tion) including alumino-silicates, carbonates, and sulfates. Here, we test some key model predictions using the sulfate mineral barite ($BaSO_4$). Atomic force microscopy (AFM) and vertical scanning interferometry (VSI) were used to look at the (001) surfaces of freshly cleaved samples. Experiments were conducted in a flow-through cell that allowed monitoring the evolution of the sample surface with AFM. Results show that etch pits appear within minutes and indeed generate steps at their outskirts that radiate away from the growing pit. Complementary investigations were conducted with VSI. This technique has a much larger field of view than the AFM, typically up to mm^2, but provides comparably high vertical resolution of up to 0.7 angstroms. VSI measurements show that the entire barite surface retreats during the dissolution process as predicted by the theoretical model. Within the last ten years biologically produced chelating agents have been discovered naturally occurring in the environment. The computer model is used to determine the effects of chelating agents and our experiments using VSI also show a marked, as much as two orders of magnitude, increase in dissolution rate of barite due to the presence of chelating agents. Our presentation will discuss a quantitative attempt to directly link molecular-scale processes with observations at the nano-, micro- and macro-scale to better understand dissolution kinetics of crystalline matter.

B11F MCC: 3014 Monday 1020h

The Impact of Dust Emission and Deposition on Biogeochemical Cycling and Ecosystem Function II *(joint with A, H, OS, PP)*

Presiding: **G S Okin,** University of Virginia**; N Mahowald,** National Center for Atmospheric Research

B11F-01 1020h INVITED

The Biogeochemical Influences of Dust Deposition in a Global Ocean Ecosystem Simulation

Jefferson Keith Moore (949 824-5391; jkmoore@uci.edu)

University of California, Irivine, Earth System Science, Croul Hall, Irvine, CA 92697, United States

Global ocean simulations of ocean biogeochemistry are driven with model estimates of atmospheric dust transport and deposition as a key source of iron to the upper ocean. The coupled Biogeochemistry/Ecosystem/Circulation (BEC) model includes explicit phytoplankton functional groups that compete for available light and several potentially growth-limiting nutrients - nitrogen, phosphorus, silicon, and iron. Diatoms, coccolithophores, picoplankton, and nitrogen fixing diazotrophs are represented in the model. These different classes of phytoplankton experience differential grazing pressure and other loss terms in the model. Global scale patterns in nutrient limitation, primary production, carbon export out of surface waters, and nitrogen fixation are all sensitive to variations in atmospheric dust deposition. Dust deposition also significantly influences the competition between phytoplankton groups (diatom vs. non-diatoms, n-fixers vs. picoplankton). The potential impacts of climate driven variations in dust deposition to the oceans will be discussed.

URL: http://www.ess.uci.edu/~jkmoore/

B11F-02 1040h

Temporal Variability of Iron in the Upper Ocean at Hawaii Ocean Time-series Station ALOHA

Edward A Boyle[1] (6172533388; eaboyle@mit.edu)

Bridget A. Bergquist[1] (bardot@mit.edu)

Jingfeng Wu[1] (jwu@iarc.uaf.edu)

[1]Earth, Atm., Planetary Sciences, Massachusetts Institute of Technology, E34-158, 77 Mass. Ave., Cambridge, MA 02139, United States

Trace metal clean techniques were used to sample Hawaii Ocean Time-series (HOT) station ALOHA on seven occasions between Nov. 1998 and Oct. 2002. On three occasions, full water column profile samples were obtained; on the other four occasions, surface and near-surface euphotic zone profiles were obtained. Together with three published samplings (Rue and Bruland, 1995; Johnson et al., 2003), this site may have been monitored for "dissolved" (<0.4 or <0.2 m) Fe more frequently than any other deep-sea site in the world. Low Fe concentrations are seen in the lower euphotic zone (<0.1 nmol/kg). Significant temporal variability is seen in near surface Fe concentrations (ranging from 0.2 - 0.7 nmol/kg); we attribute these surface Fe fluctuations to variable dust deposition and biological uptake. This variability can only occur if the surface layer Fe residence time is less than a few years. Given that residence time and typical values of Fe at HOT (0.4 nmol/kg from June through November), a higher percentage of the total aerosol Fe must be released typically from North Pacific aerosols compared to North Atlantic aerosols (as was also surmised by Johnson et al., 2003 for a single dust storm in April 2001).

B11F-03 1055h

Establishing a Functional Link Between African Dust and Region-wide Coral Reef Decline

Marshall L. Hayes[1] (+377 92 16 79 82; mhayes@centrescientifique.mc)

Richard T. Barber[2] (+1 252 504 7578; rbarber@duke.edu)

[1]Centre Scientifique de Monaco, Av Saint Martin, Monte Carlo 98000, Monaco

[2]Duke University Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Rd., Beaufort, NC 28516, United States

For nearly thirty years, coral reefs in the Western Atlantic and Caribbean basin have experienced historically unprecedented declines. Algal blooms, mass coral bleaching, disease outbreaks and shifts in the dominance of benthic coral-competitors were first documented in the 1970s and have increased in frequency, intensity, variety and range over the past two decades. Recent studies of decreasing coral cover document regional losses averaging nearly 80% over this period. Here, we provide experimental evidence that increased supplies of iron-rich eolian dust from Africa to typically iron-poor marine environments throughout the region could have played a key role in these profound changes. Atmospheric inputs of "new" micronutrients, especially iron, have the potential to overcome limitations to the growth of opportunistic coral-competitors and the virulence of coral pathogens. Microcosm and mesocosm experiments with a putative bacterial pathogen of stony corals, *Aurantimonas coralicida*, and a temperate stony coral, *Oculina arbuscula*, provide a means to test the functional relationship between iron availability, microbial growth and coral health. Iron limitation of A. coralicida growth rates is readily induced by the addition of synthetic chelators such as 2,2' Dipyridyl to bacterial cultures at relatively low concentrations (e.g. 10 μM). This growth limitation is reversed by 100 nM over-enrichments of pure reagent-grade iron as well as iron-rich "synthetic dust" derived from African lakebed sediments. The Chrome-azurol S assay demonstrates that A. coralicida also synthesizes high-affinity iron-capture mechanisms (i.e. siderophores) that may serve as critical determinants of virulence. Finally, our experimental mesocosms are based on oligotrophic Mediterranean seawater and permit controlled experimentation under relatively low iron (~5 nM) conditions. Using this system, denaturing gradient gel electrophoresis (DGGE) analysis of PCR-amplified ribosomal DNA fragments is used to study changes in the bacterial community associated with corals incubated under Fe-replete and Fe-deplete conditions. Observations of marked variability in coral bacterial profiles suggest that certain bacterial species on coral surfaces are responsive to shifts in environmental iron levels. These experiments begin to provide a mechanistic understanding of how dust, and in particular, environmental iron, might affect survival and competition in the coral reef community. This novel, model-based experimental approach can be further extended to virulence bioassays and may be useful for other process studies of coral-microbe interactions as well.

B11F-04 1110h INVITED

The global dispersion of microorganisms and pollutants in clouds of desert dust

Dale W Griffin[1] (727-803-8747; dgriffin@usgs.gov); Christina A Kellogg[1]; Virginia H Garrison[1]; Nilgun Kubilay[2]; Mustafa Kocak[2]; Eugene Shinn[1]

[1]US Geological Survey, Center for Coastal and Watershed Studies, 600 4th St. South, St. Petersburg, FL 33701, United States

[2]Middle East Technical University, Institute of Marine Sceince, P.O. Box 28, Erdemli-ICEL 01, Turkey

A current estimate of the quantity of dust that is transported some distance in Earth's atmosphere each year is approximately two billion metric tons. Whereas various research projects have been undertaken to understand this planetary process, little has been done to address public and ecosystem health issues. Our research group is currently investigating long-range transport of microorganisms associated with desert dust clouds at various points on the globe via the integration of remote sensing, modeling and microbiological assays. Using a suite of molecular biology techniques, we are identifying cultivable bacteria and fungi and enumerating total bacteria and viruses. Research results indicate that approximately 30% of the microorganisms found in Earth's atmosphere during African dust events' are species of bacteria or fungi that have previously been identified as disease causing agents in terrestrial plants, trees, and animals. This presentation will cover historical research in this field and the implications of microbial and pollutant *metals*, *pesticides*, *etc.* transport to downwind ecosystems.

URL: http://coastal.er.usgs.gov/african_dust/

B11F-05 1130h INVITED

The Biogeochemical Impact of Global and Local Dust on Hawaiian Ecosystems

Oliver A Chadwick[1] (oac@geog.ucsb.edu)

Andrew C Kurtz[2] (kurtz@bu.edu)

Louis A Derry[3] (lad9@cornell.edu)

Peter M Vitousek[4] (vitousek@stanford.edu)

Bettina Wiegand[4] (bwiegand@pangea.Stanford.EDU)

[1]Oliver Chadwick, Department of Geography, University of California, Santa Barbara, CA 93106

[2]Andrew Kurtz, Department of Earth Science, Boston University, Cambridge, MA 02215

[3]Louis Derry, Department of Geological Department of Geological Sciences, Cornell University, Ithaca, NY 14853

[4]Peter Vitousek, Department of Biological Sciences, Stanford University, Stanford, CA 94305

Hawaii is distant from continental sources of dust, yet there is abundant evidence that continental dust accumulates in soils on stable land surfaces. The physical evidence for dust accumulation is a dark grayish purple horizon that resides just below the O horizon; it is evident to a trained eye in 20 ky soils but becomes quite obvious in 150 ky soils. The continental dust contains about 20% quartz and a greater amount of mica, minerals that are not found in the local basalt and tephra. Thus presence of quartz and mica in Hawaiian soils identifies present, and in the case of buried horizons, past stable surfaces. In older soils near surface soil horizons can contain up to 30% quartz after 150 ky of accumulation. Soils on older lava flows do not necessarily contain greater amounts of dust because chemical and physical erosion removes variable amounts from different landscape positions. In soils older than 20 ky there is a progressive increase in the quartz to mica ratio suggesting that mica is preferentially weathered in locations where physical erosion is limited. In addition to mineralogy, the isotopes of Sr and Nd provide distinctive indications of dust contribution to soil profiles because the mantle-derived lavas have different isotopic signatures that the more highly evolved continental components. In horizons greatly impacted by dust the basaltic derived Sr and Nd signatures are nearly completely overprinted by continental signatures. Strontium concentrations are highly depleted due to leaching whereas Nd is less labile. Using quartz and Nd as tracers of continental dust we calculate a minimum long-term dust accumulation rate of 125 mg/cm2/ky. Dust has a profound effect on the budgets of elements that are susceptible to leaching losses and becomes the dominant source of labile nutrients, Si and P in the oldest, most intensely weathered soils. We calculate a dust-derived P input flux of 0.8 mg/cm2/ky and a dust-derived Si input flux of 35 mg/cm2/ky. Leaching losses of Si and P are high in young soils but decline to values that balance the dust input in the oldest soils. Extremely refractory elements, such as Nb, that are concentrated by residual enrichment are much less readily impacted by dust additions. For example, 150 ky soils show strong continental dust signatures when considering mineralogy, or Sr and Nd isotopes, but dust can have contributed less than 4% of the Nb in the profile. Calcium and Sr, labile elements in humid soils are little impacted by dust additions because far greater quantities of these ions are dissolved in rainwater.

B11F-06 1150h

Distribution of Aeolian Dust Determined From Magnetic and Chemical Properties in Surficial Substrates of Grassland and Shrubland, Central Colorado Plateau (Utah)

Richard L Reynolds[1] (303-236-1303; rreynolds@usgs.gov)

Jason Neff[2] (303-492-6187; neffjc@colorado.edu)

Marith Reheis[1] (303-236-1270; mreheis@usgs.gov)

Harland Goldstein[1] (303-236-5506; hgoldstein@usgs.gov)

Paul Lamothe[1] (303-236-1923; plamothe@usgs.gov)

[1]U.S. Geological Survey, Box 25046 MS 980, Denver, CO 80225, United States

[2]Univ. of Colorado, Dept. of Geological Sciences, Boulder, CO 80309, United States

Rock-derived nutrients in soils originate from both local bedrock and atmospheric dust. Distinction between sediment derived from local bedrock and from dust provides better understanding of nutrients and the processes responsible for their distributions across landscapes. Sandy surficial deposits overlying dominantly sandstone substrates cover vast upland areas of the central Colorado Plateau. These deposits typically contain 5-40% fines (silt and clay measured using laser-diffraction methods), depending on geomorphic setting and slope (excluding drainages and depressions). Far-traveled aeolian dust in the deposits is indicated by the presence of titanium-bearing magnetite grains that are absent in the sedimentary rocks of the region. Thus, the quantity of dust can be estimated from magnetic properties that primarily reflect magnetite content, such as isothermal remanent magnetization acquired at 0.3 Tesla (IRM3). IRM3 was measured on bulk (<2 mm) sediment samples (IRMsoil; 0-10 cm depth) from a transect in surficial sediment (10 samples, each separated by 20-30 m) down a 2-3 degrees slope away from an exposure of Cedar Mesa Sandstone. The mass proportion (f) of aeolian fines in each sample was calculated using values of IRMsoil, IRMrock (average of 19 samples of regionally distributed Cedar Mesa Sandstone), and IRMdust (on sediment deposited over four months in nearby dust collectors at 2-m height determined on sand-free and organic matter-free bases): f=(IRMsoil-IRMrock)/(IRMdust-IRMrock). Very small magnetic contributions from hematite are responsible for the IRMrock value, which is 6 to 60x less than IRMsoil values. IRM-based calculations show a systematic down-slope increase in aeolian dust (2-18%), similar to the down-slope increase in total fines (18-40%). Aeolian dust calculated by the same method using titanium and vanadium contents closely matches the IRM-based results (6-20% and 5-19%, respectively). IRM-based dust estimates of soils correlate much more strongly with P, Na, K, Mn, Fe, Zn, and Mg (r^2>0.8) than do amounts of total fines. The combination of substantial aeolian dust contributions to soil fines and high concentrations of rock-derived nutrients in dust relative to local parent materials suggests that dust is a major source of potential plant nutrients in this setting.

B11F-07 1205h

Detection of the geographic distribution of source soil mineralogy in long range transported aerosol from Ca measurements and simulations in the Dust Entrainment And Deposition (DEAD) model

Charles S Zender[1] (9498242987; zender@uci.edu)

Huisheng Bian[2] (3016145092; bian@rondo.gsfc.nasa.gov)

[1]University of California at Irvine, Department of Earth System Science, Irvine, CA 92697, United States

[2]NASA/GSFC, Code 916, Greenbelt, MD 20771, United States

Calcium carbonate plays important indirect forcing roles in the chemical and biogeochemical system. Dust-borne $CaCO_3$ determines whether dust forms $Ca(NO_3)_2$ and deliquesces at ambient relative humidity, helps determine aerosol pH, and limits uptake of reactive species such as HNO_3 and SO_2. We compare simulations with the Dust Entrainment and Deposition Model (DEAD) to observed climatologies of $CaCO_3$ at stations worldwide. Simulations employing realistic spatially heterogeneous $CaCO_3$ content in source soils perform better than simulations which assume the same global-mean $CaCO_3$ content is homogeneously distributed in Earth's soils. The signature of soil $CaCO_3$ heterogeneity is detected in mineral dust deposition at remote downwind stations in the Atlantic and Pacific. Examining the $CaCO_3$ deposition flux normalized by the annual dust deposition flux, we find that North Atlantic deposition is relatively poor in $CaCO_3$ due to lower-than-average content in African source regions. In contrast, Asian deposition is relatively high in $CaCO_3$ due to alkaline Central Asian soils. This regional $CaCO_3$ abundance amplifies the role of dust in heterogeneous chemistry in Asian regions. Summertime Asian dust reduces tropospheric O_3 more strongly than African dust to Asian dust encountering more ozone precursors (e.g., NO_x) and having greater $CaCO_3$ abundance. Our simulations show that assuming soil composition is globally uniform leads to detectable biases. This has important implications not only for $CaCO_3$, but for other biogeochemically significant mineral carried in dust such as Iron and Phosphate.

B12A MCC: Level 2 Monday 1330h

From Mantle to Microbe: Ridge2000 Research and Progress Posters *(joint with OS, T, V)*

Presiding: **C Fisher,** Pennsylvania State University**; D K Smith,** Woods Hole Oceanographic Institution

B12A-0725 1330h POSTER

Development of a Rapid, Standardized Data Inventory for R2K Field Programs

Robert A. Arko[1] (845-365-8752; arko@ldeo.columbia.edu); Dale N. Chayes[1]; Suzanne M. Carbotte[1]; William B. F. Ryan[1]; Kerstin A. Lehnert[1]; Timothy M. Shank[2]

[1]Lamont-Doherty Earth Observatory, 61 Route 9W, Palisades, NY 10964, United States

[2]Woods Hole Oceanographic Institution, Mail Stop 33, Woods Hole, MA 02543, United States

Effective data management for Ridge2000 requires the production of a complete data inventory for every field program in a timely and standardized way. We are developing a set of forms to document 1.) basic field program information (dates and locations, platform, science party, etc); 2.) an inventory of sensor systems, data types (marine geophysical, physical and chemical oceanographic, rock and sediment samples, and biological), and file formats; 3.) supplemental attachments (written reports, instrument diagrams, etc); and 4.) a basic navigation track. We regard this as the minimal set of metadata which should be produced immediately at the end of a field program, in order to publicize it in an online database and satisfy agency requirements. We have developed a prototype set of Portable Document Format (PDF) forms which can be completed during a cruise through a combination of manual and automated input. PDF is a stable and widely-used format, with software available as both a commercial product (Adobe Acrobat) and an open-source library (http://www.pdflib.org). Completing a PDF form requires only the Acrobat Reader software, which is freely available for every major computing platform. Acrobat offers extensive functionality to aid in data inventory, including the ability to verify content on-the-fly, import data from other files and forms, show controlled vocabularies as pop-up menus, export to XML format, and print a high-quality readable report. Prototype forms have been tested on a recent transit of the CGC Healy, and we plan to continue testing on other ships and soliciting community feedback over the next several months. We envision a long-term plan in which a master set of forms is deployed with every R2K field program, along with a copy of Acrobat Reader, on lightweight storage media such as USB keys. The completed forms will then be transmitted to the data management center, where they are ingested automatically and the information made available in the online R2K database.

B12A-0726 1330h INVITED POSTER

Time-Critical Studies: Rapid response to Transient Dynamic Mid-Ocean Ridge Events

James P Cowen[1] (808-956-7124; jcowen@soest.hawaii.edu)

Edward T Baker[2] (206-526-6251; baker@pmel.noaa.gov)

Robert P Dziak[3] (541-867-0175; dziak@pmel.noaa.gov)

Marvin M Lilley[4] (206-543-0859; lilley@ocean.washington.edu)

[1]SOEST/University of Hawaii, 1000 Pope Rd, Honolulu, HI 96822

[2]PMEL-NOAA, 7600 Sand Point Rd, NE, Bldg 3, Seattle, WA 98115-6349

[3]PMEL-NOAA, 2115 S.E. OSU Drive, Newport, OR 97365-5258

[4]School of Oceanography, University of Washington WB-10, Seattle, WA 98195

The Time-Critical Studies (TCS) Theme of Ridge 2000 focuses on observations of the immediate geochemical and geobiological consequences of magmatic and tectonic events along the global mid-ocean ridge system. To date funding has centered on the Juan de Fuca and Gorda Ridges which are within the range of the U.S. Navy's Northeast Pacific Sound Surveillance System (SOSUS). NOAA's T-Phase Monitoring Program has accessed SOSUS in real-time since 1993, providing the TCS community with detection of seismicity associated with eruptive or tectonic activity along these two ridges. This remote detection of earthquake swarms along the N.E. Pacific mid-ocean ridge coupled to NSF funding for pre-event staging equipment and supplies has allowed directed and increasingly well-organized field responses to the event site. Major rapid and follow-up response cruises have been successfully mounted to 1993 CoAxial, 1996 and 2001 Gorda Ridge, the 1998 Axial Volcano, and 2001 Middle Valley magmatic episodes. The logistical approach required to study these events has been greatly facilitated by the RIDGE/Ridge 2000 programs and collaboration between university, NOAA and Canadian investigators. Not only have our studies of these events significantly impacted our ideas on the nature of crustal accretion, but they also have led to the discovery and preliminary documentation of a previously unrecognized biomass reservoir that lives below the seafloor and is swept out during these cataclysmic events, and to increased appreciation of the formation and thermal, chemical and biogeochemical implications of the 'Event Plumes' commonly associated with sea floor magmatic events. Rapid shore-to-event site response is an important aspect of TCS. Proposals to enhance the event detection and response effort are welcome at any Ridge 2000 target date. The Ridge 2000 program recognizes that even the most rapid ship response will miss the earliest subsurface and water column expressions of magmatic events. Consequently, Ridge 2000 also seeks proposals to develop alternate ultra-rapid response methods including air-droppable monitoring devices and in situ sensors. Coordination with Integrated Study Sites and proposed cabled and moored Ocean Observatories at Ridge 2000 Integrated Study Sites is also encouraged.

B12A-0727 1330h INVITED POSTER

The Eastern Lau Basin Integrated Studies Site (ISS)

Douglas Wiens[1] (314-935-6517; doug@seismo.wustl.edu); Fernando Martinez; Charles Langmuir; Meg Tivey; Jim Childress; Charles Fisher; Geoff Wheat; Michael Perfit; Donna Blackman; Stacey Kim

[1]Dept Earth and Planetary Sci., Washington University, St. Louis, MO 63130

A new venue for Ridge 2000 (R2K) Integrated Studies, the Eastern Lau Spreading Center (ELSC) adds the element of a spreading center in a back-arc basin to the R2K program. The ELSC, located in the western Pacific near Tonga, is a 390 km-long first-order ridge segment that displays a broad range of effects of the back-arc environment. At its southern end it is only 40 km from the Tonga arc volcanic front and is propagating southward into a back-arc rift. At its northern end it is 100 km from the volcanic front and terminates at a large, non-transform offset. The ELSC displays substantial and systematic changes in multiple parameters: spreading rate, magma source and lava chemistry, axial depth and morphology, melt lens characteristics, and crustal thickness and structure. A main focus of the work at the ELSC is to determine how changes in these forcing functions affect key parameters such as magma source composition, crustal structure, and characteristics of hydrothermal venting such as temperature, chemistry, and faunal composition and abundance. Prior reconnaissance investigation shows that these hydrothermal field characteristics also vary within the southernmost segments, and show distinct differences compared with well-studied mid-ocean ridge sites. Four R2K cruises are planned for the ELSC in 2004. The first cruise (PI: Martinez) will investigate interrelationships among crustal structure, volcanism, and hydrothermal activity using deep tow, CTD's, and Tow-Yo. A second cruise (PI: Langmuir) will focus on petrological and water column properties using dredging, CTD's and ABE. The next cruise (PI: Tivey) will provide an initial characterization of vent fields, fluid chemistry, mineralogy, and biodiversity using Jason II and net tows, and a final cruise (PI: Childress) will investigate community ecology using Jason II. An additional study (PI: Thurnherr) will deploy autonomous floats to investigate hydrothermal plume circulation and dispersal . An overview of the site is presented here.