diffraction (XRD) analysis. These minerals, however, were not important metal sorbents. Rather, greater than 80 percent of the total Ni and Co content of the biofilms was shown to be associated with the manganese oxyhydroxide and organic/sulfide phases of the biofilm material, as determined by a sequential extraction scheme using microwave digestion. Mn oxyhydroxides were not identified even as trace mineral phases by XRD analysis; their high reactivity reflects the low pH values within the biofilms. Mn, Ni, and Co concentrations were 10^3-10^4 fold higher in the biofilms compared to the overlying water column (e.g. $[Mn]_{water}$ 60-85 nmol/mL vs. $[Mn]_{biofilm}$ 0.33-2.1 umol/g), making the biofilms effective metal scavengers.

Images and elemental analysis of the biofilms provided by a suite of microscopies (ESEM, CLSM, Epifluorescence microscopy) indicated that: 1) the biofilm surface is heterogeneous and characterized by distinct zones of mineralization; 2) biofilm-associated minerals are fine-grained and amorphous; 3) the dominant mode of microbial existence was a pod-like assemblage, and 4) Ni was associated both with the organic matrix and the minerals, confirming the results from the sequential extractions.

Our results show that complex microbial communities occur in the tailings seepage streams that create geochemical microenvironments that differ substantially from the bulk overlying water column and the underlying tailings. Metals are sequestered within the biofilms, mainly as a result of sorption to extremely reactive but trace mineral phases (Mn oxyhydroxides) and organic material. Currently, ongoing analysis investigates the microbial community diversity within the biofilm by molecular techniques (fluorescent in situ hybridization). Results from the integration of these molecular and geochemical techniques providing a mechanistic understanding of the biogeochemical processes controlling metal behaviour within AMD biofilms will be presented.

B22F MC: 122 Tuesday 1535h

Geophysiology: The Influence of Organisms on Their Geophysical Environment II

Presiding: **J Neff,** U.S. Geological Survey**; S Turner,** SUNY, College of Environmental Science Forestry

B22F-01 1535h INVITED

Geophysiology, Extended Organisms, and the Problem of Emergent Homeostasis

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Physiology may be broadly defined as the managed flow of matter, energy and information. Central to this concept is the attendant phenomenon of homeostasis, doing physiological work to balance the thermodynamically driven flows of matter, energy or information that naturally attend to living things. Organisms in general exhibit what might be termed a strong homeostasis, in which well-regulated and complex physiological machines drive the physiological fluxes of matter, energy and information within the organism and at the organisms outermost integumentary boundary. Organisms also structure their environments to manage flows of matter, energy and information between themselves and their environment. In so doing, living things constitute a sort of extended organism, in which an organisms physiology reaches beyond the outermost boundary of the skin. Geophysiologys radical promise is that physiology can arise at levels of organization higher than the organism, ranging from social insect colonies through ecosystems, perhaps even to the biosphere itself. However, a simple demonstration that organisms affect the flows of matter, energy and information in their environments is not sufficient to qualify as physiology. That amounts to a demonstration that organisms do physiological work on their environments, which is neither a radical nor a new idea. To be truly physiological, geophysiology must exhibit physiologys most essential attribute, namely homeostasis. Finding homeostasis and explaining how it works in the extended organism is geophysiologys radical challenge.

B22F-02 1555h

The effect of termites as ecosystem engineers in the humid tropics

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The effects of termites as "ecosystem engineers" in humid tropical ecosystems are manyfold and range from the modification of content and composition of organic matter in soils, changes of the soil structure, over effects on the composition of vegetation, to the enhancement of biodiversity of other organisms. An overview if given over findings of recent years with a focus on termites in Amazonian rain forests. Factors that determine termite distribution and diversity are then discussed, and the pests status of termites is shortly reviewed, on the basis of which management strategies for this particular group of soil organisms are outlined.

B22F-03 1610h

Application of in situ-produced 10Be to the study of Australian stone line induced by termite activity

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The aim of this study is to understand the genesis of a stoneline sequence located at the border of the Yilgarn Craton in southwest Austrtalia. The sequence was selected because a well-defined line of siliceous pebbles traces the limit between a typical tropical saprolite and a soil almost entirely composed of termite nests, providing an opportunity to study the role of biological processes in stoneline genesis. A roadcut along the Boyup Brook Road provided the opportunity to examine and sample a 100 m wide section of weathering mantle developed on a gently sloping hill. The sequence consists, from base to top, of three main weathering layers: a gneiss- and schist-inherited yellow saprolite that includes subvertical quartz veins ; a 10 to 20 cm thick stone line composed primarily of angular quartz pebble; and a 40 to 50 cm thick dark brown surficial soil rich in both active and dormant termite nests. The distribution of these layers does not vary significantly across the hill, but quartz rich veins are most abundant in the central part of the hill. Kaolinite and quartz are the major mineralogical components throughout the sequence. There is little variation in grain size distributions, other than a modest increase in the >63 micron fractions of surface samples due to termite activity (mixing of minerals with woody and grassy debris). Chemical and mineralogical analyses were used to characterise the weathering layers and to investigate the role of termite colonies. We determined the in situ produced 10Be contents of samples collected from a depth profile through the quartz-rich schist and of pebbles from the stoneline at distances up to 40 m from central quartz veins. The 10Be depth profile shows a simple exponential decrease with depth, consistent with attenuation of cosmic ray neutrons and erosion at a rate of 20 mMyr, consistent with rates of excavation by termites. The pebbles from the stoneline have nearly constant 10Be concentrations that are approximately three times higher than that extrapolated to the stoneline depth from the samples within the quatz vein. A discontinuous history of erosion is required to explain these observations. We suggest that ongoing chemical weathering was interupted by truncation of the hill and distribution of quartz pebbles occured over a relatively brief period during the past 100 kyr.

B22F-04 1625h

Bioturbation by Fire Ants in the Coastal Prairie of Texas

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Fire ants (Solenopsis invicta) were introduced to the US in the early part of the last century. They have spread throughout the southeastern US in the absence of native competitors and predators with a range limited by abiotic factors. Each fire ant mound contains thousands of individuals, can be large, and can be numerous enough to comprise a dominant feature of the landscape. Studies of this species have focused upon its spread, formation of single- and multiple-queen colonies, genetic structure, and impact on native fauna and human health. Some studies have analyzed native fire ant-soil interactions, but few studies have examined the process of bioturbation by introduced fire ants in native ecosystems.

Fire ants on the coastal prairie of Texas primarily are of the multiple-queen type that exhibit a much higher density of mounds than the single-queen type. Consequently, mound-building activities by fire ants can have a marked effect upon soil structure and nutrient content and may affect soil organisms and plants. Fire ant activity, mound density, mound dispersion, soil texture, soil permeability, soil moisture content, and soil nutrients were measured. Fire ants mounds are visible aboveground from April-November. Density of mounds was 117-738/ha, and average mound lifespan was 3.6 months with only 9% of the mounds remaining active throughout the entire season. Mounds were dispersed randomly. Foraging activity by fire ants was from June through October with a peak in July. Annual soil turnover was estimated by collecting and weighing mounds. There was no effect of ant mounds on soil texture, but water infiltration was higher in areas with ant mounds. Early-season samples showed no nutrient differences, but late-season samples showed that ant mounds contained higher amounts of micronutrients than random samples of soil. These data are compared to similar data on effects of mounds from native ants and from native and introduced ants in different habitats.

B

B22F-05 1640h INVITED

Local to Landscape-Level Effects of Bioturbation by Pocket Gophers

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All continents except Antarctica host mammal species that spend virtually their entire lives belowground. Unlike the majority of small mammals that use underground dens primarily as nests, the truly fossorial forms construct extensive burrows which they use for virtually all activities. Tailings from the burrows are deposited as mounds on the surface or are redistributed into unused tunnels, such that both the burrows and the mounds generate spatially explicit, dynamic patterns of soil disturbance. These have significant effects on vegetation, soil, and hydrology of the local area.

The amount of soil moved by North American pocket gophers is astounding, ranging from 3.4 to 57.4 m3 ha -1 year-1 (with a mean across all species of 17.8). Burrows can underlay 7.5% of the ground and mounds may cover 5% to 8% of an area at any one time, and as much as 30% to 50% of an area over one year. Studies have shown that soil movement by pocket gophers is one of the major sources of sediment transport in natural systems. Furthermore, erosion patterns generated by pocket gophers are the product of complex interactions between animal energetics and foraging behavior and differ significantly from processes of purely physical origin. Recent results provide clear evidence that soil movement by pocket gophers scales non-linearly with hillslope angle in a complex fashion not predicted by physically-based models.

The soil the pocket gophers deposit on the soil surface and in their burrows differs significantly from the background soil matrix. Mounds may have higher or lower nutrient content, moisture, water-holding capacity, or organic matter than inter-mounds areas, depending on the depth from which the soil was excavated and subsequent weathering.

As much as 59% of the soil from new excavations may be backfilled into old burrows rather than placed as mounds on the surface. This soil is 15% less compact than the surrounding soil matrix, even though the rodents pack it tightly into the vacant tunnels. Mounds exhibit an even lower bulk density, 10 to 40% lower than the adjacent consolidated soil.

Gopher burrows also have major influences on water movement by concentrating runoff into fast-flowing conduits. Under certain conditions burrows can become underground pipes, funneling water from the surface. It has been suggested that this piping can generate significant erosion, eventually leading to the collapse of the burrow roof and the initiation of a surface gully. At the landscape level, areas with high mound densities exhibited greater microtopographic variation and a greater mean height than adjacent areas with lower mound densities.

The net effects of burrow excavation, backfilling, mound production, and the subsequent movement of

soil by physical forces generate homogeneity in the vertical axis through soil mixing and significant heterogeneity in the horizontal axis. The actual influences and the spatial patterns in which they occur, comprise a significant and poorly understood process in natural systems.

B31A MC: Hall D Wednesday 0830h

Global Terrestrial Vegetation Dynamics From the EOS MODIS and Other Remote Sensors

Presiding: **S W Running,** Univ. of Montana

B31A-0075 0830h POSTER

Annual Cycle of MODIS Albedo, Nadir BRDF-Adjusted Reflectance and BRDF Products

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The MODerate resolution Imaging Spectroradiometer (MODIS) BRDF/Albedo Products (MOD43B) have been available to the public since July 2000. For the first time, an annual phenological cycle of these MODIS products is available for use by climate and biogeochemical modelers. Model parameters describing the Bidirectional Reflectance Distribution Functions (BRDF), measures of the albedo, and Nadir BRDF-Adjusted Reflectances (NBAR) have all been upgraded to a provisional status (from November 2000 onward). The operational MODIS BRDF/Albedo algorithm relies on multidate, atmospherically corrected, cloud-free surface reflectances and a semiempirical kernel-driven bidirectional reflectance model (RossThickLiSparseReciprocal) to determine parameters describing the BRDF of the global land surface. These one kilometer gridded parameters (for seven spectral bands and three broad bands) are then used to determine the global directional hemispherical reflectance ("black-sky albedo") at local solar noon, and the bihemispherical reflectance ("white-sky albedo") for each 16-day period. Global spectral NBARs (at the mean solar zenith angle of the observing period) are also computed to provide surface reflectances that have been corrected for view angle effects. Due to the consistency of this product over time, NBARs are particularly useful in capturing the phenological signal of the underlying surface vegetation. Thus annual sequences of the NBAR Product serve as the primary input for the MODIS Land Cover Product (MOD12Q). The MODIS BRDF/Albedo products are currently globally available at 1km and 5km resolutions and a 1/4 degree resolution version will soon be released. The annual temporal sequences will be presented as well as a discussion of the evaluation and reprocessing efforts that are underway.

URL: http://geography.bu.edu/brdf/

B31A-0076 0830h POSTER

Mapping Global Vegetation and Land Cover Properties from MODIS

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Data from MODIS provide a rich source of information for vegetation and land cover mapping applications. In particular, the multispectral and multitemporal information supplied by MODIS allows a variety of vegetation properties to be mapped and monitored at global scales in a fashion that was not previously possible. In this paper, we describe the algorithms and databases being used to produce the MODIS global land cover parameter, focusing particular attention on a suite of vegetation properties that complement more traditional land cover maps derived from remote sensing. Specifically, we describe a set of internally consistent maps, each depicting different vegetation attributes that have wide utility for studies of ecosystem dynamics at continental to global scales. The set of parameters being mapped include permanence of above ground biomass, leaf longevity, leaf type, and phenologic dynamics, among others. The methodology used to create these maps exploits a database of site data that includes detailed information related to ecosystem properties at global scales. The relationship between these maps and more traditional maps based on conventional classification systems, such as the IGBP scheme, will also be discussed. To illustrate the utility and information content of the maps being produced by MODIS specific examples at regional scales that include a range of climate and ecosystem types are presented.

URL: http://geography.bu.edu/landcover/

B31A-0077 0830h POSTER

Vegetation Dynamics and Seasonal Responses of North and South America from EOS-MODIS Vegetation Indices

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Consistent and long-term measurements from satellite sensors are important in assessing the spatial and temporal variability of the earth's terrestrial vegetation and in studying how global ecosystems are changing and how the earth's vegetation is being transformed. In this paper we present and evaluate one year of vegetation index product availability from the Moderate Resolution Imaging Spectroradiometer (MODIS). Two MODIS vegetation indices (VI), the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI) are produced at 1 km, 500 m, and 250 m resolutions and 16-day compositing periods. Multitemporal, seasonal profiles of the MODIS VI's are presented for numerous biome types in North and South America which depicted quite well their respective phenologies. The dynamic range of the MODIS VI's are presented and their sensitivities in discriminating vegetation differences are evaluated over sparsely vegetated areas as well as high biomass, densely vegetated areas. We found the NDVI to asymptotically saturate in high biomass areas while the EVI remained sensitive to vegetation variations in higher biomass regions such as in the Amazon. Validation campaigns were made at test sites representing semi-arid grass and shrub, savanna, and tropical forest biomes. Results show a good correspondence between airborne-measured, top-of-canopy, reflectances and VI values with those from the MODIS sensor over the test sites. Simultaneously derived field biophysical measures also demonstrated the science utility of the VI's.

B31A-0078 0830h POSTER

MODIS Vegetation Cover Products for Estimating Tree Cover and Monitoring Change

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Accurate estimates of global and regional tree cover are crucial for the study of biogeochemical cycles, ecosystem assessment, and land management. Changes in tree cover are equally important as they represent perturbations of the earth system.

We present two new products derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument onboard NASA's Earth Observing System Terra satellite. These products utilize the unique combination of spatial resolution (250m - 1km), daily global image acquisition, radiometric accuracy, and geolocation provided by MODIS.

The Vegetation Continuous Fields (VCF) product provides percent cover estimates at 500m spatial resolution for tree cover and vegetation life-form variables. This product is based on a time-series of data which captures the annual phenologic cycle. Prototype products for various regions of the world are presented and compared with other satellite-derived products as well as validation data sets collected on the ground.

The Vegetative Cover Conversion (VCC) product utilizes the 250m red and near-infrared bands on MODIS to detect changes in land cover. Changes of interest include flooding, burning, deforestation, urbanization and agricultural expansion. Various regional examples of dramatic land cover change are presented within the context of their impact on tree cover.

URL: http://glcf.umiacs.umd.edu/MODIS

B31A-0079 0830h POSTER

Siberian Landcover Analysis with MODIS and Landsat

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The Terra MODIS landcover product provides annual information on the type and extent of important cover classes. This product is useful for identifying change over large areas given the repeat observations of MODIS. It is important to know how well this product defines the landscape, especially in areas of rapid change. In Siberia, there is rapid change taking place form a host of factors including wildfire, insects, and logging. This paper reports on the results of a study to ascertain the relevance of the MODIS landcover product and its ability to detect change. In addition we evaluate the use of other products such as NDVI and EVI for our disturbance work in Siberia.

B31A-0080 0830h POSTER

The MODIS Land Rapid Response Project: A Comprehensive Suite of Products to Support U.S.D.A. Forest Service Fire Management

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