discussions of the important role of fluids in the crust and applications of the phase diagram to economic vein deposits have proved very rewarding.

ED41C-1186 0830h POSTER

Weathering of Igneous, Metamorphic, and Sedimentary Rocks in a Semi-arid Climate - An Engineering Application of Petrology

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Over the last 10 years, analytical methods have been introduced to students in CSM's undergraduate geological engineering program through a multi-year and multi-course approach. Beginning with principles and simple applications of XRD and SEM in sophomore Mineralogy and building on these skills in subsequent junior and senior year courses, geological engineers acquire proficiency in analytical methods. Essential workplace skills are thus acquired without adding an extra course in the undergraduate program. The following exercise is completed by juniors in an integrated Ig.-Met.-Sed. petrology course. The identification of clay mineral assemblages in soils provides a unique opportunity to demonstrate how basic principles of petrology and geochemistry are applied to engineering design criteria in construction site preparation. Specifically, the problem investigates the conditions leading to the formation of smectite in soils and the resulting construction risk due to soil expansion. Students examine soils developed on igneous, metamorphic, and sedimentary rocks near Denver, Colorado. The field locations are areas of suburban growth and several have expansive soil problems. The 2-week exercise includes sample collection, description, and preparation, determining clay mineralogy by XRD, and measurement of Atterberg Plasticity Indices. Teaching materials may be found at: http://serc.carleton.edu/NAGTWorkshops/petrology03/. This exercise accomplishes three objectives: First, skills in XRD analysis are developed by introducing students to concepts of particle size separation, particle orientation, and sequential analysis steps which are standard practices in clay characterization. Second, lecture material on the geochemistry of weathering of different rock types is reinforced. Students interpret the origin of clay mineral assemblages developed in soils derived from Precambrian gneisses, lower Paleozoic feldspathic sandstones, upper Paleozoic marine shales, and Tertiary basalts and volcaniclastics. Third, the role of petrologic characterization in site engineering is demonstrated. Students use Atterberg Limits measurements in conjunction with soil mineralogy to assess swelling potential and to design soil treatment needs for each building site.

URL: http://serc.carleton.edu/NAGTWorkshops/petrology03/teaching_materials.html

ED41C-1187 0830h POSTER

A Web Resource for Lab Activities Using SEM, EDX and Light Microscopy

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A resource that facilitates undergraduate activities centered on the development of perthitic textures is available at http://www.geosci.ipfw.edu/sem/semedx.html. The web site provides a coherent set of data and images from a perthite and an anorthoclase sample. Backscatter and secondary electron images, plane- and cross-polarized light images, energy dispersive X-ray (EDX) data from 13 points on the perthite and 31 points on the anorthoclase (including spectra and results files with data expressed as wt. and atomic percents) and X-ray diffraction (XRD) data are available. Care has been taken to match the areas examined by light and electron methods, allowing students to directly compare the data available from each technique. Brief descriptions of the various methods are provided. The available information can be the basis for many different exercises. Those without easy access to mircoprobes or EDX spectrometers will find the spectra useful for discussions of microchemical techniques. Different phases can be identified in the light and SEM images. The chemical results can be used to calculate formulas. (In addition to the feldspar, the anorthoclase phenocryst contains olivine, clinopyroxene, ulvospinel, apatite and glass.) Feldspar compositions can be plotted to illustrate compositional differences in perthite and anorthoclase. Glass compositions from the interior and margins of the anorthoclase phenocrysts can be compared. Numerous other possibilities, of varying levels of complexity, exist. The perthite (from Perth, Ontario) and the anorthoclase (from Mt. Erebus, Antarctica) were purchased from Wards Natural Science. There are many students with little or no access to data derived from EDX, SEM, XRD and similar techniques. It is our responsibility to find ways to make this information more universally available to all students.

ED41D MCC: Level 2 Thursday 0830h

Teacher Professional Development Programs Promoting Authentic Scientific Research in the Classroom I Posters

Presiding: **S K Croft,** National Optical Astronomy Observatory**; C E Walker,** National Optical Astronomy Observatory

ED41D-1188 0830h POSTER

Astronomy Village: Multimedia and Authentic Research in the Classroom

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Two recent trends in American science education are: the use of technology in the classroom, and the development of inquiry-based science curricula that model authentic scientific research in the classroom. Two products have been developed in recent years at the Center for Educational Technology to test the ability of multimedia to put effective research models into the classroom: Astronomy Village: Investigating the Universe (AV-IU), and Astronomy Village: Investigating the Solar System (AV-ISS). AVIU is designed for high school students and deals with topics mostly in stellar and galactic astronomy, while AVISS is designed for middle school students and deals with topics in astrobiology and planetary geology. The objective of both products is to engage students in scientific inquiry by having them acquire, explore, and analyze real scientific data and images drawn from real scientific problems. By doing "hands-on" activities both on and off-line, the students would gain an understanding of scientific concepts and how science works. The challenge is to guide students through an investigation using a stand-alone multimedia CD-ROM. The central device for guidance in both products is the "Research Path Diagram," a visual representation and interactive model of the scientific process. In the earlier AV-IU, the "path" was linear and each investigation was independent. In the later AV-ISS, the path is circular and investigations are linked, so that students can see how research activities are in a sense cyclical and build on one another. While even the AV-ISS version is still not a truly accurate representation of the sometimes tortuous path trod by the research scientist, both models provide a good framework for approximating real research in a multimedia environment. NOAO is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.

ED41D-1189 0830h POSTER

DASL–Data and Activities for Solar Learning

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Data and Activities for Solar Learning (DASL) provides a classroom learning environment based on a twenty-five year record of solar magnetograms from the National Solar Observatory (NSO) at Kitt Peak, AZ. The data, together with image processing software for Macs or PCs, can be used to learn basic facts about the Sun and astronomy at the middle school level. At the high school level, students can study properties of the Sun's magnetic cycle with classroom excercises emphasizing data and error analysis and can participate in a new scientific study, Research in Active Solar Longitudes (RASL), in collaboration with classrooms throughout the country and scientists at NSO and NASA. We will demonstrate a compact disc with the data and software, and a web site for uploading the RASL results.

URL: http://eo.nso.edu/dasl/

ED41D-1190 0830h POSTER

Workshop on Teaching Astronomy Space Science at High School and Middle School Level

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For the last two years we have conducted a workshop mostly supported by a NASA IDEAS grant on providing professional development for teachers teaching Astronomy/Space Science at high school and middle school level. In some cases this effort has also supported efforts at schools in creating new courses in Space Science. The effort has included a one week summer workshop with as many as six follow up one-day meetings in the school year. The summer workshops have included presentations by experts in current space science research themes and also tours of professional and amateur observatories in and around Wisconsin. The format also allows for some time for teachers to share ideas, curricula among themselves and to present and share "best practices". As in many other instances, the different needs of individual schools, students and teachers prevents a single approach to content and course implementation in schools. Therefore our efforts have focused in serving the needs of individual teachers as much as feasible with limited resources. We gratefully acknowledge the support received from NASA/IDEAS program as well as the Wisconsin Idea program funded by the University of Wisconsin-Madison.

URL: http://tellus.ssec.wisc.edu/outreach

ED41D-1191 0830h POSTER

Teacher Intern Experiences during a Graduate Level Summer School

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This paper summarises the learning experiences of a teacher intern who attended the two week graduate level summer school given by the Center for Space Weather Modeling (CISM); and who subsequently spend another two weeks desiging laboratory exercises that were based on the material presented at the summer school. Two of these laboratories that are based on professional research will be reviewed and the effect these laboratories had on the teacher's coworkers and the teacher's own students will be evaluated and described.

ED41D-1192 0830h POSTER

High Leverage NASA Education & Public Outreach Teacher Professional Development Programs

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A critical component of NASA Education and Public Outreach (E/PO) programs is to educate K-12 classrooms teachers in science content, inquiry-based methods of science teaching, and exemplary curriculum materials. Typical NASA E/PO programs accomplish this through workshops at teacher conventions, short courses at colleges and universities, teacher camps during the summer, etc.. These programs are extremely valuable, but unfortunately they have a low ratio of number of teachers reached to time spent by E/PO professionals in developing and organizing the programs. We have addressed this problem in two ways. First, in partnering with organizations that already conduct extensive teacher professional development (PD) programs, such as the Lawrence Hall of Science, we can reduce the amount of time spent in preparing for our own programs. Second, we target our PD programs for teachers and administrators who are committed to conducting their own PD programs for their colleagues. In this way we can highly leverage the limited resources of a given E/PO program to impact far more teachers, and hence students, than could ever be reached personally by individual E/PO professionals.

ED41D-1193 0830h POSTER

The Teacher As Scientist: A Role Model for Inspiring the Next Generation of Explorers

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NASA GSFC Education is directly involved with scientists in studies of ice and snow as they seek to gain insight into the effects of snow and ice on the Earth's weather and climate. In parts of the world the water equivalent in the snow has significant cultural and economic consequences. Better techniques for remote determination of water content in the snowpacks depend on the in situ validation of satellite remote sensing. These in situ measurements and supporting lab studies are used by those who support the NASA efforts, and evaluate avalanche hazard are the same measurements and techniques that we teach in our teacher as scientist education program held annually at Lake Placid ,New York -the home of the 1932 and 1980 winter Olympics. We developed this program called HOW (History of Winter) in conjunction with scientist Peter Wasilewski, GSFC Laboratory for Extraterrestrial Physics. The program brings together teachers and scientists (the latter having 55 expeditions to the Polar regions and numerous years of Lake Ice studies in their backgrounds) to broadly decipher the history of winter embedded in the measurable record of snowfall and details in lake ice. The concept is to have scientists create the mindset and framework for teacher scientists who can then facilitate the motivation of student scientists via an inquiry based structure. Additionally, we strive to have students view their science teachers not only as teachers, but also as scientists who are actively engaged in research projects in order to provide a stimulus to the students to not only consider teaching as an exciting career, but also science itself. This session will describe how the teachers are directly involved annually in the science role during a 7 day campaign in February, and then follow up with their students upon returning to the classroom. The structure of the program and protocols will be described.

URL: http://education.gsfc.nasa.gov

ED41D-1194 0830h POSTER

Spatial Analysis of Geohazards using ArcGIS–A web-based Course.

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As part of the Environmental Systems Research Incorporated (ESRI) Virtual Campus program, a course was designed to present the benefits of Geographical Information Systems (GIS) based spatial analysis as applied towards a variety of geohazards. We created this on-line ArcGIS 8.x-based course to aid the motivated student or professional in his or her efforts to use GIS in determining where geohazards are likely to occur and for assessing their potential impact on the human community. Our course is broadly designed for earth scientists, public sector professionals, students, and others who want to apply GIS to the study of geohazards. Participants work with ArcGIS software and diverse datasets to display, visualize and analyze a wide variety of data sets and map a variety of geohazards including earthquakes, volcanoes, landslides, tsunamis, and floods. Following the GIS-based methodology of posing a question, decomposing the question into specific criteria, applying the criteria to spatial or tabular geodatasets and then analyzing feature relationships, from the beginning the course content was designed in order to enable the motivated student to answer questions. For example, to explain the relationship between earth quake location, earthquake depth, and plate boundaries; use a seismic hazard map to identify population and features at risk from an earthquake; import data from an earthquake catalog and visualize these data in 3D; explain the relationship between earthquake damage and local geology; use a flood scenario map to identify features at risk for forecast river discharges; use a tsunami inundation map to identify population and features at risk from tsunami; use a hurricane inundation map to identify the population at risk for any given category hurricane; estimate accumulated precipitation by integrating time-series Doppler radar data; and model a real-life landslide event. The six on-line modules for our course are Earthquakes I, Earthquakes II, Volcanoes, Floods, Coastal Geohazards and Landslides. Earthquake I can be viewed and accessed for no cost at http://campus.esri.com.

URL: http://harbert.geology.pitt.edu

ED41D-1195 0830h POSTER

The Bridge: Integrating Ocean Science Data in the Classroom

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The Bridge is a growing collection of the best marine education resources available on-line. It provides K-12 educators with a convenient source of accurate and useful information on global, national, and regional marine science topics, and gives researchers a contact point for educational outreach. There are many ways a researcher can become involved in education, from working directly with students to helping develop educational materials. The Bridge facilitates the connection between researchers and teachers by integrating scientific data into a ready-to-use classroom activity. These activities, or Data Tips, focus on a different ocean science topic each month during the school year. Through the Bridge Data Tips, students participate in the scientific process and researchers share their data with a unique audience. Bridge Data Tips that incorporate geophysical ocean science research data will be highlighted in this poster.

URL: http://www.marine-ed.org/bridge

ED41E MCC: 3012 Thursday 1020h

The Benefits and Challenges of Education and Public Outreach Efforts Associated With Scientific Research Programs II *(joint with OS, P, SA, SH, SM, C)*

Presiding: **D Alexander,** Rice University**; C Morrow,** Space Science Institute, University of Colorado

ED41E-01 1020h

Bringing Ionospheric Exploration to Pre-College Classrooms: Meeting the Challenges of EPO for the CINDI Mission

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Early next year, the Air Force will launch a new atmospheric suite of ionospheric instruments, CINDI (Coupled Ion Neutral Dynamic Investigation), on board a C/NOFS (Communications/Navigations Outage Forecast System) satellite. Finding a way to successfully bring the science of CINDI to non-technical audience, both inside and outside of the classroom, has presented some unique challenges for the CINDI EPO team. CINDI will provide critical information toward better understanding how variability within the ionosphere affects radio communications and navigation. Exciting students, their teachers, and the public about a mission which will return no pictures, and which explores a region of the terrestrial atmosphere that is typically neglected in formal education (and with which the general public is unfamiliar) is difficult, despite the direct impact the ionosphere can have on the functioning of our modern society. We will present the strategies we are employing to make the science of CINDI interesting, relevant, and understandable to a general audience, and to integrate ionospheric exploration into the framework and requirements of existing secondary science curricula and education standards.

URL: http://cindispace.utdallas.edu/

ED41E-02 1035h

Experiences of an Educator/Scientist Team

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Since 1997, the NASA Langley research team focussed on the problem of the Earth's Radiation Budget and the impact of clouds thereon has been developing an offshoot: a team of educators has become involved as well. This educator team originated from the convergence of a research need with an education need. An educator indicated that she was interested in connecting her students' in-class science activities to NASA, as a motivating factor. The research team had a use for numerous and widely-dispersed ground observations of clouds. The immediate result was the CERES S'COOL Project (http://asd-www.larc.nasa.gov/SCOOL/) which currently involves K-12 cloud observers in 62 countries, and which is continuing to grow. Once established, this educator/scientist team has led to other possibilities as well. We have now joined the GLOBE program (www.globe.gov) to obtain more and better ground observations of contrails. And we are initiating a new project to make NASA Earth Science Enterprise data about the Earth accessible for use by K-12 students and teachers. This paper will discuss both benefits and challenges of these various activities, from the point of view both of the educator team and the research team.

ED41E-03 1050h INVITED

The Stanford Solar Observatory Group E/PO Program

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As PI for the SOHO/MDI and SDO/HMI investigations and a Co-I in the NSF CISM STC program I have had the opportunity to help in the formulation and development of a multifaceted education and public outreach program. Our E/PO effort began with a web page and press relations but has grown to include the development of an inexpensive spectrometer with supporting materials, poster development and distribution, and a series of webcasts in collaboration with NASA. The present program, with the support of a dedicated E/PO team, includes the development of a solar planetarium program, and a space weather monitor that can be made available through traditional distribution methods. In collaboration with the Stanford Haas Center for Public Service we are also developing a university course that will teach the essentials of science education as part of a lifetime commitment to public service. The development of the Stanford solar E/PO program and involvement of science professionals in that program will be discussed. (The Michelson Doppler Imager (MDI) is an instrument on the Joint ESA & NASA Solar and Heliospheric Observatory (SOHO) mission. The Helioseismic and Magnetic Imager (HMI), is an instrument on the NASA Solar Dynamics Observatory (SDO) mission which is under development. The Center for Space Weather Modeling (CISM) led by Jeff Hughes at Boston University is an NSF Science and Technology Center.)