the click of a mouse, a legacy that will be built upon by the Integrated Ocean Drilling Program (IODP) in the near future.

URL: http://www-odp.tamu.edu/publications/

ED32B MCC: Level 2 Wednesday 1330h

The GeoWall in the Earth Science Classroom III Posters

Presiding: **P J Morin,** University of Minnesota**; P van Keken,** University of Michigan**; A Johnson,** Electronic Visualization Laboratory, University of Illinois at Chicago

ED32B-1193 1330h INVITED POSTER

Application Of Geowall Technology To The Analysis Of A Three Dimensional Geologic Map Of The Santa Clara (Silicon) Valley, California

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Geowall, a stereo projection system suitable for meetings and conferences, is being used to visualize, understand, interpret, and test a three-dimensional geologic map of the Santa Clara (Silicon) Valley, southern San Francisco Bay area, California. Geowall*, developed at the Electronic Visualization Laboratory associated with the University of Illinois, uses dual polarized images projected onto a polarization-preserving screen to create the illusion of three dimensions when viewed through polarized glasses. The map of Santa Clara Valley encompasses a 45 by 45 km area, extends to a depth of 14 km, and includes the northern Santa Clara Valley and surrounding hillsides between the active Calaveras and San Andreas faults. It is currently divided by several major faults into tectonic blocks, within which 9 units represent the Cenozoic and Mesozoic sections. Many of these units will be subdivided as the map evolves. The map is being constructed in EarthVision*(TM, Dynamic Graphics, Inc.), a geologic modeling software that includes three dimensional rendering and model manipulation capabilities. Earthvision generates data and model images of which the entire, or only portions of the model, can be viewed in three dimensions. The geowall presentation will explore the datasets and three-dimensional geologic map of Santa Clara Valley and structures defined by geologic mapping, stratigraphy, hydrology, potential field geophysics, seismic reflection, and earthquake seismicity. The map is the result of a collaborative effort among several earth science disciplines, and as such requires the integration of diverse datasets and the communication of diverse ideas. The geowall is particularly effective at promoting group discussion and analysis of the three-dimensional map, because the map can be displayed in a group setting as a 6x6 ft., stereo image. The spatial relationships of the datasets are easily seen, and the map can be deconstructed and particular relationships isolated. For example, trends in scattered clouds of point data are often difficult to perceive in two dimensions. The rendering of earthquake hypocenter data coupled with the ability to view only the fault planes in the map, from any perspective, permits rapid examination of coherent point patterns relative to modeled fault planes. Visualizing hydrologic data simultaneously with geologic data permits scientists to see relationships that were not apparent in two-dimensions or individually. Such concurrent analysis among project scientists is vital to the iterative process of exploring relationships between data sets, hypothesis testing, and model improvement. Another important use of the geowall is the communication of project ideas and results to others. The geowall has proven to be an effective tool for conveying information about Santa Clara Valley to managers, scientific audiences, and local citizens. Managers and scientists are able to grasp the geologic problems quickly and ask targeted questions, whereas citizens with non-earth science backgrounds are able to understand such concepts as pull-apart basins and gain knowledge of the scale of geologic structures. * Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

ED32B-1194 1330h POSTER

The CoreWall; Visualization Technology for Core Interpretation and Site Selection

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The CoreWall project addresses the pressing need for the integration of all data associated with the interpretation of geologic cores. The ongoing effort is two-fold: first, a suite of hardware and software is being developed to give users full access to all associated data on a tiled display that can show entire sections of the core, and second, a set of Web based applications will be developed to provide access to the same set of tools on a standard consumer grade computer via the Internet. The suite of software tools includes tools to display lithologic, geophysical, and geochemical information referenced to scans of the split core, tools to include typed and hand written notes and diagrams pinned' to a specific core depth, and collaboration tools which allow technicians and scientists to discuss and interpret in real-time or in a non-linear fashion. All tools will be developed to access preexisting databases already in use by the coring community. Also included is software for the stereo visualization of topographic and bathymetric visualization of drilling sites. Global 30-meter resolution SRTM elevation data will be available for terrestrial sites as well as coarser bathymetric data augmented by high-resolution site surveys.

URL: http://www.geowall.org

ED32B-1195 1330h POSTER

3-D Visualizations At (Almost) No Expense

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Like most teaching-oriented public universities, San José State University (part of the California State University system) currently faces severe budgetary constraints. These circumstances prohibit the construction of one or more Geo-Walls on-campus. Nevertheless, the Department of Geology has pursued alternatives that enable our students to benefit from 3-D visualizations such as those used with the Geo-Wall. This experience - a sort of virtual virtuality - depends only on the availability of a computer lab and an optional plotter. Starting in June 2003, we have used the methods described here with two diverse groups of participants: middle- and high-school teachers taking professional development workshops through grants funded by NSF and NASA, and regular university students enrolled in introductory earth science and geology laboratory courses. We use two types of three-dimensional images with our students: visualizations from the on-line Gallery of Virtual Topography (Steve Reynolds), and USGS digital topographic quadrangles that have been transformed into anaglyph files for viewing with 3-D glasses. The procedure for transforming DEMs into these anaglyph files, developed by Paul Morin, is available at http://geosun.sjsu.edu/∼sedlock/anaglyph.html. The resulting images can be used with students in one of two ways. First, maps can be printed on a suitable plotter, laminated (optional but preferable), and used repeatedly with different classes. Second, the images can be viewed in school computer labs or by students on their own computers. Chief advantages of the plotter option are (1) full-size maps (single or tiled) viewable in their entirety, and (2) dependability (independent of Internet connections and electrical power). Chief advantages of the computer option are (1) minimal preparation time and no other needed resources, assuming a computer lab with Internet access, and (2) students can work with the images outside of regularly scheduled courses. Both methods have been very popular with both cadres of students, comprehension and performance have measurably improved, and local middle- and high-school teachers now use these methods with their own students.

ED32B-1196 1330h POSTER

A Software Tool for Effective Presentation of Earth Science Data

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A software tool for 3D scientific data analysis and presentation will be reviewed. The tool enables scientists, educators, and outreach coordinators to construct compelling visualizations from many disparate data sets and makes complex data understandable to specialists and non-specialists alike. Capabilities exist that allow presentations to be assembled in which data-based graphics, images, slides and various actions can be sequenced into logical order, creating content suitable for sharing with colleagues, students, or the general public. Data exploration capabilities facilitate further investigation and experimentation. Two case studies will be presented. In the first, undergraduate research students at Norfolk State University used the software to explore differences in the structure and characteristics of the tropospheric and stratospheric layers of the atmosphere. In the second, government scientists from EPA, NASA, and NOAA used the software on a portable GeoWall to present air quality and satellite data to audiences with a wide array of backgrounds.

ED32B-1197 1330h POSTER

GeoWall on the Cheap; Stereo Paper Maps in the Classroom and the Field

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An inexpensive version of GeoWall material has been developed for use in the field. Using freely available USGS DEM and DRG data and public domain software, local stereo topo maps can be easily created and printed on paper for use in the field without computers or projectors. We have used these maps with a broad group of K-12 students through university undergrads to help them learn to read a standard USGS 7.5 minute quadrangle. This enables students to develop a strong three-dimensional conception of their field area. Another important use of the maps is within an informal educational setting. The stereo maps easily convey topographic information to audiences with little or no Earth Science background or map reading skills. Not only are the maps instructive but they provide an engaging field or classroom activity that fosters enthusiasm for map reading. The technique for creating stereo maps will also be presented.

URL: http://www.geowall.org

ED32B-1198 1330h POSTER

Anaglyph Image Technology As a Visualization Tool for Teaching Geology of National Parks

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Anaglyphic stereo viewing technology emerged in the mid 1800's. Anaglyphs use offset images in contrasting colors (typically red and cyan) that when viewed through color filters produce a three-dimensional (3-D) image. Modern anaglyph image technology has become increasingly easy to use and relatively inexpensive using digital cameras, scanners,

color printing, and common image manipulation software. Perhaps the primary drawbacks of anaglyph images include visualization problems with primary colors (such as flowers, bright clothing, or blue sky) and distortion factors in large depth-of-field images. However, anaglyphs are more versatile than polarization techniques since they can be printed, displayed on computer screens (such as on websites), or projected with a single projector (as slides or digital images), and red and cyan viewing glasses cost less than polarization glasses and other 3-D viewing alternatives. Anaglyph images are especially well suited for most natural landscapes, such as views dominated by natural earth tones (grays, browns, greens), and they work well for sepia and black and white images (making the conversion of historic stereo photography into anaglyphs easy). We used a simple stereo camera setup incorporating two digital cameras with a rigid base to photograph landscape features in national parks (including arches, caverns, cactus, forests, and coastlines). We also scanned historic stereographic images. Using common digital image manipulation software we created websites featuring anaglyphs of geologic features from national parks. We used the same images for popular 3-D poster displays at the U.S. Geological Survey Open House 2003 in Menlo Park, CA. Anaglyph photography could easily be used in combined educational outdoor activities and laboratory exercises.

ED32B-1199 1330h INVITED POSTER

GeoPad: Innovative Applications of Information Technology in Field Science Education

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A core requirement for most undergraduate degrees in the Earth sciences is a course in field geology, which provides students with training in field science methodologies, including geologic mapping. The University of Michigan Geological Sciences' curriculum includes a seven-week, summer field course, GS-440, based out of the university's Camp Davis Geologic Field Station, near Jackson, WY. Such field-based courses stand to benefit tremendously from recent innovations in Information Technology *IT*, especially in the form of increasing portability, new haptic interfaces for personal computers, and advancements in Geographic Information System *GIS* software. Such innovations are enabling in-the-field, real-time access to powerful data collection, analysis, visualization, and interpretation tools. The benefits of these innovations, however, can only be realized on a broad basis when the IT reaches a level of maturity at which users can easily employ it to enhance their learning experience and scientific activities, rather than the IT itself being a primary focus of the curriculum or a constraint on field activities. The GeoPad represents a combination of these novel technologies that achieves that goal. The GeoPad concept integrates a ruggedized Windows XP TabletPC equipped with wireless networking, a portable GPS receiver, digital camera, microphone-headset, voice-recognition software, GIS, and supporting, digital, geo-referenced data-sets. A key advantage of the GeoPad is enabling field-based usage of visualization software and data focusing on $3D$ geospatial relationships $developedaspartofthecomplementaryGeoWallinitiative$, which provides a powerful new tool for enhancing and facilitating undergraduate field geology education, as demonstrated during the summer 2003 session of GS-440. In addition to an education in field methodologies, students also gain practical experience using IT that they will encounter during their continued educational, research, or professional careers. This approach is immediately applicable to field geology courses elsewhere and indeed to other field-oriented programs $e.g., inbiology, archeology, ecology$, given similar needs.

ED32B-1200 1330h POSTER

Coupling Near-surface Geophysics with Three-Dimensional Geological Model Building for Environmental Investigations

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Investigating the subsurface at scales relevant to environmental remedial investigations can be complicated in areas that have been repeatedly glaciated or complicated by the presence discontinuous frozen ground and fractured bedrock. Ground water flow and contaminant migration pathways are very hard to infer in such heterogeneous aquifers characterized by a complex system of juxtaposed hydrogeological facies. Our investigations have merged using near-surface geophysical surveys with complex three-dimensional geological modeling using EarthVision at various sites in Alaska to assist with better delineating possible groundwater and potential contaminant migration pathways to assist with remedial investigations. These modeling efforts provide a three-dimensional framework to assist with remediation decision-making. Site characterization data were acquired from near-surface seismic refraction tomography, DC resistivity surveys, ground penetrating radar profiles, deep borehole drilling, hydrological modeling, and water quality observations. These data are synthesized to develop a conceptual model of local geology in the context of regional record; the conceptual model is then used as the basis to develop a three-dimensional model of subsurface conditions by modeling the data using EarthVision software.

ED32B-1201 1330h POSTER

The Role of Stereo Projection in Developing an Effective Concluding Earth Science Course

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Remarkably few students enrolled in introductory earth science courses have any intention of continuing in earth science, and for most students, these classes are often the last science course they will take in their academic careers. These students would be better served, if the course was instead designed to be a 'concluding' science course. One that explicitly provided students with the knowledge they need to become more informed citizens in the global community. The University of Minnesota is attempting to develop a national model of an effective 'concluding' earth science course by integrating three essential approaches: use of regional case studies to increase student comprehension; a comprehensive evaluation of students' prior knowledge, misconceptions and post-instructional knowledge that is woven throughout the project; and, an ambitious use of 'GeoWall' stereo projection systems to facilitate the students' use of maps and data sets and level the classroom playing field with regard to spatial conceptualization. In every discipline there are some critical skills or assessments that serve as conscious or unconscious 'gate-keepers' for progress in that field. In earth science, map interpretation is probably the critical restriction curtailing students' ability to access and explore course concepts. So much of our discipline's information is encoded in maps, that students who are not innately predisposed to understanding maps find it difficult to understand much of the course content and methodology. GeoWall stereo projection systems can reduce the efficiency of this 'gate-keeping' process, allowing students of diverse backgrounds and abilities to understand map data and succeed in the course. In doing so, these systems will not only help increase students' scientific literacy, but may also greatly increase the diversity of students who do go on to consider earth science as a potential career.

ED32B-1202 1330h POSTER

Teaching Introductory Mineralogy With the GeoWall

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Mineralogy, like many topics in Earth Sciences, contains inherently three-dimensional topics that are difficult to teach. Concepts such as crystal symmetry and forms, Miller indices, the polymerization of silica tetrahedra and resulting structures of silicate mineral groups, and the interaction of light and minerals are particularly difficult. Two-dimensional diagrams are limited in their effectiveness, and physical models, while effective, are expensive and do not work as well in large class settings. The GeoWall system brings the effectiveness of physical models to the large classroom. In Fall 2003, we will integrate the GeoWall into our introductory mineralogy classes at UCSB using a combination of commercial software, atomic structure models available on the web, and custom content created in-house. The commercial software SHAPE (www.shapesoftware.com) allows users to build and display crystal shapes and their symmetry. Though not designed for the GeoWall, the software's stereopair display mode works perfectly on the system. Using the Chime web browser plug-in (www.mdl.com), computer models of silicate minerals available from the Virtual Museum of Minerals and Molecules (www.soils.umn.eduvirtual_museum) provide an interactive display of silicate mineral structure that illustrates the tetrahedral framework. Again, while not developed for the GeoWall, the Chime plug-in works seamlessly with the GeoWall hardware. 3-D GeoWall images that display light paths through minerals, and reveal relationships between crystal symmetry and optical indicatrix properties, have been developed in-house using a combination of SHAPE and 3D modeling software. The 3-D GeoWall images should convey in an instant these difficult concepts that students historically have struggled to visualize. Initial assessment of the GeoWall's effectiveness as a mineralogy teaching aid at UCSB in Fall 2003 will come from the instructor's impressions and by comparing test scores with classes from previous years.

ED32C MCC: Level 2 Wednesday 1330h

Exploiting the Electronic Media to Communicate Science Posters *(joint with OS, P, C)*

Presiding: **K B Olsen,** Institute for Crustal Studies

ED32C-1203 1330h POSTER

Community Digital Library Requirements for the Southern California Earthquake Center Community Modeling Environment (SCEC/CME)

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A community digital library provides support for ingestion, organization, description, preservation, and access of digital entities. The technologies that traditionally provide these capabilities are digital libraries (ingestion, organization, description), persistent archives (preservation) and data grids (access). We present a design for the SCEC community digital library that incorporates aspects of all three systems. Multiple groups have created integrated environments that sustain large-scale scientific data collections. By examining these projects, the following stages of implementation can be identified:

- Definition of semantic terms to associate with relevant information. This includes definition of uniform content descriptors to describe physical quantities relevant to the scientific discipline, and creation of concept spaces to define how the uniform content descriptors are logically related.
- Organization of digital entities into logical collections that make it simple to browse and manage related material.
- Definition of services that are used to access and manipulate material in the collection.