Enhancing Core Drilling Workflows through Advanced Visualization Technology

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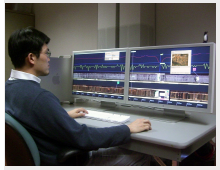
Abstract

We present the design and development of Corelyzer, an initial visual core description tool with collaboration and annotation features. Corelyzer belongs to the larger CoreWall suite of tools used to process, visualize and manage high-resolution core images gathered during core drilling expeditions. We have been observing scientists using Corelyzer over several drilling expeditions to better understand how to integrate it into core drilling workflows.

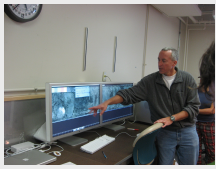
CoreWall is designed to aid real-time stratigraphic correlation, initial core description and data visualization for various core-drilling communities.

Corelyzer is CoreWall's initial visual core description tool that allows scientists to interact with and scale huge data visualizations on a desktop workstation connected to one or more monitors in order to collaborate more effectively. The user interface and data source connections were developed using Java, and the efficient rendering component was developed using OpenGL.

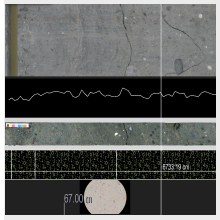
CoreWall in Working Environments



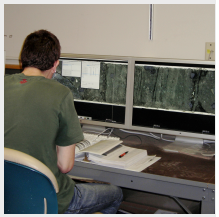
A typical CoreWall workstation.



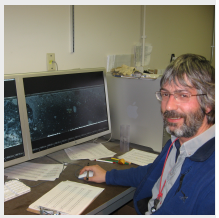
ANDRILL core tour at McMurdo Station, Antarctica.[a]



Display images and data co-registered to depth.[b]



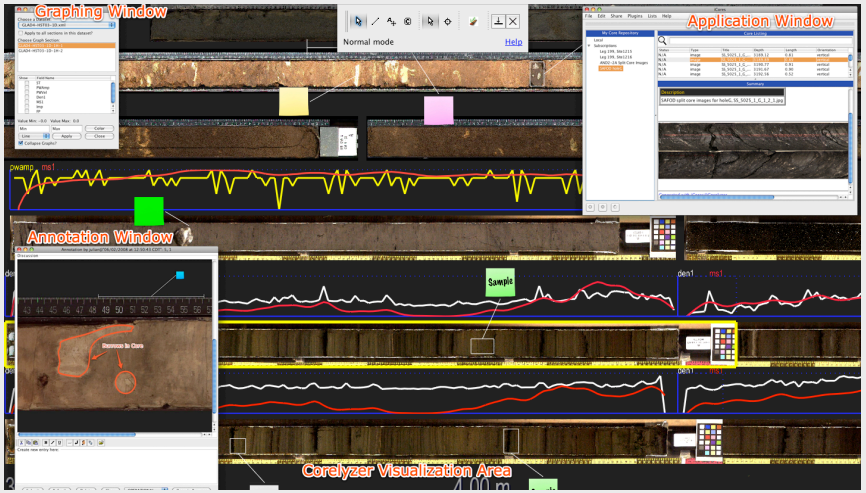
New Zealand sedimentologist using CoreWall in the Crary Science and Engineering Center at McMurdo Station, Antarctica.[c]



Before converting to CoreWall in 2006, University of Siena's Dr. Franco Talarico (pictured right) did clast petrology analysis using hand drawn diagrams placed end-to-end on the floor (image left).

a. Photos by Betty Trummel, Husmann Elementary School, Crystal Lake, Illinois, an ARISE participant.
b. Photos by Josh Reed, IT Specialist, ANDRILL Science Management Office
c. Photos by LuAnn Dahlman, Technical Education Research Centers, an ARISE participant
d. Photos by Paul Morin, Antarctic Geospatial Information Center, University of Minnesota

Corelyzer Interface



Scalability

1. Data scalability
Corelyzer contains a level-of-detail (LOD) texture paging graphics system that allows scientists to load and interact smoothly with thousands of meters of geological cores. (One kilometer of core data produces roughly 30GB of raw imagery.)

2. Visualization capability
Corelyzer supports hardware setups that range from a single laptop screen to six LCD panels driven by a single desktop workstation. The tool manages the mapping of different high-resolution images to their proper physical scale. The main user interface supports the major data visualization tasks in core drilling, including the ability to integrate high-resolution core imagery, numerical core logging data, lithology diagrams, smear slides, thin sections and user-generated freeform or structured annotations.

3. Software extensibility
The Corelyzer source code has been released under an open source license and stores working sessions in a plain XML file format, so that anyone can make modifications to fit his or her needs. For example, with a simple exporter module, the Drilling Information System (DIS) can export core data along with core imagery to the Corelyzer session file format and all data will be loaded into Corelyzer seamlessly.

Corelyzer also provides a plug-in framework to allow third party developers to extend its functionalities and capabilities. For example, Josh Reed, IT manager of the Antarctica geological drilling project, developed PSICAT lithology diagram support. Moreover, for standardized core (meta) data distribution, a "core feed" plug-in was designed to allow users to subscribe to core data description feeds defined in the standard syndication format. Users can browse available feeds and subscribe to interesting core data just like "Podcasts". The feed provides the metadata required to download and interpret actual imagery and numerical core log data sets.

Deployment

2006:

•A CoreWall prototype workstation was installed at the University of Minnesota's National Lacustrine Core Repository. Scientists began regularly using Corelyzer for initial visual description of lake cores.

•Two six-panel CoreWall workstations were installed at Columbia University's Lamont-Doherty Earth Observatory. Using the full suite of CoreWall tools, scientists conduct side-by-side comparisions of legacy high-resolution core imagery.

•Two CoreWall workstations at the ANDRILL geological drilling project at McMurdo Station in Antarctica. One was used during daily initial core description sessions to allow scientists to "drill down" into the high-resolution images of the cores for more accurate and detailed observations. The second was set up in a public discussion area to augment progress reports and core tours. All involved personnel were encouraged to install Corelyzer on their laptops so that they could easily access the related data.

2007:

•ANDRILL adds four additional CoreWall workstations based on positive feedback from the scientists working in the 2006 season. One is dedicated to providing immediate on-site visualization of data to aid the drillers in making drilling decisions.

References

CoreWall
www.corewall.org

Electronic Visualization Laboratory, University of Illinois at Chicago
www.evl.uic.edu

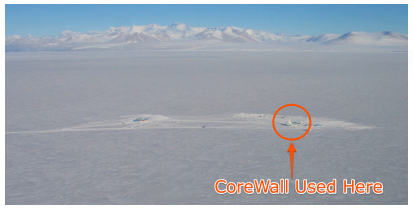
LacCore: U.S. National Lacustrine Core Repository at the University of Minnesota
www.laccore.org

ANDRILL: Antarctic Drilling Program
www.andrill.org

PSICAT: Paleontological Stratigraphic Interval Construction and Analysis Tool
www.psicat.org

Drilling Information System, International Continental Scientific Drilling Program
www.icdp-online.org

ANDRILL Drill Site Deployment



CoreWall workstation deployed in drill site in the ANDRILL Southern McMurdo Sound Expeditions in 2007.[d]

Acknowledgements

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