B22C-0176 1330h POSTER

Controls on Arctic NDVI Patterns: a Zonal Analysis

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Summer temperatures are thought to be the primary control of circumpolar-scale phytomass patterns. The Normalized Difference Vegetation Index (NDVI) is often used as an index of vegetation greenness, and consequently the amount of green phytomass. Understanding the variation in NDVI and phytomass along present-day climate gradients provides key information for predicting responses to global climate change. The Arctic Zone (the tundra region north of the arctic treeline) has been subdivided into five bioclimate subzones, with boundaries at approximately 2°C intervals between 12°C mean July temperature (MJT) at continental treeline areas to 0°C at the ice margin. We estimated total-aboveground-phytomass density (TAPD) within the five arctic bioclimatic subzones using a regression of phytomass against NDVI that was developed along the arctic climate gradient in arctic Alaska with supplementary data from the Canadian High Arctic. Total aboveground phytomass for the Arctic is estimated at 2.42 Gg. TAPD in subzones 1 through 5 was: 51 g m-2, 116 g m-2, 169 g m-2, 454 g m-2, and 796 g m-2 respectively. Circumpolarly, Subzone 3 has anomalously low TAPD values. We investigated three possible causes of this anomaly: (1) greater elevation in Subzone 3 causing relatively lower biomass on average, (2) relatively large areas of low phytomass on limestone substrates in Subzone 3, (3) a greater percentage of barren areas and lakes in Subzone 3 due to late-Pleistocene glaciation. When the NDVI data are broken down according to region, Eurasia has much higher NDVI values than Canada. The lower NDVI values in Canada are the result of a combination of factors. The primary cause is the late-Pleistocene glaciers that covered nearly all of Arctic Canada, and left large areas of barren rock, and lake-covered landscapes . Both rock and water have low NDVI values that lower the mean NDVI values within each subzone. Canada also has large areas of limestone and relatively high elevations, particularly in Subzone 3. Circumpolarly, higher elevation corresponded with lower NDVI values. For areas in both Alaska and Canada, where substrate pH data are currently available, nonacidic substrates had lower NDVI values than acidic substrates.

B22C-0177 1330h POSTER

Interannual variability in carbon flux of arctic tundra detected with combined optical and flux measurements

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Warming is expected to have large impacts on early season biosphere-atmosphere carbon exchange in northern latitude ecosystems, in part through earlier snowmelt, and early season weather conditions could further modulate ecosystem gas exchange. Using spectral reflectance, eddy covariance, and chamber gas exchange from an arctic tundra site in Barrow, Alaska, we explored the interannual variability in whole-ecosystem carbon exchange in 2000 and 2001. Despite an earlier snowmelt and higher light levels, gross carbon uptake in 2001 was substantially lower than in 2000, due in part to a combination of temperature and moisture conditions early in the season. Key uncertainties in this analysis involve accurate accounting of ecosystem respiration and photosynthetic light-use efficiency. Clearly, early season weather events have a disproportionate impact on whole-season carbon exchange, and an earlier growing season is not necessarily associated with enhanced carbon uptake in northern latitude ecosystems. This analysis illustrates the importance of field monitoring for any attempts to derive whole season carbon gain from temporally limited datasets (e.g. satellite remote sensing).

URL: http://vcsars.calstatela.edu

B22C-0178 1330h POSTER

Soils and Carbon Transformations in Northern Michigan Forested Watersheds

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By controlling pH and redox chemistry, organic/inorganic carbon transformations affect important soil processes such as mineral weathering and the transport of trace metals. Carbon cyling was studied using two natural forested sites (Cheboygan and Tahquamenon watersheds) and using results from chambered tree-growth experiments conducted under different treatments of soil fertility and PCO_2. Although both watersheds are established on sandy glacial drift deposits, Cheboygan soils are carbonate-rich, while Tahquamenon soils are carbonate-poor. The occurrence and transformation of organic and inorganic carbon was followed in soils and soil solutions from different forest types: aspen and mixed hardwood forests in the Cheboygan watershed, and conifer and mixed hardwood forests in the Tahquamenon watershed. Geochemical characterization of soils, soil solutions, shallow groundwaters, and streams included major, minor, and trace elements in addition to inorganic and organic carbon concentrations. Soil and soil water chemistries were also followed over the 2 years of chambered tree growth experiments.

Tahquamenon soils lack inorganic carbon to at least a depth of 150 cm, while inorganic carbon is present in Cheboygan soils at depths greater than 80 cm. Tahquamenon soils have higher organic carbon contents than Cheboygan soils. Shallow groundwaters and stream waters of both Tahquamenon and Cheboygan watersheds are Ca-Mg-HCO_3 solutions, but Cheboygan waters are up to twice as concentrated, due to the abundance of reactive carbonate minerals in the soil, higher respiration rates, and higher growing season soil gas CO_2 values. Carbon in both watersheds is present in shallow soil solutions as DOC derived from organic matter decomposition, and is rapidly transformed and replaced by DIC from organic matter oxidation, respiration, and carbonate dissolution with increasing depth in the soil column. The DOC to DIC transition occurs at different depths in different forest soils and is related to the underlying geology and vegetation, both of which influence mineral weathering and soil development. In the two watersheds, a positive correlation exists between DOC and metals such as Pb and Al, and soil solutions with low pH and high DOC contain higher trace metal concentrations than stream waters. Similarly, weathering of silicate minerals is enhanced at shallow depths by organic ligands present in DOC, and carbonate mineral weathering occurs deeper in the soils.

While DOC and DIC maxima generally occur at different soil column depths in natural forests, our work in the tree-growth chambers shows that in disturbed soils, mineral weathering processes facilitated by DOC and DIC may occur together at shallow soil depths. Homogenization of the chamber soils brought reactive carbonate minerals up to shallow depths into the zone of highest PCO_2, allowing for dissolution of carbonate minerals to occur simultaneously with silicate mineral dissolution. Soil disturbance due to development or agriculture in carbonate-rich areas may thereby increase DIC fluxes from the landscape while decreasing transport of trace metals by moderating pH.

B22D MC: Hall D Tuesday 1330h

Biological Mineralization: Early and Extreme Environments I *(joint with OS, P)*

Presiding: **P M Dove,** Virginia Polytechnic Institute and State University**; J J DeYoreo,** Lawrence Livermore National Laboratory

B22D-0179 1330h POSTER

Microorganisms From a Depth of 1350 m in Hawaii

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The Hawaii Scientific Drilling Program recovered cores of igneous rock from the surface to a depth of 3109 m near Hilo, Hawaii. After examining most lithologic units from this site with a petrographic microscope, we concentrated on a single unit of hyaloclastite at 1335 to 1415 m below sea level. For this study we used deep ultraviolet laser-induced native fluorescence imaging, ultraviolet Raman spectroscopy, scanning environmental electron microscopy, DNA-staining, electron microprobe chemical analysis, and microscopic petrographic observation. Each technique revealed a signature consistent with biological activity associated with alteration of glass to clay. Vesicles were surrounded by dark zones of alteration from which smooth, rounded channels extended into the glass similar to those attributed to microorganisms in deep sea basalt glass. Enrichments of phosphorus and carbon were associated with these same regions of the basalt. The rims of vesicles produced laser-induced fluorescence and Raman spectra that indicate the presence of amino acids and nucleic acids. These same rims were examined with an environmental electron microscope and were found to contain microorganisms. This result was confirmed with DNA staining of vesicle rims. These results taken together confirm the presence of microorganisms at the boundary between primary volcanic glass and secondary clays. This boundary is the site of chemical transformations that can provide metabolic energy for microorganisms. The glass can also be a source of nutrients such as phosphorus, however, at this time the physiology of the microorganisms is not known. Although we examined only one lithologic unit in detail, petrographic examination of other samples suggests that microorganisms are, or were, present in over 700 m of the hole.

B22D-0180 1330h POSTER

Facies architecture and sequence-stratigraphic features of the Tumbiana Formation: A depositional setting of late Archaean stromatolites in the Pilbara Craton, northwestern Australia

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The Tumbiana Formation (ca. 2700 Ma) is a succession developed in response to late Archaean crustal extension in the Pilbara Craton, northwestern Australia. The formation is characterized by intercalations of stromatolite carbonates and provides a perspective of evolution of photosynthetic organisms that are interpreted to have been responsible for oxygenation of atmosphere. Here we investigated a depositional setting

of the stromatolite limestone for better understanding of an environment that may have controlled early development of oxygenic photosynthesis. We studied lithofacies and sequence-stratigraphic features of the Tumbiana Formation in the Redmont area based upon three-dimensional analyses of onshore outcrops.

The Tumbiana Formation, as much as 170 m thick, unconformably overlies the early Archaean basement rocks and is unconformably overlain by the Maddina Formation that consists of mafic tuffaceous sediments and basalt. The lower part of the Tumbiana Formation is characterized by planar- and trough-cross stratified conglomerates that are interpreted to be an alluvial-fan deposit shed from the northern hinterlands and developed mainly in local depressions of the basement rocks during an early transgressive stage. The base of the middle part is defined by a transgressive erosional surface overlain by conglomerates and/or breccia that pass upward to mafic tuffaceous mudstones and sandstones intercalated with accretionary lapilli, breccia, and basalt. Mudstones are commonly laminated and sandstones contain current- and wave ripple-lamination, parallel lamination, hummocky cross-stratification, and trough cross-stratification. In general, the middle part exhibits an overall fining- and coarsening-upward pattern and is interpreted to indicate transgressive and regressive shelf-to-coastal lithofacies successions. In particular, the uppermost horizon of the middle part is characterized by sandstone beds with herringbone structures and desiccation cracks and is interpreted to indicate an intertidal environment developed during a late highstand stage. The middle part, in general, thickens to the northern proximal area and eventually flattens out topographic irregularity of the basement rocks. The upper part is characterized by stromatolite carbonates, associated with minor wave- and current-rippled sandstones and desiccation cracks, and does not exhibit distinct lateral variation in thickness. The base of the upper part is also characterized by a transgressive lag deposit and the ensuing transgression over intertidal deposits of the middle part is interpreted to have developed an accommodation space for the vertical stacking of stromatolites with different external shapes from columnar and small domal types to a large domal type that may have responded to the increase in paleowater depth possibly from intertidal to subtidal environments. In conclusion, stromatolites in the upper Tumbiana Formation in the Redmont area are interpreted to have developed in coastal and shallow marine environments in response to a rise in relative sea level rather than in ephemeral saline lakes as proposed by previous studies from different locations.

B22D-0181 1330h POSTER

Microbes in ocean floor basalt: their association to alteration textures and influence on the geochemical composition of palagonite

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Samples of recent lava flows from the rift valley of the Mohns Ridge and Knipovich Ridge have been studied by electron microscopy and geochemical analyses, aimed at describing the microbial community in the basalt and the influence of microbes on the dissolution and alteration of the basaltic glass (Thorseth et al., 1995; Torsvik et al., 1998). The samples were collected at 2000-3500 m below sea level and the ambient seawater temperature was measured to -0.7 °C. Along fractures in the glassy margins of the lava flows, yellow brown to red brown alteration rims (palagonite) are developed. The thickness of the alteration rims varies from 80 m at the outer surface to <1 m in the interior. The alteration rims have a zoned texture where porosity and chemical composition differ. In most fractures various types of coccoid, rods and stalked cells are associated with the alteration product. The dominant morphology has multiple stalks (up to 100 m long), radiating out from a central spherical cell (1m in diameter) in a star-shaped manner. In all samples fossilized cells are observed as hollow sub-spherical, rod-shaped and filamentous structures, due to precipitation of alteration products around the different morphological forms of microbes. An increased accumulation of Fe and Mn in some morphological forms compared to the surrounding palagonite, may indicate utilization of these elements in energy metabolic processes (Lysnes et al., 2001; Steinsbu et al., 2001). Generally, the microbes are more numerous in the outer part of the glassy margin than in the inner part. The microbes are observed both at the primary fracture surfaces, in high porosity palagonite zones and at the glass-alteration fronts, where they attach to the fresh glass. Within zones of dense palagonite it is difficult to distinguish microbial morphologies. However, alteration rims showing numerous microbial morphologies nearly throughout, indicate a high content of living andor fossilized cells. Preliminary analyses of the palagonite show an organic carbon content of about 0.25 wt.% and a dC13-value of -22. This indicates 1010 cells per 1 g alteration product, assuming 10-13g of C per cell. Since 1% of the glass in these samples is altered and pillow basalt generally are 2 % glass, there are about 106 cells per cm3 in these ocean floor basalts. Microbes that colonise the basaltic surface layer at spreading ridges may be buried below younger volcanic flows. This may carry the textural and geochemical traces of life and organic carbon into the deeper part of the ocean crust. Burial of microbial communities that colonise the surface layer may thus be of importance in studies of the deep sub-surface biosphere.

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B22D-0182 1330h POSTER

Characterizing Microorganisms in Pillow Lava From the East Indian Ridge and From the Arctic Ridges

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Microbial investigations has been carried out on basalts drilled from 10-30 Ma oceanic crust north of the Australian-Antarctic Discordance (ODP Leg 187) and dredged from the neovolcanic zones of the Mohns and Knipovich Ridges (Norwegian-Greenland Sea). The main objectives with the study are to document microbial diversity of the oceanic subsurface biosphere, and in particular to identify microorganisms participating in basalt alteration. Microorganisms in the pillow lava were characterized using enrichment techniques and DNA based methods. Cultivation experiments were started on board immediately after collecting the samples. Seawater and sediment samples were collected for comparison. The enrichment culture media were aimed at microorganisms participating in the iron, manganese, sulfur, and methane cycles. DNA, extracted directly from basalt, sediment and seawater, and from enrichment cultures, was used for PCR, DGGE and 16S rDNA sequencing. Results from enrichment studies, chemical analysis of metabolic products and DNA based techniques show that iron and manganese oxidizing and reducing bacteria, methanotrophic bacteria, and methanogenic Archaea are present in the basalt samples. These main functional groups of bacteria were found in both the 10-30 Ma drill samples and the neovolcanic dredge samples. The DNA based techniques reveal that the native basalt samples contain mostly uncultured and unidentified groups of microbes. Sulfate reducing bacteria were not abundant in the basalt samples, but were common in the seawater and sediment samples.

B22D-0183 1330h POSTER

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Access to the Au mines of South Africa has provided us with an unparalleled opportunity to investigate the diversity and abundance of microbes from hydrologically restricted environments at depths up to 3.2 kilometers beneath the surface (kmbls.). Samples of highly pressurized, anaerobic water collected from freshly drilled bore holes into fault or dyke structures ranged in temperature from 32o to 60oC, in salinity from 0.2% to 2.5% and in pH from 7.2 to 10. Flow cytometry analyses of 21 samples amended with a fluorescent DNA stain yielded microbial concentrations ranging from <5×103 (detection limit) to 5×105 cellsml. The cell concentrations for half of these samples were below the detection limit and those of all the samples collected at 3.2 kmbls. were below detection. Fluorescent, forward and side scatter intensities indicate that the remaining samples contain one or two morphotypes. These values contrast with water samples from subsurface, dammed water pockets or service water where the cell concentrations range from 5×104 to 2.5×106 cellsml and as many as three morphotypes can be readily distinguished. Thermophilic enrichments suggest that some of these morphotypes are cultivable under conditions that are comparable to the environment. The apparent lack of cells in some of the water samples may reflect a combination of the thermal history of the basin, the origin of the fluid and the isolation of some of the fractures.

URL: http://www.home.mweb.co.za/ja/jahall

B22D-0184 1330h POSTER

Cyanobacterial Bioamarkers: Triterpenoids plus Steroids?

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Reconstructing the biomarker record of the early Earth requires us to make assumptions about the constancy and specificity of lipid biosynthetic pathways through geological time and rests upon our knowledge of the lipid composition of extant organisms. For example, the three domains of extant life Eukarya, Archaea and Bacteria were present in Archean ecosystems if we are to believe the record of chemical fossils that have been found in rocks as old as 2700Ma. However, the validity of the steroid signature as an indicator for Eukarya has questioned because of some reports of phytosterol biosynthesis in cyanobacteria and we examined this issue in some new experiments with cyanobacteria grown in culture. After initial cultures of Phormidium and Chlorogloeopsis proved to contain sterols, in addition to the expected complement of hopanoid and 2-methylhopanoid, we hypothesized that these might be the result of fungal contamination. Subsequent cultures grown after repeated sub-culturing in the presence of cycloheximide proved to be devoid of sterol. Our results are therefore consistent with the notion that sterol biosynthesis is, with very few exceptions, a primary characteristic of Eukarya. Consequently, the steroid hydrocarbons that are found in ancient sediments are most likely the remains of algae and other eukaryotes.

B22D-0185 1330h POSTER

Microbial Growth of a Denitrifying Bacteria at *In-situ* Hydrothermal Conditions: Implications for Biomineralization at Mid-ocean Ridges

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Current interest in subsurface microbiology at hydrothermal vents has resulted in greater attention being given to the characterization of new microbial species and their feedback with the sub-seafloor environment. In response to a need for integrated biogeochemical studies, we have developed a new type of experimental apparatus to study microbial processes at *in situ* pressure (250 bars) and temperature (70°C). This high-pressure open-system apparatus, modified from HPLC technology, is capable of supplying fresh media, including dissolved gases, to the system, while removing metabolic waste products. Thus, we eliminate the need to artificially elevate certain components in the fluid chemistry and allow continuous growth of the culture, maximizing interaction between the bacteria and mineral surfaces.

Preliminary pure culture experiments designed to monitor bacterial effects on mineral surfaces were completed using a new strain of denitrifying thermophilic bacteria, EX-H1. By monitoring aqueous and dissolved gas chemistry, we confirmed its use of the following energy-producing reaction during metabolism: $19H_{2(aq)} + 3NO_3^- + 5CO_{2(aq)} + 3H^+ = N_{2(aq)} + C_5H_7O_2N + 17H_{2(aq)}$ where ($C_5H_7O_2N$) represents bacterial cell mass. Reaction rates at ambient pressure were on the order of 0.02 mmolal/hr in closed system. Abiotic control experiments at pressure confirmed that mineral dissolution/precipitation reactions were kinetically inhibited at 70°C over 18 hours. Biotic experiments were successful in showing attachment of cells to the quartz fiber substrate during cell growth in the reactor. Due to insufficient residence time of fluid in the reactor (50 minutes), however, metabolic changes in fluid chemistry were slight. Future experiments will incorporate longer residence times to allow comparison of the stoichiometry and rate of the denitrification reaction with theoretical estimates. Also, we will assess the effect of microbial growth on minerals in the reactor to quantify the link between cell growth, metabolism, and the broader geochemical environment.

B22D-0186 1330h POSTER

Environmental and developmental controls of morphological diversity in a thermal spring gastropod from Coahuila, Mexico

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Isolated thermal springs and associated aquatic environments near Cuatro Ciénegas, in north-central Mexico provide an opportunity to study patterns of evolutionary diversification under extreme conditions. Significant differences in temperature, seasonality, pH, and salinities among other variables may allow for high levels of differentiation and endemism. Biological studies of the unique faunas in this type of environment may serve as analogues for extreme and/or evaporitic environments as targeted by astrobiological research.

The endemic hydrobiid gastropod *Mexipyrgus* is widely distributed in a variety of aquatic environments within the Cuatro Cienégas basin. Original description of this genus by Taylor listed six distinct species reflecting shell and anatomical features. Later revision by Hershler suggests that this diversity be reduced to one single, highly-variable species, based mainly on the morphology of reproductive structures. The systematic conflict emphasizes the need to understand the bases of morphological variation at small scales and in environmentally unusual settings.

Shells of *Mexipyrgus* were collected from six localities and the following species were identified based on Taylor's classification: *M. carranzae*, *M. escobedae*, *M. multilineatus*, and specimens intermediate in character between *M. carranzae*, *M. lugoi* and *M. mojarralis*. All specimens consisted of 4-6 whorls. Shell shape was archived by the digitization of geometrically homologous landmarks on the spire (apex, whorl sutures in apertural view) and aperture. Shell size was calculated as Centroid Size. Data were analyzed using uniform and principal warp analysis of raw landmark coordinates, followed by relative warp analysis of uniform and partial warp scores. Three separate analyses were performed for 4, 5 and 6 whorled specimens. Results indicate two different levels of variation based on individual age. Variation among 4 whorled specimens is dominated by locality: each locality is distinct from all others, regardless of individual species composition. Analysis of 5-whorled specimens reveals some locality-based differentiation, but also taxonomic (and possibly gender) differentiation. Finally, by the 6-whorled stage, the pattern of differentiation is based solely on taxonomy, with Taylor's morphospecies forming distinct and discrete groups. Another analysis conducted on the first four whorls of all specimens supports the hypothesis that location and local environmental factors are the largest influence on morphology earlier in development.

In summary, environment seems to exert a significant influence on morphology during shell development, but terminal adult morphology is largely under intrinsic (genetic) control. Resolution of the systematics and true diversity of *Mexipyrgus* will ultimately rely upon further quantitative morphological studies in addition to future population genetic studies of this genus in a variety of microhabitats.

B22D-0187 1330h POSTER

The Effect Of Aldehydic Carbonyls On Iron Sulfide Biomineral Formation

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Iron sulfides have long been recognised as important biominerals. However, attempts to identify the specific effects of microorganisms on the product iron sulfides have generally been unsuccessful. An exception has been magnetotactic bacteria which contain the thiospinel greigite (Fe_3S_4) as a functional adjunct. This ability to produce metastable Fe_3S_4 rather than stable pyrite (FeS_2) is not understood. The problem extends to fundamental biochemicals, such as the iron-sulphur proteins, which include Fe_nS_n clusters as their active centres.

We show that iron sulfides of different compositions and oxidation states are produced by the catalytic activity of aliphatic and aromatic aldehydes. The product of the oxidation of precipitated $FeS_{(am)}$ by aqueous H_2S at pH=6 between 25 and 100°C can be determined by trace quantities of aldehydes. In the absence of aldehydes the product is euhedral pyrite. In their presence the product is ferrimagnetic greigite. Other simple organic compounds have no apparent effect on the transformation, suggesting that aldehydes are the functional agent. This is confirmed by examining the relative reaction rates of aldehydes with different stereochemistries.

Compared with other mineral switches, the effect of this first observed mineral switch in the iron sulfide system is quite dramatic. In the presence of aldehydes, two thirds of the Fe(II) in $FeS_{(am)}$ is oxidised to Fe(III), but S(-II) remains unaffected. In the absence of aldehydes, the S(-II) in $FeS_{(am)}$ is oxidised to S(-I) in pyrite, but Fe(II) remains unchanged. Aldehyde recovery after reaction is in excess of 95%, and aldehydes are not consumed.

The switch works by aldehydes catalysing the formation of Fe_3S_4 from FeS and inhibiting the formation of pyrite. The catalytic effect of aldehydic carbonyl on greigite formation from $FeS_{(am)}$ is also observed for reactions with no excess aqueous H_2S. We show that removal of $FeS_{(aq)}$ clusters from solution by interaction with aqueous aldehyde inhibits pyrite formation. The effectiveness of the switch suggests that trace organics can determine the stoichiometry, crystal structure and oxidation state of the products of iron sulfide transformations.

The results have a general implication for the coupling of iron sulfides with prebiotic organic systems in the early development of life. They constrain the use of greigite as a biomarker in planetary sciences, since greigite formation need not carry any implication of intracellular activity. However, the availability of aldehyde moieties in cells suggests a possible biochemical pathway for biogenic greigite formation in magnetotactic bacteria, and why later transformation to pyrite is apparently inhibited. In sediments and soils where greigite contributes to remanent magnetism, it is possible that greigite develops through analogous extracellular processes, especially with the aldehydic products of degrading biological material.

B22E MC: 122 Tuesday 1330h

Geologic Influences on Biogeochemical Cycles II *(joint with H)*

Presiding: **J M Holloway,** U.S. Geological Survey**; J R Rogers,** University of Kansas**; S T Petsch,** Woods Hole Oceanographic Institution

B22E-01 1330h

Relict Stream Channels in the McMurdo Dry Valleys, Antarctica: Ecological Legacies Controlling Response to Climate

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In the McMurdo Dry Valleys, glacial meltwater streams feed permanently ice-covered lakes in the valley floors. Cyanobacterial mats persist through the winter in a freeze-dried state and grow when stream flow begins in summer. Algal mats are abundant in streams where streambed rocks are configured in a stone pavement, wedged together, largest flat side up, forming a smooth surface that enhances laminar flow and reduces sediment mobilization and scour. These stone pavements may form through peri-glacial processes operating over long time periods. In dry valley maps and aerial photographs, about half of the stream channel features do not currently have an obvious meltwater source. In January 1995, we began a long-term experimental reactivation of a relict channel in Taylor Valley by redirecting water from an upper stream using a low sandbag wall. Based upon aerial photographs, we estimate that the relict channel had not had carried stream flow for 20-30 years. We observed abundant algal mats growing in the stream within about a week of redirecting the flow. The algal mats in the relict channel had high or comparable growth rates to mats in other streams in the valley and have continued to grow in subsequent summers. The higher solute concentrations in the reactivated channel may have enhanced growth rates of relict algal mats. We hypothesize that the overall stability of stone pavement channels in the dry valley landscape preserves streambed habitats and possibly cyanobacterial populations capable of rapid recolonization should flow resume.

B22E-02 1345h

Microorganisms Implicated in Degradation of Organic Matter During Black Shale Weathering

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Sedimentary rocks rich in organic matter are common features of the geologic record and in general usage are termed black shales. Presence of organic matter and sulfide minerals in black shales generates a chemically reducing environment within these rocks. Once uplifted and exposed on the earths continents to surface environments, an oxidation front begins to penetrate into these rocks. Oxidative chemical weathering of black shales results in loss of organic matter and sulfides. The oxidized zone within black shale weathering profiles provides an unusual habitat for microbial activity. Although organic carbon is abundant within black shales, it occurs in a complex and chemically recalcitrant form that is less susceptible to biological degradation than simple carbon compounds. The oxidation of shale sulfide minerals generates significant acidity, such that the pH of porewaters measures <2 in some locations. Thus the organisms living within black shale weathering profile must be able to access complex carbon substrates and tolerate highly acidic conditions.

Samples were recovered from a weathering profile developed on Late Devonian New Albany Shale exposed near Clay City, Kentucky. This site has been the subject of previous studies of shale weathering and geochemistry. This study examines whether microorganisms are present within the weathering profile, if they unambiguously are accessing shale organic matter as