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## GeoWall Project Expands the Window Into Earth Science

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Electronic Visualization Laboratory, the University of Illinois, Chicago

Arun Rao, right, and Nicholas Schwarz, graduate students at the university, with a four-panel display of core images and data.

By **HENRY FOUNTAIN**

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**P**AUL MORIN, who helps earth science researchers and teachers visualize information at the University of Minnesota, remembers being frustrated five years ago with the 3-D technology he was using.

"I was working with a cave at the University of Michigan," Mr. Morin said, referring to an elaborate and expensive room-size three-dimensional display system. "And it was cheaper to fly me to the cave from Minneapolis than it was to build one ourselves."

What's more, while the system was good for researchers, it wasn't suitable for teaching. "A cave is really a one-person operation, it's really immersive," said Mr. Morin, who is affiliated with the National Center for Earth-surface Dynamics in Minnesota. But students didn't need to feel as if they were someplace else; they needed to be able to

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visualize basic things like mountain ranges and the interactions of tectonic plates. "We needed stereoscopic imaging, but we didn't need immersion," he said.

Mr. Morin voiced his concerns to other visualization specialists, including Jason Leigh at the Electronic Visualization Laboratory at the University of Illinois, Chicago, who had developed cave systems. The result, after several years of tinkering and tweaking and with support from the National Science Foundation, was the GeoWall, an inexpensive system that uses a PC with an advanced graphics card and digital projectors to present the geophysical world to dozens or even hundreds of students at a time.

The success of the GeoWall - there are now more than 400 of the systems in use at schools, colleges and other institutions, loosely linked through a consortium ([geowall.org](http://geowall.org)) - has spawned next-generation efforts meant more for researchers than for students. These include the GeoWall2, a system that typically uses 15 flat-panel liquid-crystal display screens stitched together, and a desktop system, the Personal GeoWall2, with four L.C.D.'s.

While these newer systems can be used for 3-D displays, the more immediate goal is to give geoscientists the resolution they need to study things like maps with remote-sensing data or images of rock cores. A 15-panel GeoWall2 system, for example, has a resolution of about 30 million pixels.

"If you want a lot of resolution, getting the big flat-panel system works well," said Dr. Leigh, an associate professor of computer science at the University of Illinois, Chicago, and a director of the visualization lab. The high resolution eliminates the need to constantly zoom in to study detail, as is necessary with a typical single-screen PC.

The display also allows someone studying a rock core, for example, to "drive" its length to compare the composition at different points. Such comparisons can be a tedious process with the actual core itself.

These newer systems are more expensive: a 15-panel setup, with its cluster of computers, costs about \$90,000, although that should drop as the price of L.C.D.'s fall. And their 3-D capabilities are limited.

"The holy grail is 3-D without glasses, but at enormous resolution," Dr. Leigh said. The systems are not there yet.

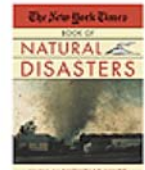
For teaching, the original GeoWall system is generally preferred. It uses off-the-shelf parts ("Anything that a nerdy kid in his basement uses to shoot aliens," Mr. Morin said) and open-source and vendor software for creating 3-D images from data. A PC with a graphics card controls two digital projectors that use polarized light to display slightly offsetting images on a silvered screen. Simple glasses with polarizing filters block one image from each eye,

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Electronic Visualization Laboratory, the University of Illinois, Chicago

DEEP IMPACT - At the University of Illinois, Chicago, Naveen Krishnaprasad, a graduate student, examines core images on a 15-panel GeoWall2.



Electronic Visualization Laboratory, the University of Illinois, Chicago

Systems for visualizing geoscience information include a 3-D GeoWall, above, used by elementary students in Oak Park, Ill.

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creating the stereoscopic effect.

A basic GeoWall, either purchased as a unit or assembled by someone with a basic knowledge of computers, costs less than \$10,000. That figure is important, Mr. Morin said. "It's what a department chair or a dean can sign off on without going through an approval process," he said.

Stephen J. Reynolds, a geology professor at Arizona State University who uses the GeoWall for as many as 220 students at a time in introductory earth science classes, said he takes his students on a tour of the main features of the planet using a presentation developed by Mr. Morin.

"It's a lot easier for them to learn," Dr. Reynolds said. "We spend a good hour or so just exploring the face of the earth."

Later he uses the GeoWall to explain more complex subjects like seismicity - rotating a 3-D plot of earthquake epicenters off Indonesia, for example, so that students can see how one plate slides under another. "They can see the data we've used to come to some of the models we've developed in geology, like plate tectonics," he said.

The GeoWall uses such basic technology that it is unlikely to change much. But Mr. Morin, Dr. Leigh and others in the consortium are keeping an eye out for improvements to the more advanced systems.

"We are always trying to find better display technology so we can make higher resolution, more seamless displays," Dr. Leigh said. One improvement, he said, would be to eliminate the frame around each L.C.D., which gives a multipanel display a segmented look.

But he acknowledged that most geoscientists are much more concerned with improving resolution. When it comes to eliminating the frames, Dr. Leigh said, "the geoscience community couldn't care less."

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