

**3:05 PM Stiles, Cynthia A.****SYSTEMATIC GEOCHEMICAL VARIATIONS IN PEDOGENIC IRON-MANGANESE NODULES FROM A MODERN VERTISOL CLIMOSEQUENCE, TEXAS**

STILES, Cynthia A., cstiles1@utk.edu, MOIRA, Claudia I., and DRIESE, Steven G., Dept. Geological Sci., U. Tennessee, Knoxville, TN 37996-1410

Pedogenic iron-manganese (FeMn) nodules form in response to prevailing hydro-chemical conditions within the soil matrix. Variable nodule chemistry is attributed to the Eh/pH environment of the soil matrix, largely dictated by meteoric water supply/deficit in the vadose zone. Elements such as Ba, Co, Ni, P, and Pb sorb onto or are incorporated into secondary oxides, mostly remaining fixed as nodules mature or undergo post-pedogenic dehydration. Thus, geochemical composition of pedogenic FeMn nodules may be a useful indicator of climatically-influenced soil paleohydrology. Pedogenic FeMn nodules were isolated from modern (<35 ky) Vertisols formed along a precipitation gradient from 750mm to 1400 mm MAP on the Beaumont Formation, Texas Coastal Prairie. Three MAP climozones are defined: <900 mm, 900-1200mm, and >1200mm. Although FeMn nodule macromorphology differs only slightly between climozones, significant and systematic geochemical trends can be directly related to MAP. Total Fe:Mn ratios ranged from 0.43 to 11.72, increasing with higher precipitation. Mn:Co ratios vary inversely with MAP, ranging from 49.7 in >1200 mm climozone to 108.1 in < 900 mm climozone. Deep vadose or phreatic zone activity can cause reducing environments leading to Co depletion and skewing elemental ratios. Co depletion in isolated nodules above the present water table is an indicator of possible past phreatic zone shifts or climatic change. The Ba, P and Ni contents of FeMn nodules increase with decreasing MAP to around 1000 mm, then decrease in proportion with increases in Mn. These trace element trends indicate a shift in Fe/Mn oxide mineral structure induced by hydro-logic conditions. It may be possible to use these features in paleosols as tool to interpret the paleoclimate or paleoenvironment.

**3:20 PM Schroeder, Paul A.****EVIDENCE FOR THE RECRYSTALLIZATION OF SECONDARY SOIL MINERALS AND IMPLICATIONS FOR ESTIMATES OF PALEO-ATMOSPHERIC CONDITIONS**

SCHROEDER, Paul A. and MELEAR, Nathan D., Dept. of Geology, Univ. of Georgia, Athens, GA 30602-2501. schroe@gly.uga.edu; BIERMAN, Paul R., Geology and Natural Resources, Univ. of Vermont, Burlington, VT 05405; CAFFEE, Mark W. and KASHGARIAN, Michael, Lawrence Livermore National Laboratory, Livermore, CA 94550.

Carbon mineralized into the soil mineral gibbsite appears to preserve both a stable isotopic record and radiogenic record of carbon dioxide mixing between the atmosphere and soil/saprolite horizons in a residual weathering profile. The study site, located at the Panola Mountain Research Watershed, Georgia, has developed a granite/saprolite/soil regolith in which 14-C-gibbsite model ages deep within the profile (C-horizon) average about 8000 years. Near the surface (A- and B-horizon) 14-C-gibbsite model ages range from 2100 to 4200 years. Near-surface quartz has acquired 26-Al and 10-Be inventories suggesting it has a residence time of at least 90,000 years. This age disparity supports the notion that secondary minerals undergo significant recrystallization as a weathering front propagates into the landscape.

Stable carbon isotopic data (fit via least-squares and a diffusion-based depth function) results in an estimate of 82 gC m<sup>-2</sup> y<sup>-1</sup> for the soil respiration rate. This long-term rate estimate is an order of magnitude less than the short-term annual efflux rate of 950 gC m<sup>-2</sup> y<sup>-1</sup> measured at the mixed deciduous forest in the Panola watershed. This rate disparity may in part, reflect climate change in the S.E. United States over the period of gibbsite mineralization (i.e., cooler and seasonally drier Holocene conditions) and/or the need to refine soil respiration models used to relate relict stable carbon isotopic measurements to ancient atmospheric PCO<sub>2</sub> estimates. These results suggest that using paleosol mineral proxies to understand terrestrial-atmospheric relationships may be biased toward a recording of long-term soil respiration rates.

**3:35 PM McLain, A. A.****SR ISOTOPE AND MINERALOGIC STUDIES OF SOILS IN THE MOJAVE DESERT: IMPLICATIONS FOR THE RELATIVE ROLES OF CHEMICAL WEATHERING AND ATMOSPHERIC DUST DEPOSITION**

MCLAIN, A. A., MCFADDEN, L.D., and ASMEROM, Y.A. Earth and Planetary Science, New Mexico, Albuquerque, NM, 87131; MCDONALD, E.V., Desert Res. Inst., R The Providence Mountains (PM) and Cima Volcanic Field (CVF) in the Mojave Desert have been the sites of several important studies concerning the origins of desert pavement landscape evolution. More recently we have conducted strontium (Sr) isotopic studies of pedogenic carbonate in these soils utilizing contrasting parent materials (PM: mixed plutonic; CVF: basalt) and surface ages (mid to late Pleistocene and Holocene) to understand the sources, changes in composition and overall impacts of the incorporation of desert soil development. Previous Sr isotope data confirm that eolian dust is the source of calcium (Ca) in the pedogenic carbonate of these soils, but each soil profile has its own distinct carbonate Sr signature which varies little from surface to the lower horizon. Isotope ratios of vesicular horizons (Av) and carbonate rinds at depth in the Holocene are shifted closer to the ratios of the underlying parent material than are the late Pleistocene soils. The purpose of this study is to examine the mineralogic reasons for these differences in carbonate Sr composition of the Av horizons between soils located within kilometers of each other. X-ray diffraction results show variation in the mineralogy of the Av horizons, particularly types of feldspars and relative abundance of carbonate minerals, suggesting that in these soils, more of the alluvial material present in the Av horizon is being chemically weathered. The observed Sr signatures. Pedogenic calcite at depth also records this mixture of eroded and weathered fine alluvial material. We propose that the incorporation of rapidly modifies the upper part of the soil to a far less permeable state and increase holding capacity, which is arguably conducive to chemical weathering. Previous studies of the mineralogy of the Av horizons suggested, but could not confirm some contribution of chemical weathering to soil development. This study more convincingly clarifies the role of chemical weathering in these desert soils.

**3:50 PM Rickard, David****THE MIOCENE GOSSAN AT LAS CRUCES, SPAIN.**

KNIGHT, Fiona and RICKARD, David, Department of Earth Sciences, Cardiff University, Cardiff CF10 3YE, Wales

The Las Cruces deposit near Sevilla in Spain (373020N 060540W) was discovered beneath the erosional margin of the Neogene Guadalquivir Basin. It is a classical 3T Pyrite Belt massive sulphide deposit but is unusual in that it retains part of a 6Ma Tc preserved beneath ca. 150m of Miocene marine marls. From the base of the Tertiary sequence moves downward through Tertiary sands, Tertiary conglomerate (with gossans), a local silica cap and finally the Pliocene deposit. The gossan developed sub-aerially on a late-Miocene paleosurface. The Tc marl sequence reaches over 1000m in thickness within 10km of Las Cruces and the cover is an erosional remnant of the original sequence. Burial of the relatively permeable Tc over 1000m depth was accompanied by penetration by Miocene seawater which heated during circulation through the cover sequence. Mineralogical, fluid inclusion studies reveal cryptic geochemical and mineralogical alteration of the gossan complex. Observations suggest that diagenesis and lithification of permeable gossans may in any hydrogeological processes. This in turn will constrain interpretations of paleo-atmospheric conditions based on the geochemical and mineralogical compositions of fossil gossans.

ssic boundary in Australia  
he Antarctic paleosols  
drive the precipitation of  
prompt the formation of  
in Antarctica indicate that  
Antarctic circle than in  
ric methane are likely the  
lining levels of atmospheric  
of these different coeval

**OR A MORE ACTIVE**

owa, Iowa City, IA 52242  
y Bureau, Iowa City, IA  
of Iowa; B.J. Witzke, Iowa

adients in  
lux was 17-27% greater  
ermil at 34° N paleocli-  
ata is steeper and more  
hese data challenge the  
itation 18O relationship,  
10 latitudinal gradients.  
he isotopic composition of  
fractionations during phase  
e evaporative feedback.  
re gradients; marine 18O  
oration fluxes.  
adients, however, signifi-  
32-54% respectively) are  
itudinal gradients. Flux val-  
ial and marine sources.  
s that are consistent with  
the utility of spherosiderite  
e hydrologic cycle.

**APPLICATION OF A**

University of Iowa, Iowa City,  
Geoscience, Iowa City, IA;  
Geoscience, Iowa City, IA;  
a DNR Geol. Surv. & UI  
, Iowa City, IA.  
shallow groundwaters and  
vigson et al. (1998, Geology  
sphaerosiderite horizons  
ons or operating claypits,  
weathering environments;  
in core samples. As siderite  
80 values even under burial  
ial sphaerosiderite d18O val-  
cannot be presumed without  
in original spherulitic struc-  
growth zonation. Textural evi-  
ystal coarsening to blocky  
e zonation, and (3) corroded  
ily aggressive fluids. Lack of  
lues, whereas diagenetically  
ange over 6 permil. Paleosol  
ons; and formation in brackish  
ormation in freshwater set-  
ones of pyrite inclusions and

**ECOSYSTEM IN MODERN**

, Dept. Geological Sci.,

(M) and pedogenic carbonate  
exas record systematic  
t climate change over the past  
wing climate/ecosystem his-  
r conditions and a significant  
i o/oo; warmer/drier condi-  
le (SOM = -13 to -20 o/oo;  
presence of C3 plants are  
? o/oo), in concordance with a

es. Coexisting SOM and PC  
ontemporaneous or that PC  
the microlow and microhigh  
ts are systematically related to  
nt depths but are in predictable  
cord of stable carbon isotopes  
ot self-mulching , as typically  
norphology and isotopic pro-  
te records.