently being obtained by utilizing a CHNS Elemental Analyzer coupled to the IRMS.

[1] Dworkin, Nordt & Atchley (2005) *Earth Planet. Sci. Lett.* **237**, 56-68. [2] Ekart, Cerling, Montanez & Tabor (1999) *Amer. J. Sci.* **299**, 805-827.

## Geochemical maps of the oceanic mantle – What do they mean?

W.M. WHITE

Department of Earth & Atmospheric Sciences, Cornell Univ., Ithaca, NY 14853 USA (wmw4@cornell.edu)

Over the last 40 years isotopes and other tracers have been used to map the mantle on all possible scales. At the largest scales, the suboceanic mantle divides into 5 or 6 domains with length scales of 5000 to 10,000 km. These are defined more by differences in correlations between isotope ratios than in absolute values of these ratios (e.g.,  $\Delta 8/4$  of [1];  $\delta(\text{Nd-Sr})$  of [2];  $R_c$  of [3]). While the ultimate origin of the isotopic differences is still debated, the domains certainly reflect fundamental features of mantle convection; either convection cells themselves [1, 4] or the manner in which the asthenosphere is resupplied by flow from the lower mantle [3]. The sharp, mobile boundary at the AAD is evidence of the former [5], while the relationship to deep mantle flow patterns revealed by seismic studies and the close isotopic affinity of MORB and OIB in the South Atlantic and Indian Ocean seems evidence of the latter [3].

At scales of  $10^2$  to  $10^3$  km, regional isotopic gradients reflect the pollution of the upper mantle by mantle plumes. Two- and even three dimensional maps of these plumes, and their interaction with upper mantle are possible, where the plume produces multiple volcanoes or sustained volcanism over time [e.g., 6, 7], and perhaps mantle flow become possible. Plume-related isotopic signals are broadly, but not completely, consistent with other plume-related effects, such as ridge elevation, extent of melting, and crustal thickness.

While isotopic mapping of the mantle is well advanced, these efforts must ultimately be integrated with geodynamics and geophysics. This requires relating isotopic compositions to material properties that are seismically observable and that affect flow. That in turn means relating isotopic composition to major element composition and lithology. There is much to be done in this respect.

[1] Hart (1984) *Nature* **309**, 753-757. [2] Vlastelic *et al.* (1999) *Nature* **399**, 345-350. [3] Meyzen *et al.* (2007) *Nature* **447**, 1069-1074. [4] Castillo (1989) *Nature* **336**, 667-670. [5] Klein *et al.* (1988) *Nature* **333**, 632-629. [6] White *et al.* (1993) *J. Geophys. Res.* **93**, 19533-19563. [7] Bryce *et al.* (2005) *Geochem. Geophys. Geosyst.* **6**, 2004GC000809.