Proceedings of the 42\textsuperscript{nd} Meeting
of the Geoscience Information Society

October 28-31, 2007
Denver, Colorado USA

GEOSCIENCE INFORMATION:
MAKING THE EARTH SCIENCES ACCESSIBLE FOR EVERYONE

Edited by

Claudette Cloutier
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PREFACE

The Geoscience Information Society (GSIS) was established in 1965 as an independent, nonprofit professional society. Members include librarians, information specialists, publishers and scientists concerned with all aspects of geoscience information. Members are based in the United States, Canada, Austria, Australia, France, Sweden, Taiwan and the United Kingdom.

GSIS is a member society of the American Geological Institute (AGI) and is an associated society of the Geological Society of America (GSA). The GSIS Annual Meeting is held in conjunction with that of GSA, and the papers, posters and forums presented there are part of the broader GSA meeting.

Oral presentations of the papers in this proceedings volume were given at the 2007 GSA Annual Meeting in Denver, Colorado, October 28th – 31st, 2007. The papers are arranged in the order in which they were presented. As editor I made minor grammatical and spelling changes and appreciate the care with which authors prepared their manuscripts. The authors are solely responsible for the opinions and ideas expressed herein.

Informed decision making for a sustainable earth depends on information being accessible to the public. The year 2007 marked the beginning of the International Polar Year and the International Year of Planet Earth. Research will be generated from these two international events, but how much of it will be retrievable in the future. The theme for this proceedings volume is “making earth sciences information accessible to everyone.” The papers included within examine the broad issues of research and data preservation through digitization, the importance of developing meta-data standards for information retrieval, and the evolution of libraries within a digital framework.

The proceedings volume is divided into three parts:

3. Reports of GSIS program sessions.

Thank you to all the presenters, session chairs and committee and GSIS members who provided rich opportunities for professional development and discussion. Thanks also go to the Geological Society of America for permission to reprint abstracts for the oral presentations and the posters.

Claudette Cloutier
GSIS – GSA Topical Session Convener 2007
PART 1: GSA Topical Session T144

Geoscience Information: Making the Earth Sciences Accessible for Everyone

Informed decision making for a sustainable earth depends on information being accessible to the public. Join us as we discuss how geoscience information is created, disseminated, organized, accessed, used and archived.

Convener
Claudette Cloutier
October 29, 2007
Abstract – The first International Polar Year took place in 1882 and 1883, before the rise in greenhouse gas pollution associated with global climate change. Carl Weyprecht, an Austrian scientist-explorer who was the inspiration behind the IPY, had forward-thinking ideas about how to most profitably conduct polar research. In his Fundamental Principles of Scientific Arctic Investigation he proposed fielding coordinated expeditions that would collect comparable synoptic observations necessary to study very large-scale phenomena such as meteorology, geomagnetism and the aurora. The field program he suggested was successfully implemented but the hard-won synoptic observations were never fully analyzed. Long delays in the initial publication of the data and the lack of a central office tasked with coordinating data synthesis contributed to this disappointing result.

The fourth IPY began in March, 2007. Climate change, especially in the Arctic, adds urgency to the objective of taking a “snapshot” of current conditions using synoptic observations. And making observations accessible to everyone is proper not only because the public is aware and interested, but because to do so would help ensure that exceeding valuable data is used to its fullest potential. Now IPY research involves over 50,000 participants from 63 nations. How much of this research will be accessible in the future? What can be done to promote the flow and preservation of information? Are there lessons in data management from the first IPY than can be applied here?

Now, web services, distributed data archives and metadata standards are being employed to keep track of and work with data from ‘virtual observatories’: confederations of projects and instrumentation like the National Science Foundation's Arctic Observing Network. Metadata can insure that future generations will be able to find the data. So many types of data from so many sources is driving a move to self-describing data formats. In an age where most data are ‘born digital' we still need to go back and preserve old analog data so that it can be used to investigate phenomena such as the Earth's climate that vary on timescales longer than the digital era.
THE REASON FOR DAHLI: MAKING THE HOLDINGS OF
IPY INFORMATION ACCESSIBLE TO ALL

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Abstract – The need for access drives a project to locate, digitize and make available historical materials from the previous three IPYs. The DAHLI project will provide a searchable online bibliography of records and publications from International Polar Year (IPY) events: 1882-1883, 1932-1933, and 1957-1958. This bibliography will constitute a new offering of scientific research, scientific observations, sociological and historical data. These items, still being discovered in archives around the world, are estimated to be several thousand items. Recently, these materials are scattered about the globe, largely uncatalogued and unpreserved. They are rare and typically only one or a few copies exist. At best they are difficult to discover and access, and at worst, in danger of total deterioration or destruction. These materials are the legacy of past IPYs and stand as milestones of scientific progress. They continue to be of scientific, historical, and sociological value, but their value cannot be exploited if inaccessible. As older generations of researchers retire, particularly those who participated in the 1957-1958 IPY/IGY, even the memory of these materials is lost. The need is imminent to identify and catalogue these materials while these researchers are still available to advise.

Overview

• NSIDC – who we are
• Discovery and Access of Historic Literature from the IPYs (DAHLI)
  • Motivation
  • Big Picture
  • Proposal status
  • Accomplishments

National Snow and Ice Data Center

Our Mission
To make fundamental contributions to cryospheric science and excel in managing data and disseminating information in order to advance understanding of the Earth system.

Data Management and Distribution

Outreach
International Data Activities

Research

Institutional Relationships

• Part of the University of Colorado
• Within the CU Cooperative Institute for Research in Environmental Sciences (CIRES) Cryospheric and Polar Processes Division
• Chartered by NOAA’s National Environmental Satellite, Data, and Information Service. Affiliated with the NOAA National Geophysical Data Center (NGDC)
• Part of the World Data Center system
• Funded by NASA, NOAA, NSF, and others at the project level

Major Programs

• NASA Distributed Active Archive Center
• NOAA at NSIDC and WDC for Glaciology, Boulder
• NSF IPY at NSIDC - IPYDIS, CADIS, and ELOKA
• NSF Antarctic Glaciological Data Center
• IARC Frozen Ground Data Center

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• NSF Antarctic Glaciological Data Center
• IARC Frozen Ground Data Center
**DAHLI – Motivation**

- Expectations of instant access
- Legacy materials have value
  - Scientific
  - Historical
  - Cultural
- Part of the mission of the World Data Center

**DAHLI – On-Line Gazetteer**

A merger of library style and data center style interfaces

**DAHLI – Proposal Status**

- NOAA Climate Database Modernization
  - Proposal funding continues
  - Pays for materials digitization
  - Could pay for keying/OCR with QC of data sets deemed to be valuable
  - Negligible funding for NSIDC staff time & facilities

**DAHLI – Proposal Status (continued)**

- NSF IPY DAHLI proposal is still pending
  - Advisory committee
  - On-line gazetteer
  - Merged digital library/data center web presence
  - Intercontinental backup
  - Staff support

**DAHLI – Accomplishments**

- IPYPD agreed to extend their original plans to allow inclusion of materials from previous IPY’s
- 53 books, technical reports, etc. have been scanned and QC’d; some materials sent back for rework
- Text bibliography created and posted to NSIDC DAHLI website
- ~1,300 IGY-related photos scanned to be added to the NOAA@NSIDC Glacier Photograph Database
- NSIDC holdings of IPY-related materials have been added to the IPYPD

**DAHLI – Big Picture**

- Creating an on-line gazetteer of who has what and where
- Creating a searchable bibliographic database of records and literature from the three prior IPY’s
  - These records are scattered around the world and many have never been cataloged
- Digitizing materials held at NSIDC and a variety of other facilities around the world based on advisory committee recommendations
- Allowing direct access to those materials that are or will be made available digitally (subject to usual copyright restrictions)
- Creating digital data sets from analog sources where appropriate

**DAHLI – Searchable Database**

A merger of library style and data center style interfaces

**DAHLI – Current Activities**

- Climate Database Modernization Program
  - Continuing local digitization efforts
  - Contemplating whether to start extending program to partner holdings…
**Examples**

**DESCRIPTION OF THE ANTARCTIC CIRCULATION OBTAINED FROM APRIL TO NOVEMBER 1987 AT THE SCIENTIFIC STATION CENTRAL LITTLE AMERICA STATION**

By:
- National Oceanic and Atmospheric Administration, National Sea Ice Data Center
- and
- U.S. Antarctic Program

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**DAHLI – Future activities**

- More NSIDC materials
- Solicit more IPY materials
- Online bibliography
- Pursue other grants
DIGITIZATION OF GEOLOGY THESES AND DISSERTATIONS

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Abstract – A leaking pipe damaged a number of the universities theses and dissertations. This resulted in a project to digitize these materials as both a reservation measure and a method to improve access to the collection. The specific details of the process of digitizing the geology theses and dissertations are discussed, as well as the problems that were encountered with the geology titles. The decisions that were required are listed, with reasons as to why those decisions were made, and the results of the projects are reviewed. As a result of the lessons learned from this project the University of Wyoming libraries have since digitized all of our theses and dissertations.

On the morning of Wednesday, August 4, 2004, a small hole in a dry pipe fire suppression system caused the failure of that system, resulting in the spraying of 1,804 archival copies of University of Wyoming (UW) theses and dissertations from the Hebard Collection with high-pressure tap water. Since these materials were located in the secured rare book vault in the American Heritage Center (AHC), it was not immediately obvious what had happened. It is estimated that water was spraying for 20-30 minutes before an AHC staff member walking down the hallway around 11:30 a.m. heard the running water and immediately investigated.

The only materials in the Rare Book Vault belonging to the library were the UW theses and dissertations. The rest of the materials were rare books from the Toppan Library in the AHC, which is administratively separate from the University of Wyoming Libraries. AHC staff located the leak, and while relieved that their material was spared, were horrified to see that the water was continuing to spray the first three rows of compact shelving containing the theses and dissertations. University Physical Plant staff were immediately contacted to shut off the water. As soon as the water was off AHC staff transferred the wet theses and dissertations to their cold storage vault, which is maintained at 32 degrees Fahrenheit. The wet shelves in the vault were dried to prevent further damage. The librarian in charge of the Hebard Collection was contacted and informed of the situation.

Library staff immediately responded. The Wyoming bibliographer evaluated the theses and dissertations remaining on the shelves in the vault in order to pin point the extent of the damage. Administrative staff located a freezer plant that would accept the books. Luckily, the High Plains Freezer Plant in Laramie had housed some of the material damaged in the 1997 Colorado State University flood, so they understood our needs and agreed to have space available for the UW Libraries’ material the next morning.

On August 5, 2004, a group of volunteers from the libraries arrived at the AHC and packed the chilled, wet books in to plastic garbage bag lined boxes, counting as they packed. The boxes were transported the three miles across town to the freezer plant in the libraries’ van. The Wyoming bibliographer had a current inventory of the theses and dissertations in the Hebard Collection. While library staff boxed the damaged books, the Wyoming bibliographer compared items remaining on the shelves and generated a call number/title list of the damaged items. Using her list, systems and cataloging staff changed the status of the damaged material in the online catalog to unavailable. Fortunately, the manual count and the system generated list agreed, and we knew that the extent of the damage was 1,804 theses and dissertations in seventeen subject areas.
The geology theses and dissertations were in the middle of the affected ranges, and many were damaged. The materials in the vault were housed in compact shelving, and it was unfortunate for geology that their shelves were on the open aisle and as a result were wetter than those materials that happened to be in the closed sections of the compact shelving.

Library staff responsible for UW theses and dissertations already had a meeting scheduled with the graduate school on August 12, 2004 to discuss the submission of new theses and dissertations in electronic format only. The discussion was expanded to include how the libraries would like to handle the damaged titles. On August 23, 2004, ProQuest was contacted to see how many of the damaged titles they already had in either microform or digital format. They also explained what they could do for us digitally. We had a preliminary proposal in hand on August 26, 2004.

On September 23, 2004, after the faculty returned for the fall semester, departments with damaged titles were notified of the incident, and what steps were in place to repair or replace the items. Departments with damaged materials were provided with a list of those titles. In October the entire campus was notified about the incident.

The insurance adjuster arrived on September 9, 2004 to assess the damage and determine under what category the damaged materials would fall. At this point funding sources were preliminarily identified, and the Dean of the Libraries directed that we explore digital options for titles that could not be salvaged. ProQuest arrived on October 7, 2004, to explain what our options were for digitization.

Once it was determined that the material was covered under the university’s fine arts policy, options for recovery were discussed. The first decision was to have the materials freeze-dried to see how much could be salvaged with this step alone. Quotes were obtained, a contract awarded, and the material shipped to Texas in a refrigerated truck on November 9, 2004. The materials were freeze-dried and returned to us on December 7, 2004. Each title was evaluated to assess its condition and to determine what additional treatment, if any, was needed.

From December 2004 through February 2005 library staff in Technical Services completed the initial evaluation of the condition of the damaged titles. Some were returned to the stacks with no further processing, but most needed to be digitized, since they were beyond repair. After freeze drying, there were 271 geology titles that required additional handling before they could be returned to the collection.

The committee decided to sacrifice the paper copy allowing the material to be disbound before scanning, since this would result in significant cost savings. The circulating paper copy was pulled from the collection and paired with the damaged archival copy. In cases where the damaged copy was acceptable for digitization, that copy was sent to ProQuest for digitization and the circulating copy sent to the Hebard Collection. In cases where the archival copy was too damaged, the circulating copy was sent to ProQuest. Cataloging staff handled withdrawals and updated locations, and Processing charged the material out to a repair account.

Several problems were encountered in preparing the materials for digitization. First, it became obvious that the graduate school had not enforced their rule against erasable bond paper which turned out to be present in many of the theses from the 1960’s through the early 1980’s. The typescript on erasable bond from that era could literally be wiped off the page. At first we thought this might be a side effect of the freeze drying, but when the undamaged circulating copies were checked, the print could be wiped off those pages as well. This meant that the paper had to be checked on all damaged copies, and any titles on erasable bond could not be automatically fed through a scanner, but had to be manually scanned page by page. These titles had to be kept separate from the others. This meant that there was a much larger issue to deal with than the water damaged items, one that needed to be dealt with in the future.

Another problem concerned color images that we wanted to preserve in color, most from art theses, but also from geology theses. This was a simple problem to solve, with the specific images scanned in color by ProQuest and appended to the text.

The largest problem was the 271 damaged geology titles, many of which contained large scale maps. The large size of these maps caused problems for digitization. This was further complicated because many of the maps were
hand colored. ProQuest initially expressed concern that the UW maps were unusually large, but after contacting other schools in the region with large map collections, they realized that the maps, while large, were fairly standard.

At this point we had to make several decisions before we could proceed. For geology theses with color illustrations we chose to have them microfilmed in color. While University Risk Management had some concerns about the destruction of the paper copies during digitization, we finalized the decision to sacrifice the archival copy for digitization and have them disbound before scanning as this resulted in a significant cost savings. Even though we still had the circulating copy for local use, this was the most difficult decision to make, and while a consensus was never achieved, a decision was made to disbind the theses and recycle them after digitization.

There continued to be issues with the size of the maps and how we could best deliver a reasonably useful copy in a digital format. The Geology librarian, in consultation with the committee and the Systems Department, agreed that we would go for a quality image, which meant a very large file size, rather than choose a lesser quality image with a smaller file size.

These continue to be problematic since the file size of the high quality images of the digitized maps is currently too large for our campus internet connection to handle. While network technology improvements should eliminate this problem over the next few years, in the short term users are provided access to smaller, less detailed images, and we remind patrons that paper copies of these maps are available in our Geology Library. We are confident that our choice of a higher quality image will provide exceptional access in the future.

In February, ProQuest provided an updated proposal based on the final numbers which included an itemized count of the maps by sizes, which were known to be problematic. The proposal was finally approved and funded by the University, and in May 2006 the last of the geology titles were sent to ProQuest.

The process of preparing the titles before they could be sent out for digitization was labor-intensive. All theses had to be manually examined page by page. It was at this point that we checked for erasable bond paper. Great care had to be exercised with those titles so as not to wipe the ink off of the pages.

Since our doctoral dissertations had been microfilmed since 1972, ProQuest would be digitizing these titles from the microfilm where possible. We still had to check all of these previously microfilmed titles for color illustrations as they would be rescanned in color and new color microfilm masters would be reproduced.

All color illustrations had to be flagged so the digitization staff at ProQuest would know where they were located within the thesis. All loose photos had to be taped down with double-sided tape. As we only needed the theses to hold together for digitization, we were interested in securing loose objects and not preservation. As we are located in a very dry climate, much of the original glue or tape that had secured these items had dried out and was no longer providing any adhesion. All folded maps, charts and stratigraphic sections had to be unfolded, measured, and repaired where needed.

We found that there were some theses with missing pages and we had to copy and insert the missing pages, in some cases having to track down a departmental or personal copy to get the needed pages. In addition some had other collation errors, such as pages in the wrong order.

We also discovered some theses with three dimensional objects, such as rock and clay samples that could not be digitized. These three dimensional objects were cataloged as accompanying material and transferred to the AV collection.

We were very pleased with the results of the project. UW had never microfilmed our masters’ theses so now we have better archival backup, as all theses that were digitized were also microfilmed. Digitization has made the geology theses more accessible for our students, especially distance students, and for other researchers. While we had been microfilming our doctoral dissertations since 1972 and having them included in Dissertation Abstracts, we had never done this with our masters’ theses. These are now available in Digital Dissertations, which we hope will increase usage.
This project started with a failed sprinkler system, and while we were not happy with having to deal with a small disaster it did bring to our attention some major problems with our theses and dissertations, especially the erasable bond problem. At UW the theses are turned in to the graduate school and the libraries only received the paper copies well after the student had graduated, so we were not able to exercise any control over the paper the students used. As a result of this discovery we have since completed the digitization of our entire collection of theses and dissertations. This major project has been time consuming but has been a huge step for us in terms of preservation. As of 2007 all theses and dissertations at UW are only submitted electronically which has streamlined the process and improved access to this important collection.
MANAGING AN OIL SHALE LEGACY COLLECTION

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Abstract – The Arthur Lakes Library at the Colorado School of Mines houses a legacy collection of oil shale materials, most dating from the 1920s to the 1980s. The collection is an aggregate from 23 donors, including individuals, government agencies, and corporate entities. Materials include technical reports, personal papers, and historical documents, organized by donor in archival boxes. Interest in oil shale as a potential energy source has been cyclical, and generates periodic interest in the legacy collection. Sustained, heightened interest in oil shale in the past few years resulted in a Library project to reassess the collection by present-day standards.

Users expect a modern research experience, with organized, indexed, easily accessible—preferably digitized—items. Project results indicate that with time and money we can begin to meet these expectations. However, some difficult information management issues will need to be addressed. Donations include potentially proprietary materials that were deemed "valueless" at the end of the last oil shale boom in the 1980s, but may have value today. Digitization, although desirable, will require obtaining permissions from copyright owners who may be difficult to identify and/or locate.

INTRODUCTION

The deposits of oil shale in Colorado and Utah are among the richest in the world. Development of the deposits will be costly, and will need to respond to economic, environmental, technical, and social concerns (Andrews, 2006; Bartis, et al., 2005; Fine 2007). Interest in oil shale has been cyclical, with heightened cycles in the 1920s, the 1940s, the 1970s-80s, and again in the present-day, roughly tracking oil price upswings.

Colorado School of Mines Connections

Colorado School of Mines has had a long-standing connection to oil shale, performing research as far back as 1916. Extracting useable shale oil from oil shale rock can involve bulk mining, rock crushing and retorting techniques, areas where CSM faculty and students had expertise. There was an annual Oil Shale Symposium hosted by CSM between 1964 and 1992; the Symposium resumed in 2006.

The Arthur Lakes Library connection to oil shale is the Tell Ertl Oil Shale Repository, an archive established in 1989. The Repository is the last resting place for documents and collections related to oil shale in Colorado and around the world. Technical reports in the Repository represent millions of dollars of original research, some of which could not be replicated at any price. Materials date back to the 1920s, although most are 1950s-80s. Donations came from 23 different companies, government agencies, and individuals. The Repository presently contains 65,000+ items in 380 boxes, plus about 40 boxes of unprocessed donations. There is a printed finding aid, and limited bibliographic access to processed items through a rudimentary database, http://tellertl.coalliance.org.

Repository Project

In the early years of the Repository, usage and interest were low. Researchers were more interested in the historical and social literature of oil shale (e.g., Gulliford, 1986, 1989) than in the technical literature. Beginning in about 2002, the price of oil went up and stayed there, reliable world sources of oil for the U.S. became increasingly problematic, and oil shale (along with other alternative and unconventional energy resources) became a hot topic. There was a realization that prior technical research in oil shale could have value, and usage and interest in the Repository increased. Librarians took notice.

In 2006, a small subset of materials in the Repository was evaluated (Whitehead and Tomeo, 2007). From this pilot project, a long-
range plan was developed to improve on-site access to technical information in the Repository, enhance database records, and identify targets for future digitization. Implementing the plan will require confronting management issues such as user expectations, donor rights, and “the big one”: intellectual property.

**ISSUES**

**User Expectations**

Following Black Sunday (May 2, 1982) (e.g., Spehar, 2007), oil shale information was widely scattered. Some eventually wound up in safe storage with libraries or companies or individuals, but an unknown amount wound up temporarily in garages, attics, old mine buildings, and permanently in landfills. Oil shale was a dead topic for 20+ years; people and companies moved on. During that time, the information revolution bypassed collections like ours, which sat quietly gathering dust for those 20+ years. Time and money are required to bring it to present day standards.

Today’s users expect information of all kinds and from all sources to be easy to find, digital, and only a few keystrokes away. They are not satisfied with printed archival finding aids, rudimentary bibliographic records in databases, and items stored in boxes. The Library needs to walk a fine line, promoting the research value of the technical materials in the Repository, but conveying the realities of current access to it.

**Donor Rights**

Information related to processes for extracting shale oil from oil shale may not be valuable when oil is $20/bbl, but at $100/bbl, that information can have a second life. The Library inferred this was the situation when a donor asked to remove documents related to a particular oil shale process technology from the Repository. Donations are usually considered irrevocable, but there were factors that allowed a compromise in this case: some of the items had been cataloged by other libraries and were available through OCLC; the Repository housed duplicates from a different donor; the Library wanted to stay on good terms with the parties involved. After weighing all the factors, the documents were withdrawn and returned to the donor. A similar situation, with unique or rare documents, would probably have a different outcome.

**Intellectual Property**

The most difficult management issue (and one we have not solved) is figuring out who owns the research. The majority of it was performed under government-paid contracts, by government agencies, corporations, academic institutions, and individuals, in ever-changing configurations. Many of the individuals are gone, and many of the corporations, agencies, and institutions no longer exist as the same legal entities. The Library owns the physical items, but not their copyright. Identifying the real copyright owners, and getting permission to digitize and make the technical information available online, is a daunting task that will take time, money, creative sleuthing, and probably extensive legal assistance.

**Confidential Stamps, Secrecy Agreements, and More**

Some documents in the Repository have complications beyond copyright and intellectual property issues. Examples include:

**Paraho**

Paraho Corp. was a major oil shale player in western Colorado in the 1970s and 80s, but it no longer exists. Many documents produced by the company have a large red *Confidential* stamp. Conversations with a former Paraho employee indicate the company was very liberal in its use of this stamp. Does the stamp have any legal power?

**Paraho-Conoco**

Paraho Corp. worked with other companies, such as Conoco Inc. (a different corporate entity than today’s ConocoPhillips). Some documents donated to the Repository have a confidential/secrecy agreement stamp (Figure 1). Does this stamp have any legal power? To add to the confusion, the Repository has copies of the same document with no stamp, and WorldCat shows copies available at other libraries. As a final touch, at least one of these documents can be found via DOE Information Bridge, with linked full text. The cover of the pdf file is marked *Public releasable, 1/26/06*. Identifying who owns the research may be affected by which copy you look at.

Bureau of Mines
A 1951 report by the Bureau of Mines Oil Shale Demonstration Plant, under cooperative agreement with the University of Colorado, includes a typed cover note that it should not be distributed (Figure 2). The item was donated and accepted with the understanding that it would be used. Does this note carry any legal or moral obligation?

Figure 1. Confidential stamp, Secrecy Agreement; no expiry date

Figure 2. From cover of a 1951 report, Bureau of Mines Oil Shale Demonstration Plant, under cooperative agreement with the University of Colorado.

Sandia
A document produced by Sandia National Laboratories, a government-owned, contractor-operated facility, has a cover stamp that reads *Proprietary Information: Subject To Special Dissemination Restrictions.* There is no further information in the document as to what those restrictions are. To complicate matters, our version is most likely a photocopy.

Internal Files
A document labeled *Interoffice Communication,* with a corporate routing list and a *Confidential* stamp, was requested for Document Delivery by a researcher. The document may not have been meant for public distribution, but it was donated and is in the database. The Library elected to deny this Document Delivery request, which is within our rules. A researcher making their own copy for private study would have been considered fair use.

CONCLUSION
These and other “stumpers” make us question how to do the right thing—to make valuable information available to oil-shale researchers, without violating legal, moral, and practical obligations. For the on-site researcher, we can manage improvements by allocating time and money to the project. We can organize the items, have them accessible on shelves, and enhance the database records to improve search results. Managing the transition to digital access will be much a more complex journey, taking us through copyright law, orphan works legalities, and confusing markings by previous owners. The
time and cost of this journey will need to be weighed against its benefits to our users.

REFERENCES


METADATA: THE KEY TO THE PRESERVATION AND DISSEMINATION OF SPATIAL DATA

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Abstract – The preservation and dissemination of digital research data has become a hot topic among the university research community. Often the biggest roadblock to making GIS data available is that the creator of the project either does not have the time or the skills to create the metadata, a crucial component to making spatial data retrievable from GIS data portals. This paper describes how the University of Nebraska – Lincoln Libraries (UNL Libraries), as part of its GIS program, has stepped-in to help its campus community develop and distribute FGDC/ISO compliant metadata through the UNL Libraries’ catalog, as well as state, regional and national GIS metadata portals.

INTRODUCTION

Academic libraries have always been responsible for archiving and providing access to research data. In the print age this role was accepted by the campus community with many academic libraries described as the 'heart of the campus'. In the digital age the role of the library has become more ambiguous to the research community. Researchers are developing data and metadata portals outside the purview of their university library, often without considering long-term access and preservation of the data, or the standardization of metadata records. Yet, the mission of an academic library has not changed and these libraries are still responsible for the preservation and dissemination of research materials regardless of format. Academic library personnel have found they need to be proactive with their research communities in advocating the need for the preservation of digital data, the standardization of metadata records, and emphasizing their role in this process.

The Association of Research Libraries (ARL) and the Cartographic Users Advisory Council (CUAC), among other organizations, have been advocating, with the academic library as a key player, for the preservation of digital data at the national level.

The ARL Steering Committees for Scholarly Communication and for Research, Teaching, and Learning jointly appointed a task force in 2006 to study the effects of e-science on academic libraries. The task force published a report in 2007 which, in part, advocates that, "Libraries be far more engaged in the processes of research, integrating content, tools and services more intimately within scholarly communication workflows"(ARL, 2007). The report continues, "Library expertise in developing systems and standards for digital content is relevant, as are library roles for stewardship and preservation of content"(ARL, 2007).

Reports from various government agencies during CUAC's Spring 2007 meeting focused on digitization issues and concerns. Dr. Brett Abrams, Electronic Records Archivist, National Archives and Records Administration (NARA) reiterated that his agency's mission to preserve the original work and to assist federal agencies in managing their records includes that of geospatial data. He indicated three initiatives of his agency that focuses on geospatial data and map digitization projects. One, the development of a working group (OGCTC) within the Open Geospatial Consortium (OGC) whose goal is to get private industry, international, federal and local government agencies, and universities to work together in developing open standards for geospatial information. Two, working with the Geospatial One Stop Portal community to assure access to historical collections, and three, the increased scanning of historical maps. He concluded by advocating the importance of the historical dimension of geospatial data and encouraged research libraries to join working groups that focus on the topics of preserving, archiving and accessing geospatial data (CUAC,
Recognizing the importance of this national trend to preserve spatial data and provide access through the standardization of metadata records, the GIS program at the UNL Libraries includes an access and archive component. The goals of this component are: To advocate the importance of open access, the need for the preservation of GIS spatial data, and the necessity of metadata standards. One objective of these goals is to create and maintain the metadata for Nebraska geospatial data sets created by UNL faculty, staff and students, with the outcome of having that metadata searchable from the state's GIS metadata portal as well as the UNL Libraries' online catalog.

GIS PROGRAM AT UNL LIBRARIES

The GIS program at UNL Libraries consists of three components; development, outreach, access and archive. As part of the development component, the UNL Libraries provide four public workstations where patrons can create and store GIS data sets. The workstations offer a variety of GIS development aides including ESRI’s ArcView and ArcInfo software. Patrons also have access to a large scale color scanner and a GPS unit which is available for check-out. Through the outreach component the GIS librarian offers introductory level GIS workshops in the UNL Libraries’ electronic classroom using ESRI’s ArcView software. In addition, the GIS librarian speaks to various campus organizations on the variety of ways to use GIS in their research.

The UNL Libraries began focusing on the access and archive component of their program in 2004 when they became a member of the Metadata Taskforce formed by the Nebraska Geographic Information Systems Council (NGISC). The NGISC is responsible for coordinating GIS data from the various state and local governmental agencies including those affiliated with the university. The purpose of this taskforce was to develop a metadata clearing house as part of the state’s GIS data portal. In order to make the metadata searchable from this and other metadata portals, such as the Geography Network www.geographynetwork.com or the Geospatial One Stop (GOS) http://gos2.geodata.gov/wps/portal/gos, it must meet the Federal Geospatial Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM). As an incentive to get UNL GIS programs to contribute their metadata to the clearing house, the UNL Libraries offered to write and maintain it for them on the clearing house portal. (Nebraska’s metadata clearing house portal can be viewed at this url: http://www.dnr.state.ne.us/databank/geospatial.html)

BUILDING SUPPORT

In order to convince GIS users on campus that the UNL Libraries had the expertise to manage their GIS metadata, the GIS librarian attended a week long GIS metadata training class sponsored by the United States Geological Survey (USGS), and was certified to create metadata to FGDC/ISO standards. The GIS librarian then developed a PowerPoint presentation defining the role of academic libraries and made several presentations to various departments around campus. The presentation emphasized that libraries were always in the 'business' of organizing, classifying and providing access to information and correlated the similarities between the traditional library catalog and a metadata portal (Figure 1). As a result, in 2005, the UNL Libraries formed a partnership with the Nebraska Conservation and Survey Division (CSD) of the UNL School of Natural Resources to clean-up and maintain the GIS metadata to their various spatial data sets.

PROCESS

Metadata is best when the information is provided by the originator of the GIS data. However, in this case much of the CSD's GIS data was created over a period of years and the principal researchers on the projects were no longer available. In addition, only one of the four people working on the project, the GIS librarian, had a background in geology and was able to interpret the data. To rectify this, the GIS librarian developed a packet consisting of an information sheet, a copy of the original GIS metadata, and a template to use with one of the metadata editors.

The information sheet was designed to include information that was unique to each data set. For example, the title, abstract, original attributes, and a summary of the process would be included. This information was obtained either through an interview with the originator of the
spatial data, or derived from the existing metadata.

Personnel working on the project had a choice of metadata editors; the editor embedded in ESRI’s ArcCatalog, or TKME, a free editor developed by Peter Schweitzer of the USGS. For those using ArcCatalog a template or ‘dummy’ record was created with information that was the same for every data set, such as contact information, legal notices, etc. This record was imported into the editor and then the unique information was filled in. For information on how to create a metadata template in ArcCatalog go to this article on the ESRI website: http://support.esri.com/index.cfm?fa=knowledge base.techArticles.articleShow&d=15270. For those using TKME, ‘snippets’, a macro function within the software, were programmed with the repetitive information. For information about creating TKME ‘snippets’ view this memo by the editor’s author: http://geology.usgs.gov/tools/metadata/tools/doc/opinion/announce/snippets.html.

The packet, along with a color coded example of metadata that met FGDC/ISO standards was then distributed by the GIS Librarian to those who were also working on the project. Once the metadata records were completed, the metadata was exported as an xml file and run through MP, a parser created by Peter Schweitzer which checks the syntax against the CSDGM standard. Once the errors were corrected, the metadata was returned to CSD’s GIS coordinator for final review and then uploaded to Nebraska’s metadata clearing house.

Initially four people worked on the project: Adonna Fleming, GIS – Maps – Geosciences Librarian and Margaret Mering, Principal Serials Catalog and Metadata Librarian from UNL Libraries; Les Howard GIS Coordinator from CSD and Rachel Simpson, Natural Resources Data Specialist, Center for Advanced Land Management Information Technologies (CALMIT). Fleming, Mering and Howard continue to work on this project.

Currently the UNL Libraries plan to expand this project by creating Dublin Core level cataloging records in the UNL Libraries’ catalog for CSD’s GIS data sets.

CONCLUSION

The UNL Libraries continue to stress to the GIS community their knowledge of GIS metadata standards and their expertise in the maintaining and cataloging of metadata records. They expanded their GIS program to include teaching metadata workshops. In 2007 NGISC, sponsored a metadata workshop taught by the UNL GIS librarian and Leslie Bearden from the USGS. In 2008, the UNL GIS librarian and Patrick Wilke-Brown of the Iowa Department of Natural Resources taught two metadata workshops as part of the Mid-America Geographic Information System Consortium’s (MAGIC) Metadata Triage program.

METADATA RESOURCES

- USGS website with information about GIS metadata, including information about TKME and MP. http://geology.usgs.gov/tools/metadata/
- Mid-America Geographic Information System Consortium (MAGIC) website. includes metadata training exercises. http://magicweb.kgs.ku.edu/. Training exercises are at this url: http://magicweb.kgs.ku.edu/magic/projects/metadata_triage.cfm

REFERENCES


Abstract – No other type of geoscience information has been more in the public eye in recent years than aerial photography and satellite imagery. These two types of remotely sensed images have become ubiquitous on television news, advertisements, and even on police drama television series like Numb3rs. Real estate Web sites, city and county Web sites, and online mapping sites all use imagery to impress, to illustrate geography, and to allow for analysis. Remotely sensed imagery is widely used in earth science research. Applications range from fire detection, to vegetation or forest assessments, to the identification and analysis of geological features and events such as faults, drainage patterns, landslides, and volcanic eruptions. Libraries are increasingly fielding requests for remote sensing imagery and are adding these data to their collections.

For all its presence in the media and value for research, however, remotely sensed imagery is still difficult to organize and access. Access to remote sensing imagery varies from easy to complicated and from free to very expensive. This article will introduce different types of remotely sensed imagery, describe the organization of this class of data, and illustrate its many research applications. The traditional and emerging methods of access will be explored and important resources for aerial and satellite imagery will be highlighted.

WHAT IS REMOTE SENSING IMAGERY?

Definitions of remote sensing imagery vary from the simplistic to the very technical. The basic definition used by Avery in his classic Fundamentals of Remote Sensing and Airphoto Interpretation is a good place to start. He defines remote sensing imagery as, “the technique of obtaining information about objects through the analysis of data collected by special instruments that are not in physical contact with the objects of investigation” (Avery, 1992, p. 1).
past, remote sensing images were distributed in print, but now most imagery is found only in the digital format.

Remote sensing imagery is often thought of as satellite imagery or aerial photography, but it includes many more types of imagery. Remote sensing measures the electromagnetic energy emitted by objects. The electromagnetic spectrum is divided into different bands, such as visible light (black and white or color), infrared, thermal, and microwaves. The different properties of these bands make them useful in different research applications. For example, infrared imagery is particularly useful for weather analysis by detecting areas of higher and lower temperatures and for vegetation analysis. Radar imagery is also used for weather applications and applications such as sea ice measurement and detection. Radar, satellite imagery, and aerial photography can all be used for different geological studies.

Remote sensing has four components: the target, energy source, transmission path, and sensor. For example, in the case of the data collected from a weather satellite, its target is the earth’s surface, which gives off infrared radiation (energy source) that travels through the atmosphere (transmission path) and is detected by the instrument or sensor. When people speak about remote sensing, the sensor and the platform are often conflated. Cameras, radiometers, sonar, radar systems, and thermal instruments are examples of sensors (Center for Geographic Information Sciences, Towson University; Avery, 1992). The platform carries the sensor and can be a satellite, airplane, hot air balloon, or other support surface. For example, the Terra and Aqua satellites carry the MODIS sensor. MODIS can detect information in 36 different spectral bands, including thermal wavelengths, visible light, and fluorescence, which detect atmospheric temperature, water vapor, aerosols (mostly due to pollution), and chlorophyll content (Short, 2007; Lindsey et al.).

The resolution of remote sensing imagery can be divided into three categories. The spatial resolution refers to how much detail and geographic area are shown in the image. The portion of electromagnetic energy detected by the sensor is referred to as spectral resolution. Temporal resolution indicates when and how often the imagery is collected.

The interpretation of remote sensing imagery is a technical skill. Avery describes seven elements researchers use to interpret remote sensing imagery: shape, size, pattern, shadow, tone or color, texture, association, and site (Avery, 1992, p. 52). Looking at each of these elements in a remotely sensed image allows the research to analyze the image and draw conclusions about the area of study.

**RESEARCH APPLICATIONS OF REMOTE SENSING IMAGERY IN THE GEOSCIENCES**

Given the multiple types of remote sensing imagery and the diverse nature of research in the geosciences, there are a myriad of different applications for research using remote sensing imagery. Geology, hydrology, sea ice detection, and mapping are just a few areas where remote sensing imagery is used often. In geology, for example, imagery is used in analysis of drainage patterns, fault detection and measurement, mineral exploration, and more (Figure 1). Bedrock, lithological, sedimentation, geohazard mapping activities all use remote sensing imagery. In the discipline of hydrology, remote sensing imagery provides data for river and delta change detection, snow pack measurement, soil moisture content estimation, and flood mapping and monitoring, to name just a few applications.

**TRADITIONAL AND EMERGING MODES OF ACCESS**

Collecting remote sensing data in libraries presents significant challenges for many libraries. Imagery is expensive, requires large digital storage capacity, and necessitates technical knowledge to catalog and manage the data. Many libraries traditionally purchased images from aerial photography flights or satellite missions on print or film roles (Figure 1). A small amount of imagery, like the county digital orthophoto quadrangle CD-ROMs produced by the USGS in the 1990s, was distributed through the Federal Depository Library Program. Most imagery collected by the government, however, has not been released through the Federal Depository Library Program. Because of the difficulty in obtaining remote sensing imagery, and the other obstacles described above, it has not often been collected by general earth sciences libraries, but left to research institutes or GIS laboratories with money to purchase expensive datasets for projects and the technical infrastructure and knowledge to manage them. Today, while there are more libraries collecting remote sensing imagery, the large imagery collections are still found in specialized collections such as the Map and Imagery Laboratory in Davidson Library at the University of California, Santa Barbara or the University of Florida Map and Imagery Library.
ONLINE DATA CENTERS AND ACCESS POINTS

As the availability of free or inexpensive aerial photography, satellite imagery, and other remote sensing imagery increases, libraries that do not have the expertise or storage capacity to manage data in-house are now able to connect patrons to remote sensing imagery. Earth sciences librarians can teach and promote these online resources to their patrons. Librarians can include them in their collection development activities by including these data sites in research guides, linking to them, or, better yet, cataloging them to be included with all other library materials in the library catalog.

These free or inexpensive remote sensing imagery resources are available online, usually through web mapping interfaces. This article will examine three basic, yet robust, online resources: Terraserver-USA, Google Earth, and data services offered by the Center for Earth Resources Observation and Science (EROS).
Figure 2. TerraserverUSA http://www.terraserverusa.com/

Terraserver-USA
Terraserver-USA (Microsoft Corporation, 2005), a partnership between the US Geological Survey and Microsoft, delivers black and white and high-resolution color aerial photography and satellite imagery of the United States for free. The imagery is easily searched through a map or by place and feature names. Images can be printed at the original resolution or downloaded at a reduced resolution. There is even a script add-on to the popular ESRI ArcGIS software which allows full-resolution imagery to be downloaded directly to a GIS software user’s current project.
Google Earth

Google Earth (Google), a free program available for download, provides satellite imagery for the entire earth, at varying levels of resolution. For many areas, especially in the United States, the level of detail is extremely good. The user can zoom in or out to view more or less detail of a location, rotate or tilt the view (to better view the topography), and look at the viewshed from any vantage point. Google Earth is being used both as way to provide access to images and an imagery source for students and researchers. For example, both NASA and the satellite company Digital Globe have used Google Earth as an index to their images (Figure 3). The location of their very high resolution photos is overlaid onto the available Google Earth imagery, with links to previews and ordering information.

As an imagery source, Google Earth is gaining increasing popularity in the earth sciences. Researchers are using Google Earth for a fast, easy, and detailed look at their study areas. For example, Roger Bilham, a geologist at the University of Colorado at Boulder, uses Google Earth for the current high resolution imagery he needs to identify and analyze historical earthquakes (Bilham, R., personal communication, October 25, 2007).

The imagery available through Google Earth is often astounding. The ease of use and ability to add other data or link to other resources makes Google Earth imagery very appealing to many researchers. Users can print and email a jpeg file of the current extent and level of detail, as seen on the screen. One of its main drawbacks is that Google Earth does not identify the date of the imagery. The imagery source changes as the user zooms to different levels of detail. An approximate date (emphasis Google’s) is given, along with the data provider in the bottom right-hand corner of the program window (Google, 2008). There is no way to find the actual date of the imagery.
Center for Earth Resources Observation and Science (EROS) Data Services

The Center for Earth Resources Observation and Science (EROS) (Figure 4) is a research, data management, and systems development field center of the U.S. Geological Survey (U.S. Geological Survey). EROS manages most of the remote sensing imagery of the U.S. Geological Survey (USGS). A confusing array of services offer viewing and downloading or ordering options. Earth Explorer, the National Map Seamless Data Server, the Global Visualization Server (GloVis), and other services provide access to high resolution imagery.

Landsat imagery, black and white digital aerial photography, color higher-resolution imagery, ASTER satellite imagery, land cover data, and the national elevation dataset are among the datasets provided by EROS (Figure 5). These many datasets are offered through more than one interface and it can be difficult to decide which one to use. A USGS Web site describing the purpose of the data services is helpful:

http://eros.usgs.gov/about/customer/search.html. This page describes Earth Explorer this way: “A complete search and order tool for aerial photos, elevation data, and satellite products distributed by the USGS,” and GloVis as: “A quick and easy search and order tool for a growing satellite database. “ Depending on
datasets needed and level of comfort with a particular interface, a user may choose from any of eight different data services.

These services allow the user to preview the data and download selected areas. Metadata is also available for download. Users can also check the status of the data collection for specific imagery sets. Large areas (with the size depending on the chosen dataset) cannot be downloaded. Some of the EROS data services simply require the user to select a smaller area. Others allow the data to be ordered on a DVD—usually with a cost of about $30.

It has been this author’s experience that delays in loading and glitches with selection and download functions can happen with any of the EROS data services. The USGS has updated them over the years, and they continue to make improvements to their functionality. The services offered by EROS are, for the most part, research-oriented and, in most situations, these benefits outweigh the problems a researcher may encounter with the interface.

![Figure 5. Satellite Products Managed by EROS](http://eros.usgs.gov/products/satellite.html)
Terraserver-USA, Google Earth, and the data services offered by the U.S. Geological Survey’s EROS Data Center are but three examples of the many data services available. These data services provide an illustration of the diverse resources and interfaces available for remote sensing imagery and are merely a taste of the data services available. (See the Appendix for a selected bibliography of further resources.)

CONCLUSION

Remote sensing imagery is used extensively in research in many geosciences disciplines and is an important component of the geosciences research collection in libraries. Traditionally, collections of remote sensing imagery have required a lot of resources, technical skills, and computer storage capacity within the library. However, as the resources explored in this paper illustrate, free or inexpensive imagery is increasingly more available. Traditional library skills and processes such as outreach and cataloging can easily be used to develop a wide-ranging remote sensing imagery collection to support geosciences research.

REFERENCES


APPENDIX

Selected Bibliography of Remote Sensing Imagery Resources

Tutorials

- Canada Centre for Remote Sensing tutorial
- NASA tutorial
  - http://rst.gsfc.nasa.gov/
- Towson University Center for Geographic Information Sciences Remote Sensing Tutorial
  - http://chesapeake.towson.edu/data/all_tech.asp

Other Data Sources:

- National Satellite Land Remote Sensing Data Archive (EROS)
- Archives of Landsat, AVHRR (NOAA dataset), plans for MODIS, ASTER, STRM, and more
- Land Processes Distributed Active Archive Center (NASA/EROS)
  - Land-related archives including ASTER and MODIS
- NASA Earth Observing System (EOS) Data Gateway
  - Search and order data sets from NASA and affiliated centers
- NASA's Visible Earth
  - Catalog of NASA images
  - [http://visibleearth.nasa.gov/](http://visibleearth.nasa.gov/)
- NASA’s Global Change Master Directory
  - Searchable metadata for all NASA earth sciences data sets and services
- More tutorials and data sources from the CU Boulder Map Library
  - [http://ucblibraries.colorado.edu/map/links/aerial.htm](http://ucblibraries.colorado.edu/map/links/aerial.htm)
I HAVE SOMETHING TO SAY ABOUT THAT PIECE OF EARTH: ENABLING INTERACTION WITH GEOSCIENCE MAP DATA

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Abstract – Librarians have much to learn from gossip bloggers, whose rapid and fluid methods of interaction with – and indeed upon – their "data" allow for efficient discussion around, annotation upon, sharing of, and collaboration about their topics and subjects. Overlooking the fact that their topics are fleeting and their subjects decidedly un-academic, gossibloggers' techniques and methods are of interest here, as the model for collaboration using modern but not terribly complex web technologies could be transferred to the daily workflows of geoscientists and their subjects: geospatial datasets. Presented here are three small examples of how the discussion and communication inherent to doing geoscience could be migrated to a more intuitive and appropriate platform: the geodata about which the discussion and communication takes place.

INTRODUCTION

Say what you will about the world of celebrity gossip blogging, the ease and alacrity with which gossipers are able to acquire, consume, manipulate, and then share data should not go unnoticed. Gossipers acquire and swap millions of celebrity photos and study them, alter them, mark them up, annotate them, mash them with other objects, even hold remarkably long conversations about them with any number of contributors. The infrastructure, technologies, and standards that sit behind and enable this pastime are largely transparent.

Scientists in general, and geoscientists in particular, should be righteously jealous of the way data are interacted with online, with the way gossipers are able to discuss their digital subjects, cite other resources, snip out previous threads or similar topics, introduce counter evidence, argue, annotate, and alter their "data." "To collaborate," in other words, and to do so with an efficiency unfamiliar to most academics.

Additionally interesting is that in many cases, the image or other datum is both the subject of discussion and the platform upon which the discourse takes place. This could be particularly relevant to geoscientists, who tend to hold discussions about earthly locations and locatable phenomena and could perhaps benefit if those conversations were delivered in situ, as it were, on an earthly platform. Either way, it would behoove library scientists to help solve this problem for their constituents, so many of whom still live in closed, controlled, but nonetheless inefficient realms of communication fueled by email, email attachments, and...often little else. Certainly the rapid, easy workflows indulged in by so many gossibloggers could also be leveraged against scientific discourse and collaboration, especially in those situations where the object of discussion – some place in geospace – could also be the platform for discussion.

THE MEANING OF WORKFLOW

It is important here to distinguish between the kind of workflow growing out of larger cyberinfrastructure-building communities and "workflow" imagined here. A number of visible, well-funded projects exist already that endeavor to build shareable, reusable scientific workflows to benefit interdisciplinary research. Perhaps most visible among these are the tools born of The Geosciences Network (GEON), and certainly evidence of these richer, more robust workflows are appearing in many contexts and domains (Altintas, et al., 2004; Fils, Ambite and Cervato, 2007; Ludäscher, et al., 2006). These developments are in capable hands, to be sure, and although librarians should probably be shocked at how many of these projects and ideas were born outside of the library science domain.
and even without much thought toward the inclusion of librarian expertise, there are still places for library contribution to this rapidly-advancing body of work – particularly in keeping with libraries' commitment to providing information and services to those communities who don't already have the resources and abilities to develop their own solutions. These services are usually simpler and less extravagant, but these days being "simpler" and "less extravagant" than NSF-funded cyber-infrastructure can still be plenty rich and robust.

THE VISCOSITY OF MODERN DATA

For reasons not within the purview of this article, libraries seemed not to have seen it coming that if digital information were made mobile it would be made usable. If it were made consumable it would be made reusable. Celebrity photos and the technologies devoted to discussing and sharing them are ubiquitous and voluminous and largely free. The driving factor here could be that celebrity photos are just...everywhere. It is in no way difficult to locate a snapshot of Halle Berry's phantom sixth toe, for example, and certainly easier than finding an article on the relationship between polydactyly and obesity. And what it truly means to be "accessible" is perhaps another issue altogether that goes beyond mere ubiquity. But to argue that library catalogs, with their lumbering MARC records and you-come-to-us mentality, are still the best model for locating and using information takes the hubris of a celebrity. To be fair, clearly it was not "use" as it known today for which the OPAC was designed but rather the location (and acquisition, purchase, cataloging, etc.) of materials. Moreover, the monograph's use could be presumed. Digital data carry no such presumption and stricture. Libraries have not historically been worried about mashability and the multi-directional flow of information because there used to be one flow: the user into the library and they'd better like how they get their information once they're there. Somehow we didn't see it coming that we would have this opportunity to allow the world to access and interact with information on their terms, in their applications, but still organize and manage it on ours.

Increasingly fluid ways to mark up, wrap up and exchange information means that even an institution charged with the management of information in perpetuity can begin piping data and information from one system to another in new ways, and this in turn means library-supported opportunities for distributed, even interdisciplinary data-based collaboration are increasing. If librarians can develop ways their collections (including their data collections) can be made more amenable to other systems, more mashable, the research workflow might be better off for it. If librarians can build or contribute to workflow solutions, they would no doubt be heroes to their academic community.

Beyond ease and swiftness there is additional benefit to storing and serving (or just connecting to) data that can be moved and mashed, in particular with geoscience data. In an unfortunately common workflow scenario, teams meet then disperse only to carry on extended, multi-threaded conversations via email by attaching increasingly confusing versions of documents and other output. This seems, at best, preciously outdated. Probably worse it is inhibitive to practicing good geodata management. This is not how gossip bloggers share their data, collaborate, do their "science." Granted, gossibloggers don't have data stewardship in mind. If their Fisher-Stevens-is-balding post doesn't survive the turn of the decade no scholarship will have been harmed. Nor do they really demand much in the way of infrastructure or semantic web technologies. PhotoShop or GIMP + PhotoBucket + Blogspot typically suffices.

Geoscientists need more in the way of data and information support, to be sure. This is fair because presumably they have it from their university library. If university libraries could decide that it is a library issue, more robust and extensible platforms could exist not just for collaborating – that's the easy part – but rather integrating the subject of collaboration (data, models, inputs and outputs) into the mode of discussion. Geoscientists should be holding conversations about maps...on those maps. They should be holding conversations about charts and graphs...on those charts and graphs. They should be easily citing library-hosted data and information stores, and in more capable systems (but not altogether complex still), siphoning those stores into (or is it onto) these platforms.

If librarians really want to support researchers and scholars on campus they can develop ways that make it just as easy to include geodata (as well as tangential information like citations and
references and full texts of literature elsewhere) in a day-to-day workflow of a 5-person team, as it is to include 150 paparazziphiles in a discussion of a pregnant Cate Blanchett. Then future work can be done to integrate these capabilities with larger cyberinfrastructure efforts built on semantic web technologies.

Discussed below are three small projects that each represent a cog in a machine that, if developed, could contribute to making geospatial data into a platform for the multi-user, multi-modal, distributed discourse about geospatial data. They are admittedly simple, nascent examples of integrating data into communication and workflow (or rather integrating workflow and communication into data), but they are working and need only to be bolstered with business logic before a working prototype could be handed to adventurous teams of researchers looking to move away from massive stores of untagged, unversioned, unruly email threads and attachments, irc transcripts, and cell phone photos of meeting room whiteboards (it happens).

VISIBLE PAST

Visible Past is a wiki, which is nothing special these days (Matei, 2006). Its articles are marked up with minimal geographic attributes (latitude, longitude), which is not terribly novel as many Wikipedia entries are as well. Visible Past, however, is more ambitious still. Not only are entire wiki articles deliverable geographically, Visible Past works at the substring level, able to deliver snippets of articles, paragraphs, sentences, single images or tables according to how they've been tagged inline with geographic attributes. The result is a wiki that is as modular as possible, where any given piece of an article can be delivered to a map in the location referenced in the article markup.

Visible Past is designed to be a platform, not just a wiki. By virtue of its inline markup of articles and article fragments, then the additional virtue of an application programming interface (API) layer on top of that, the articles and article fragments can be delivered in other spatially-aware modi. So one could interact with the wiki using a map interface embedded in the wiki itself, but the experience will have been sold short. Google Earth and NASA WorldWind are clients, wherein the bounding box coordinates of a globe view are sent to the wiki and passages located within are returned. A FLEX Virtual Reality Theater environment is a client, so the four-walled virtual reality theatre at Purdue's Envision Center can also query the wiki in real time. As one "walks" through a spatially correct virtual reconstruction of ancient Rome the wiki is queried and returns articles or fragments whose markup places them within the view of the walker. Wherever there is read capability, articles can stream to clients based on the client's location.

Planned additional clients include location-aware cell phones, and planned additional functionality includes more advanced integration with virtual reality, so that users can edit wiki articles in virtual reality as well as read them. Visible Past attempts to present Rome or other historic realms as complex databases, rich with content at different 2d spatial and 3d virtual scales. Allowing the world to be annotated and interacted with by a user's position within it allows for more intuitive exploration and discovery. And while Visible Past is targeted to archaeologists and classics educators, the tenets of the project (as seen in other examples, below) transfer well to the need of geoscientists to be able to use location against itself, as it were, to use the subject of their work as the platform upon which to discuss it.

Making this relevant to libraries takes just a short hop. Wiki authoring, however controlled and closed, isn't in and of itself the concern of librarians. In the likeliest Visible Past scenario, students and professors contribute to the wiki – some with their desktop PCs, others with iPhones – and librarians augment student submissions with germane content piped in from library collections. Ergo, librarians must at least ensure that their information and data be "pipable," must be mobile and accessible in the ways modern web applications communicate (through xml, ajax, web service protocols, etc.). Not only that, library data must be made semantically available. Gone are the days when library patrons (let "patrons" = students, faculty, staff, their web mashups, their cyberinfrastructure, and their home-grown software applications) will wait for a librarian to find the time to help annotate their wiki with better, more authoritative information. Libraries are cyberinfrastructure, like it or not.

It is fine if librarians want to consider themselves a last bastion of authoritative, quality
information (as opposed, most obviously, to Wikipedia and other communal sources), but we must work harder to unsequester that information. It certainly does not make it any more authoritative, certainly does not make it any more secure, and it certainly does appear to make it less used. Visible Past is an effort to bring together the agility of modern, read/write web technologies, the scholarly value of authoritative or professor-to-student information, and true geographic location. The result is a platform for collaboration where the method and subjects of communication – places on the earth, multimedia objects, and good old fashioned digital text – are also the methods of communication. Library content and library support for such a platform would surely be welcomed by populations beyond students of ancient Rome.

SOIL SURVEY RESURRECTION

The second of the three small examples discussed here is a more traditional mashup model, wherein two otherwise distinct sources of information are intertwined in some useful or meaningful way. Over the summer of 2007 Purdue Libraries digitized the 1906 Soil Survey of Tippecanoe County, Indiana and extracted its contents into two distinct types; one full-text prose document and a pair geospatial datasets (Miller and Stowell-Bracke, 2007). These different formats are stored and delivered by two separate systems; one a CONTENTdm repository installation, the other an online map application. The online map application was designed to approximate but improve upon the way soil surveys are typically used by soil scientists in their research and field work by allowing them to query and search for soil units contained in the online map, then use the results of the searches and queries to link straight into that/those portions of the survey text that also discuss that soil type. This project is an unfunded pilot as of this writing, which means the focus was merely to get the text and soil map data "speaking" with one another based on a shared topic (the soil unit). Little additional functionality was intended for the pilot. As the project develops, however, and adds additional soil data sources in both formats, additional semantic functionality can be introduced (based on methods tested in-house already). The map application speaks xml already, and additional development could include the addition of a layer or two of semantic abstraction that would allow data from virtually any provider to be wrapped in xml and piped into the map interface in order to augment the map's contents in some meaningful way. A likely example of such content would be a digital collection of surveyor's field notes (in many ways the source data of the survey document itself). From a collection of scanned, digitized, geocoded (either manually or through a natural language algorithm) survey notes, any page or passage could be extracted and passed into (or called from within) the map interface based on their shared subject: some soil unit, some spatial landmark, or some coordinate reference to a place on earth. Of course this is in anticipation of more and more library collections of data and other digital objects that can interact and actually be mashed.

Here the possibilities move beyond the mashup model and further into the realm of web services and cyberinfrastructure. If libraries consider these areas to be in some way outside of the scope of library work in 21st century academia, they might as well work on cataloging solutions for Twitter tweets about David Spade's hairdo. The use of and access to information – foundations of library science – are increasingly becoming functions of not necessarily web services, but certainly cyberinfrastructure at various scales. The Soil Survey Resurrection is an example of this work at a rather local and very manageable scale.

CONTENT MANAGEMENT IN GEOSPACE

"Scale" is a decent segue here, as the third of three projects is in some ways the smallest of all. Where Visible Past presumes a certain amount of crowd sourcing and the Soil Survey Resurrection project relies mostly on library developers (less on user contribution and editing), the third example, which endeavors to integrate a content management system (CMS) with geospatial data, nests neatly within the scope of both large-scale web publishing efforts and more limited, solo, or small-group projects as well. It is therefore a promising candidate for the ultimate development of systems that more intelligently and robustly support geoscience workflows. Taking the Drupal CMS as our test case, with minimal coding, Purdue Libraries GIS staff were able to integrate a slightly altered Drupal installation with a map tightly enough that any
whole or partial CMS entry could be marked up in a simplified subset of Geography Markup Language (GML) and delivered in situ, which in this case means the article can be called from within an online map interface based on the user's current view of the map. The benefit here is that all of the power of content management, including threaded discussions, versioning, tagging and taxonomic structures, syndication (in and out), style and module control, user management, and native extensibility can be handled entirely by CMS code but can be simultaneously executed from within the environment that is the subject of the content to be managed. So geospatial input, output, or intermediate map data can be served to a map interface, and within that map interface much discussion and commentary can take place inline; citations and references to relevant materials in other places can be placed; swift calls to other data collections can be made; annotations can be written; and ideally some formal or informal metadata can be constructed, all attached to points on the earth or features of the geodata themselves.

CONCLUSION/FUTURE WORK

Obviously much is left to do even as a proof-of-concept, but there are collaborations between librarians and faculty researchers that could already be benefiting if the ideas sketched out here were a living, even slightly robust platform. Too many projects still operate at the desktop and personal computer level because the tools that could integrate data, visualization, information sharing and location, and communication and annotation at the day-to-day workflow level don't exist, are developing outside of a potentially powerful, centralized agent such as the university library, or are so complex and computationally heavy that the programs devoted to building them are still too young to disseminate workable products into the wild. Grand, after-the-fact systems exist or will soon exist that allow post-project sharing and interoperability of data, but if librarians truly want to proselytize for good data hygiene from the start to the finish of the research workflow (under the presumption that good hygiene during research will facilitate sharing and dissemination and curation following research), and truly want to provide solutions to their academic communities, it might behove us to pitch in and make it happen.

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CONNECTING TO THE PAST: ACCESSING EARLY GEOLOGICAL LITERATURE IN DIGITAL COLLECTIONS

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Abstract – Almost every researcher would like to access the literature in their field without having to go to the library. However, unlike other sciences, some geologists do use older publications from government agencies, societies and other sources. Some early geological publications are available online, but the trick is knowing where to look for them.

Many government agencies, including the U.S. and state geological surveys, are providing access to current geological publications online. Some of these agencies are also scanning and providing access to their older publications. Geological information is also available through non-geological collections and databases, including Making of America, Lexis-Nexis Congressional, the American Periodical Series and Early American Newspapers. Each of these resources can be used to access the full text of early geological articles and publications. A survey of these geological information available in full text databases reveals some interesting results. While some of these resources do not provide access to traditional scholarly articles, the information is still useful for tracing the development of geologic thought and historical geological events.
Abstract – Internet surfers have demonstrated an increasing tendency to depend on Google (or one of its domains like Google Scholar) for their every information need. When combined with tight library budgets this observed tendency can lead library administrators, librarians, researchers, and students to question why they should pay for subject-specific bibliographic services when a free search engine like Google Scholar is available. Major differences abound between a structured bibliographic system like GeoRef and the one-size-fits-most approach of Google Scholar. Currency, comprehensiveness, ease of use, user expectations, search features, ability to integrate in library systems, and access to full-text differ significantly between Google Scholar and bibliographic services like GeoRef. An outline of the some differences between the two systems will be developed. Through an examination of the similarities and differences between Google Scholar and some of the implementations of GeoRef, the strengths of each system for a variety of purposes will be presented.

INTRODUCTION

The increasing use of Google and/or one of its domains like Google Scholar by researchers and students poses some interesting questions for those of us responsible for providing or producing information resources for use by the geoscience community. With tight library budgets, some geoscience librarians have already been faced with evaluating the value of subject-specific bibliographic services in comparison with free search engines like Google Scholar. As the archive of web-based geoscience literature grows and larger numbers of publications become available online, the need for greater understanding of the differences and similarities between these information sources becomes critical. The objective of this paper is to begin to outline some of the similarities and differences between a subject-specific bibliographic service like GeoRef and a free search engine like Google Scholar.

QUESTIONS AND PROCEDURE

The primary questions to be considered are: What are the characteristics of a subject-specific bibliographic service like GeoRef and a search engine like Google Scholar?; and, What does a traditional abstracting and indexing service like GeoRef provide that Google Scholar does not and vice versa?

The following procedure was followed to investigate the two systems. First, the web sites for both were examined. Descriptions of each service are provided on their respective web sites and the information was compared. Search interfaces were tested using three different search scenarios and the search features, handling of results and the available search tools were explored. Finally, the strengths for each system as determined from the web sites and from the search tests were outlined.

CHARACTERISTICS OF EACH SERVICE

Descriptions of Each Service

GeoRef

GeoRef is a traditional abstracting and indexing service that produces a subject-specific bibliographic database in the area of the geosciences. The database aims to cover formal geoscience publications and some gray literature in a well-defined subject area. An explanation of coverage is provided on GeoRef’s web site. The target audience of the GeoRef database is the geoscience researcher. As the target audience is a knowledgeable professional in the geoscience field, a Controlled Vocabulary is used in the GeoRef metadata to describe the subject content of the database. The Controlled Vocabulary provides a means of insuring consistency and precision of retrieval. The database is available by subscription on a variety of different platforms. 

http://www.georef.org
Google Scholar

Google Scholar is a web-based search engine. Google Scholar aims to cover many disciplines and many sources and uses a one-size-fits-most approach. No precise information was found on the Google Scholar website regarding which databases or publishers are included, but coverage is indicated to be restricted to ‘scholarly work.’ Articles retrieved in Google Scholar are ranked using the search criteria and the availability of the full-text. Access to the articles or sources is immediate as the coverage is based on web-based materials. Google Scholar is freely available. [http://scholar.google.com/](http://scholar.google.com/)

Interfaces

GeoRef

Since GeoRef is distributed on multiple platforms, a choice was made to use the CSA Illumina platform for this comparison. [http://www.csa.com/](http://www.csa.com/) The search options available to the user on the CSA Illumina platform include a Quick Search and an Advanced Search. Queries can be developed using both single words and exact phrases and options exist for the use of wildcards, proximity operators, Boolean operators and fielded searches. In GeoRef, the CSA Illumina platform allows for 46 separate fields to be searched. A user can limit a search by date, by the English language, to journal articles only or to the latest database update. Indexes are available for the author name, journal name and publication type fields, allowing the searcher to scan and choose from existing data.

Results from GeoRef can be saved to a file for later use, printed, or e-mailed. Citations can be downloaded in formats pre-formatted for citation management software. The citations displayed on the screen frequently have links to full-text. A search history is provided to allow the user to reuse the search strategy, edit or refine the search for improved results or to combine the search with another query. Authors that are retrieved may be searched separately by clicking live links. The Controlled Vocabulary terms may be selected to link to additional citations of potential interest. The CSA Illumina platform hosts the GeoRef Thesaurus, a guide to the Controlled Vocabulary. The GeoRef Thesaurus contains 29,000 controlled subject and geographic terms that are used to describe the content of the citations selected for GeoRef.

Google Scholar

Search options for Google Scholar include a Simple Search and an Advanced Search. The possibility of searching for single words or exact phrases exists and Boolean operators may be used. There are three potential fields to use for fielded searching (including author and journal) and results can be limited by date, broad subject areas or to seven languages. The broad subject areas employed by Google Scholar do not include a geoscience grouping. The interdisciplinary nature of the geosciences forces results to be spread across four of the seven subject areas as defined by Google Scholar (Biology, Chemistry, Engineering and Physics groupings).

Google Scholar’s subject areas:

- Biology, Life Sciences, and Environmental Science
- Business, Administration, Finance, and Economics
- Chemistry and Materials Science
- Engineering, Computer Science, and Mathematics
- Medicine, Pharmacology, and Veterinary Science
- Physics, Astronomy, and Planetary Science
- Social Sciences, Arts, and Humanities

Results from Google Scholar contain links to full-text and, in some cases, can be linked to a local library collection. Downloads to citation management software are possible. Author names that are retrieved may be searched. It is possible to click links to citing articles or to expand a search by looking for related items. Google Scholar searches online text, but the website was not specific about what material was available.

TESTING THE SYSTEMS

To test the two systems, three types of search queries were selected: an author search, a subject search and a known-item search. In an attempt at making the searches as applicable to real situations as possible, the most recent search of each type that had actually been attempted by the author as part of normal activity was chosen.
Results were examined and compared in terms of content and accuracy.

1. For the author search, a recent publication by Timothy H. Dixon and J. Casey Moore was chosen – *The seismogenic zone of subduction thrust faults*, Columbia University Press, 2007. This book had arrived from the publisher only a few days before – practically guaranteeing that it would not be found in GeoRef, but the potential for testing author-search capability and examining search results seemed to make it a fair candidate for testing.

2. The subject search selected was a fairly specific topic: bearing capacity of foundations in permafrost. This topic was chosen in hopes of using it to test the subject-search capabilities of both systems – including the use of phrases, Boolean operators and Controlled Vocabulary.


**Author Search**

**GeoRef**

To perform an author search in GeoRef one option is to use the ‘author index’ on the CSA Illumina platform. Using the index, five variations of the author were chosen.

- dixon, t h
- dixon, tim
- dixon, tim h
- dixon, timothy
- dixon, timothy h

One-hundred ninety-four references were retrieved and were examined. All of the references in the list appeared to be appropriate. The option to sort the records by the date of publication was used and the most recent publication by the author in the GeoRef database was published in 2006 indicating that the book being sought was not yet in GeoRef.

To further confirm that the publication was not present, the search history was used to edit the search and add a second author. Again, using the author index and the variety of options with initials and first names, J. Casey Moore was found to have four hundred and ninety-eight publications. Combining this result with the result from the search for Dixon resulted in no references – no surprise since the book had just arrived in the GeoRef offices.

**Google Scholar**

In Google Scholar the same author search was performed using the author index. The author index requires the author be entered as TH Dixon. One-hundred five references were retrieved. The first eleven were references to the correct author, however, the sorting of references seemed haphazard as current articles did not sort first even though the ‘Recent articles’ feature was used. The results seemed to be presented in order by relevance. The top item was published in 2002 and more recent publications appeared later. Approximately 25% of the retrieved publications were relevant to the author being searched. The sorting pattern and the retrieval of articles not written by the author were puzzling, however, in a recent article on Google Scholar, Jasco noted that the Google Scholar search software extracts both dates and author names from full-text resulting in misidentifications in both bibliographic fields (Jasco, 2008.)

To further test for the presence of the publication, the second author needed to be added to the search. The addition of a second author in the author field box did not seem to function cleanly and resulted in no hits. The keyword field was used to add the second author to the search. The sought-after publication was not found, however, a book announcement for the publication was located and an option to search for a library that had the book was provided.

**Subject Search**

**GeoRef**

The subject search for ‘bearing capacity of foundations in permafrost’ was performed using the Advanced Search screen in the CSA Illumina
platform. The phrase was separated into three separate search fields: ‘bearing capacity’ ‘foundations’ ‘permafrost’. The Search Anywhere option was chosen and the Boolean ‘and’ operator was used to connect the three fields. ‘Bearing capacity’ was entered as a phrase. One-hundred seven references were retrieved. The first twenty were examined and found to all be relevant to the search. The results were sorted by publication date. The most recent references were found to be published in China in 2006; a Russian permafrost conference from 2004 comprised the second group of references followed by a range of English journal sources.

Google Scholar

The search for ‘bearing capacity of foundations in permafrost’ was performed using the Google Scholar Advanced Search option and clicking on the option ‘with all the words’: permafrost bearing capacity foundations. Twelve-hundred forty references were retrieved. The first item was relevant, but was actually not a publication. It was a citation contained within a publication on another topic. Oddly, nine out of the first ten were off the topic, however, eight of the next ten were relevant. Using the sort to see recent items, the item that sorted to the top was published in 2004. As with the previous author search, the ‘Recent articles’ feature seemed to provide a confusing arrangement of references. The Chinese and Russian conferences found in the GeoRef search did not appear. When this search was repeated several times on the same day, the number of references retrieved increased and decreased, giving the searcher the sense that results could not necessarily be reproduced.

Known-item search

GeoRef

In the CSA Illumina platform the Basic Search function was used and the two words ‘Gargasian cassis’ were entered. The item being sought was the first of three items retrieved. The title link on the record display took the user to the full bibliographic record where there was a further link to the full-text. The other two items retrieved were references to other articles by the same author on the same location.

Google Scholar

Using the Advanced Search option ‘with all of these’, the phrase ‘gargasian cassis’ was entered. Google Scholar responded with a suggested correction for the word ‘gargasian’ and offered the option to change the search to ‘gagosian’. In addition, Google Scholar located twenty-nine items that might be relevant. The first item was the one being sought and most of the twenty-nine items were different pathways to the same publication. Full-text was available through a single-click.

STRENGTHS

Strengths of the two different systems observed during testing are summarized below.

GeoRef

- Search features
  1. Powerful search options including Boolean operators, wildcards for stemming, proximity operators, search history displays, ability to edit and combine searches
  2. Indexes for scrolling through and searching author names and Controlled vocabulary
  3. Manipulation of results in a variety of ways is possible including selection of subsets, sorting by relevancy or dates, emailing selected references, and downloading into citation managers
  4. Searches can be dependably repeated with similar results

- Ease of Use
  1. Flexible interface with both simple and varied options

- Coverage
  1. Well-defined subject coverage which avoids false retrieval (pre-selection)
  2. Wide-range of media included in addition to web-based materials (print, fiche films)
  3. Restricted coverage to formal publications
  4. Foreign-language materials identified using same Controlled vocabulary
Google Scholar

- Coverage
  1. Includes more than formal publications (book announcements, citations/references)
  2. Covers all disciplines

- Currency
  1. Frequent updating with new publications

- Ease of Use
  1. Search box embedded in browser
  2. Free with no access limitations
  3. Provides suggested corrections to typos

- User Expectations
  1. Quick and easy
  2. One click to full-text

TOO CLOSE TO CALL

Full-text access and ability to integrate within library systems presented a very complex situation. Some of the variables that influence full-text access through library systems include:

- Is the publication web-based? Open-Access? Available through subscription?
- If available through subscription, how is the library managing access control?
- Where is the user located? In the library, remote, on campus?

With so much variability it was not possible to compare full-text access with any degree of confidence. Google Scholar did present the fewest number of clicks to move from the display to the full-text for the Open-Access item found in the Known-item search.

CONCLUSION

In summary, both GeoRef and Google Scholar provide useful information, but the results the user retrieves will vary significantly. Each system has strengths that make it more applicable under differing circumstances.

Examination of the descriptive information and the three search scenarios outlined above were instructive and the following general conclusions were drawn. A subject-specific bibliographic database such as GeoRef provides dependable identification of web and non-web-based information sources. Its powerful search features permit precise and flexible queries and eliminate false retrievals. The defined subject area and Controlled Vocabulary permit the user to locate the most-relevant publications with a high degree of precision. A more general search engine like Google Scholar is effective for quick information requests where completeness is not a concern and irrelevant results can be easily ignored. It also provides options for finding useful additional information such as book announcements and citing references.

WHAT’S NEXT

The procedures described above provided some useful insights into the two very different information retrieval systems, however, they have only scratched the surface. Almost nothing was discovered regarding library connectivity. Search results didn’t always match expectations regarding sorting, inclusion of authors and publication dates. And, last, but not least, more searches need to be examined in detail for further insights into coverage and currency.

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CONNECTING LIBRARY USERS WITH FREE GEO SCIENCE DATABASES

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Abstract – Many freely-accessible databases from universities and research institutes that support geoscience education and IPY (International Polar Year) are appearing on the Web. Subjects include northern environments, Antarctic management, and IPY research. Grey literature, photographs, and maps are often included. Many of these databases are off the radar of the traditional library database collections, yet can be valuable sources for students and researchers. The INSTAAR Information Center conducts workshops to introduce its users to these databases. In the process, the Information Center, despite its small collection and tiny budget, achieves higher visibility within its community and connects with new groups of library users. This paper describes how the workshops are constructed and some lessons learned.

INTRODUCTION

The INSTAAR Information Center conducts a series of workshops throughout the academic year as outreach and information literacy tools. The workshops connect participants with particular resources and also connect participants to the library. They help potential users establish trust and habits of use and give me a higher profile within the institute. The workshops can be considered as, among other things, a marketing activity.

BACKGROUND

The Institute of Arctic and Antarctic Research is part of the University of Colorado—Boulder. It consists of about 200 people, mostly scientists and graduate students with some support staff and undergraduates. The institute is expanding its original focus on cold regions science, climate change, and Quaternary science to more general earth and environmental science. This interdisciplinary research straddles traditional subject divisions. As a result, our small library has an expanding mandate, but also only a part-time staff and very small materials budget. This requires some creativity on our part.

To thrive these days, all libraries must take information to their constituents, rather than waiting for them to come to us. For very small libraries, this is a matter of survival. My users must feel connected to my library; they must get worthwhile and visible services from it. As users become ever more plugged-in, digital Google searchers, that need only increases. I need to reach out to new and existing users all the time. I need to make it easy for them to think of coming to the library first. And I need to educate them about the role of the library, not as a repository, but as a gateway.

Services are the key to this process. INSTAAR has more money for my time than for materials. Marketing can be a scary concept, so I never call it that. Instead, I ask how I can connect with someone new or with a group of patrons.

As part of these efforts, I run two or three workshops each semester, most often on a particular database such as GeoRef or ScienceDirect. The workshops are designed to forward information literacy skills, encourage exploration of new resources, and connect users with the library.

WORKSHOP DEVELOPMENT

One of the workshops that has enjoyed the most success explores freely accessible databases from universities and research institutes that cover northern environments, IPY and polar research, and geology and earth sciences. These databases are off the radar of traditional library database collections, yet can be valuable resources for students and researchers. Often, the databases include grey literature, photographs, maps, online museum exhibits, and research project summaries as well as citations of journal and newspaper articles, books, and reports.
I run this workshop every two years. Through trial and error, I have discovered a few rules of thumb that make the workshop more successful:

- Cover no more than four or five resources per workshop. After that the only thing participants seem to take away is a case of information overload.

- At the beginning, I give participants a handout with a list of the web sites covered in the workshop, a few basic pieces of information, and Information Center contact info. This saves people from getting distracted taking notes, but doesn’t spell out the material so much that people just read it and disengage from the discussion. The handout also serves as a calling card for the Information Center.

- The workshop begins at the Information Center web site, which gives participants orientation (starting at “home”), connection (reinforcing the library’s brand), and utility (the site lists many free and subscription databases, including those covered in the workshop).

- An Introduction describes where these resources come from, explaining fee vs. free and the motivations of commercial publishers vs. research institutes and universities. Students, especially, tend to find this information novel and useful.

- A brief guided tour of each resource in sequence showcases:
  - What the resource does and does not include.
  - What it might be good for (and when to go elsewhere).
  - Who publishes the resource.
  - How to perform searches.
  - Any special features. For example, can you export references to EndNote or RefWorks? See artifacts in 3D?
  - Drawing out participant interjections and questions during the guided tours can be difficult, but engages people like nothing else. I sometimes ask participants to describe their research, then use keywords from that subject during searches. Alternatively, I’ll ask the group who knows about the web site or the authoring organization. Being alert to the nuances of responses, drawing out questions, and using terms that come up in conversation right away in searches can lead to a really enlivening experience.

- It would be easier to engage participants in the workshop if each person had their own computer connected to the internet and followed along—this would reinforce the information with the tactile experience of being on the sites. Unfortunately I only have one computer available, so I am reduced to encouraging discussion!

Many of these free resources are probably familiar to those in GSIS, and I am sure that I have not listed nearly all that is available. In the past couple of iterations, this workshop has covered the following resources:

- The IPY Publications Database (http://biblioline.nisc.com/scripts/login.dll?), a collaborative project between ASTIS, CRBP, DAHLI, NISC, and the SPRI Library. This resource is especially appropriate during this International Polar Year, and showing it lets me encourage students and scientists to report their IPY materials.

- Cold Regions Bibliography Project (www.coldregions.org), compiled by AGI with contributions from CRREL, NSF, and librarians and scientists worldwide. This bibliography links to Arctic and Antarctic Regions, which I purchase; so this resource gives me a good opportunity to market that Information Center resource. We also glance at the old CRREL Bibliography hosted by the Library of Congress (http://www.loc.gov/rr/frd/coldregions), to differentiate the two products. This is especially important because the closed LoC bibliography is the first to come up in a Google search for [CRREL bibliography], and students searching for it this way may miss the active AGI version.

- Scott Polar Research Institute Library databases (www.spri.cam.ac.uk/resources) on Antarctica, the Russian North, and ice and snow, and the new Polar Pictures online. These are right on-topic for INSTAAR researchers and generally completely new to them, and are compiled by actual subject experts rather than machine code.
• Arctic Science and Technology Information System (www.aina.ucalgary.ca/scripts/minisa.dll), from the Arctic Institute of North America, University of Calgary. A fantastic collection of references about northern Canada, many of which are not indexed in other sources. We also touch on the various subsets of ASTIS that are searchable separately, including Inuvialuit Settlement Region Database, Nunavut Environmental Database, Circumpolar Health Bibliographic Database, and Yukon Biodiversity Database.

• Northern Research Portal (http://scaa.usask.ca/gallery/northern), from the University of Saskatchewan Library and Archives. Materials for teachers (interpretive exhibits, etc.), general readers, and advanced researchers draw from photographs, historic documents, unpublished materials, and maps. Detailed finders guides for archival collections and pointers to online bibliographies by subject and geographic area are unique features of this well-organized site.

• Encyclopedia of Earth (www.eoearth.org), a collaborative wiki project of earth scientists. Vetted, scientifically accurate articles on topics in climate change, biodiversity, geographic regions, ecosystems, environmental ethics, environmental modeling…the list goes on and on. For research papers this resource beats Google searching hands-down.

• Ocean Drilling Citation Database (http://odp.georref.org/dbtw-wpd/qbeodp.htm), also hosted by AGI, searches newly digitized reports and citations from the Deep Sea Drilling Project, Ocean Drilling Program, and Integrated Ocean Drilling Program Research, 1969 through the present.

• Integrated Ocean Drilling Program (www.oceandrilling.org), a complement to the Ocean Drilling Citation Database. The IODP recently digitized many data sets, available through this site.

Lessons learned from these workshops include:

• List free-access databases with the rest of your resources. I list these databases on the same web page that I point to pay databases available through the University of Colorado library system.

• Keep workshops short and focused.

• Format should be open and engaging.

• Provide a handout with web sites, a few tips, other general info.

• Be attentive to participants’ reactions and interests.

• If possible, structure sample searches ahead of time to match the research interests of participants. If I know who is coming, I often look at their papers or personal web sites to find the topics of their research, then weave them into my examples.

The results of the workshops for our library have been positive. Participants have returned to the Information Center to find materials and ask reference questions. Many wrote later to say that the workshop broadened their perspective or helped them find on-target materials. I have been surprised at the range of participants: our last workshop included graduate students, research scientists, a visiting scientist, and emeriti.

These workshops have proved to be low-cost, effective bridges between the Information Center and potential user groups and between library users and free, useful materials. They have given the Information Center some free publicity and have resulted in new and return users. Last but not least, they have forced me to play with new resources, expanding my own horizons and ensuring that I don’t fall into the same kind of information rut that I am always warning my patrons against.
Appendix

**IPY Publications Database**  
http://biblioline.nisc.com/scripts/login.dll?

**Cold Regions Bibliography Project**  
http://www.coldregions.org/

**Scott Polar Research Institute Library**  
http://www.spri.cam.ac.uk/resources/

**Arctic Science and Technology Information System (ASTIS)**  
http://www.aina.ucalgary.ca/scripts/minisa.dll?

ASTIS subsets:

- Circumpolar Health Bibliographic Database  
  http://www.aina.ucalgary.ca/chbd/

- Inuvialuit Settlement Region Database  
  http://www.aina.ucalgary.ca/isr/

- Nunavut Environmental Database  
  http://ned.nunavut.ca/

- Yukon Biodiversity Database  
  http://www.aina.ucalgary.ca/yb/

**Arctic Health**  
http://www.arctichealth.org/

**Northern Research Portal**  
http://scaa.usask.ca/gallery/northern/

**PolarInfo**  
http://polarinfo.library.ualberta.ca/index.cfm

**Sami Research and Project Database**  
http://arcticcentre.ulapland.fi/radju/radju.aspx

**Encyclopedia of Earth**  
http://www.eoearth.org/

**Geologic Guidebooks of North America Database**  
http://www.agiweb.org/georef/onlinedb/gnaintro.html

**State Geology Bibliographies Online**  
http://www.lib.ohio-state.edu/sites/geology/StateBibliographies.php

**Ocean Drilling Citation Database**  
http://odp.georef.org/dbtw-wpd/qbeodp.htm

**Integrated Ocean Drilling Program**  
http://www.oceandrilling.org/

**GIS Bibliography**  
http://training.esri.com/campus/library/index.cfm
Abstract – Environmental geology is a subject capable of engaging undergraduate students with differing interests. These real-life tangible problems contain elements of social and natural sciences that connect with students’ concern for social justice. At SUNY Geneseo, Chemistry 100, a one-hour class, seeks to give freshman chemistry majors a broad-based sense of the discipline and an introduction to chemical methods and research. Using constructivist pedagogy, librarians taught research skills to these introductory students by way of the environmental issues surrounding the current hot topic of pharmaceutical substances in surface water. Building upon research presented by geologists at the 2006 GSA annual meeting, librarians introduced the issues through active learning exercises conducted over two class sessions. Students created a list of characteristics to distinguish scholarly from non-scholarly sources and received guidance on choosing resources appropriate to their needs. They practiced searching several databases including Academic Search Premier and SciFinder Scholar, where they also retrieved substance-related data. Learning outcomes were based on ACRL Information Literacy Standards for Science and Engineering/Technology. Following the second session, a brief in-class assessment evaluated student perceptions of the sessions and learning outcomes. Students were generally enthusiastic about the classes, the newly-discovered information resources, and the roles that chemists might play in a complex environmental issue. Assessment revealed that the use of an environmental geology topic can be useful for engaging lower level undergraduate students and can provide a vehicle for teaching basic research skills.
Abstract – For the past 37 years, the Geoscience Information Society members have been documenting change and making predictions for the future of our libraries and information centers. The card catalog has become an OPAC, the Bibliography and Index of Geology is now GeoRef, and the reference questions that once came in person or by telephone now come via e-mail, IM, Chat, and occasionally in person.

After an analysis of the subject content of the papers presented to the Geoscience Information Society from 1969 through 1993, Derksen and O’Donnell (1995) made some predictions for the geoscience information center in the year 2000. The analysis of the papers presented after 1993 show some shift in their trends and topics, but their predictions have come to pass. This paper presents the new trends and makes new predictions for the Geoscience Library in the year 2017.

INTRODUCTION

When I started on this research, I did not realize that by 2017, the Geoscience Information Society will have celebrated its fiftieth anniversary. We have seen a lot of changes in the past years, and there are more to come. What are these changes, and where are we heading? Charlotte Derksen and Jim O’Donnell in their paper in 1995 looked back 25 years to see what we had been doing and then make some predictions for the year 2000 as to what we would be doing. They also had a “wish list” for what they wanted to see before 2000.

1994 predictions for year 2000

1. We will be answering questions.
2. We will be looking for space.
3. We will be developing collections in more formats than paper.
4. We will be training and assisting patrons to use tools.
5. We will be getting information for users.
6. We will be trying to get more equipment and current equipment.
7. Bibliographic databases will continue to proliferate.
9. More books, journals, and maps will be available electronically.
10. Books and journals will still arrive in paper.
11. Cataloging and indexing will be more automated, more complex, and more important.
12. Archiving and preserving information will be more vital as we deal with new formats.
13. Providing access to information for remote users.

Wish List for year 2000

1. Online theses and dissertations.
2. Online technical reports.
3. Easy GIS software that can be used by anyone to produce a map in the same time it takes to find a printed map in a drawer.
4. Compatibility of platforms and formats for documents on servers.
5. Core journals available electronically, at flat fee prices.
6. Photocopiers in libraries that automatically scan any document photocopied for retention into the “library of electronic documents.” Copyright is an issue here as well as privacy.

I feel that by 2000 or at least by 2007 we have achieved most of these. So what have we been doing since 1994 to get to this point? Where are
we now? Where are we going in the next 10 years?

PAST ACTIVITY

What have we been doing for the past 13 years?

A review of the papers presented at the Geoscience Information Society meetings from 1994 through 2006 gives a snapshot of what has been happening in our profession. We have continued to report on many of the traditional “library” things such as collection analysis, database development, serial prices, bibliographic instruction, and preservation. But new technology has changed how we do these things and introduced us to new things to do.

Databases have gone through four stages of change:

1. Print bibliographies;
2. Electronic bibliographies with online searches done on demand through a vendor;
3. Bibliographies issued on CD-ROMs that we had to figure out how to network in our libraries; and finally

Journals were only in print, and now some are only online or the online version is the version of record (Holoviak, 1995; Mosher and Gries, 2003).

GIS used to stand for our society, the Geoscience Information Society. Now GIS is geographic information systems and more and more we are dealing with GIS data needs of our users (Levine et al, 1996; Larsgaard, 1997).

Preservation has continued to be a concern but we have moved from problems of color maps on microform to being able to scan and produce digital copies (Wishard and Musser, 1999). Preservation issues now include how to handle data such as drill cores, well logs, computer files, fossil and rock specimens as well as paper reports, maps, photographs, and books (Blome et al, 1999; Browne and Love, 1997; Gilbert, Packard, and Dustman, 2002).

Several papers described new or renovated library space, the library as place continued to be important even as virtual libraries were being created (McLeod and Dubberke, 2001; Scott, 1999; Triplehorn, 1997).

The World Wide Web moved into our lives during this period. Papers were presented on developing web pages and services and have included our role in development of digital libraries and databases on the web (Buttenfield and Larsen, 1997; Hallmark, Masterson, and White, 1996; Musser, 1996).

Serial prices have continued to be a topic of discussion but the focus has changed from the rising prices to include online access, archiving, licensing, copyright, and package deals (Duranceau, 2001; Wesley and O'Donnell, 1999).

We have watched as our collection scope has changed from geology to geological sciences to geoscience to earth science to earth system science, ever broadening and challenging (Musser, 1997).

TODAY

The 2007 Geoscience Library

The Library as place still exists, but the collection is downsized. Remote storage is available for less used materials or print material that is now online. Many serials now are online only. Either they are published online as electronic journals or the print subscriptions have been cancelled to pay for the online access and to save binding cost and shelf space. Remote access to the electronic journals and databases is available to registered users from anywhere in the world via proxy server authentication. The Library is probably a member of a consortium and resource sharing is the norm. There is an online catalog to the collection and it includes print as well as electronic resources. A reference desk may still exist, but “Ask a librarian” service is available online and sometimes it is offered 24/7. This service may have different forms – e-mail, chat, instant messaging, etc. Bibliographic instruction sessions are presented and usually include information on evaluation of web resources and copyright issues. The Librarian is probably involved with educating faculty and students about issues in scholarly communication. Terms like open access, intellectual property rights, institutional repositories, metadata, and knowledge
management are part of our vocabulary. Document delivery is electronic. Wireless access is provided campus wide. More users in the library have their own laptops and use library space for many functions. Demand for group work space is increasing and many libraries provide computer workstations designed for group projects. Collection development activities are affected by large package deals such as GeoScienceWorld, AGU Digital Library, Lyell Collection, AAPG Datapages, as well as publisher serial and electronic book collections such as Elsevier, Springer and Wiley. Now the decisions the collection manager needs to make are:

1. Should there be two copies, one print and one electronic?
2. Should I wait for a title to come electronically through some package deal?
3. Is the electronic version the best format for this title?

More acquisition money is used to purchase the large packages so less is available for ordering individual items. Collecting and evaluating web resources is now part of collection development. More government (national and state) maps and reports are online now, and keeping up with these and providing access is a challenge for both collection managers and catalogers. Preservation and access to older materials is increasingly a concern.

THE FUTURE

Where are we heading?

There have been several articles or reports recently on the future of libraries. I will mention four of them here. First, the April issue of *C&RL News* included an article listing the top 10 assumptions for the future of academic libraries. Here are their top assumptions in their ranked order (Mullins, Allen, and Hufford, 2007).

1. There will be an increased emphasis on digitizing collections, preserving digital archives, and improving methods of data storage and retrieval.
2. The skill set for librarians will continue to evolve in response to the needs and expectations of the changing populations (student and faculty) that they serve.
3. Students and faculty will increasingly demand faster and greater access to services.
4. Debates about intellectual property will become increasingly common in higher education.
5. The demand for technology-related services will grow and require additional funding.
6. Higher education will increasingly view the institution as a business.
7. Students will increasingly view themselves as customers and consumers, expecting high quality facilities and services.
8. Distance learning will be an increasingly common option in higher education and will co-exist but not threaten the traditional bricks-and-mortar model.
9. Free, public access to information stemming from publicly funded research will continue to grow.
10. Privacy will continue to be an important issue in librarianship.

David W. Lewis (2007) in a paper deposited in the IUPUI Digital Archive lists five components to a strategic model for academic libraries in the first quarter of the twenty-first century. These are:

1. Complete the migration from print to electronic collections.
2. Retire legacy print collections.
3. Redevelop library space.
4. Reposition library and information tools, resources, and expertise.
5. Migrate the focus of collections from purchasing materials to curating content.


1. Communication systems are continually changing the way people access information.
2. All technology ends. All technologies commonly used today will be replaced by something new.
3. We haven’t yet reached the ultimate small particle for storage.
4. Search Technology will become increasingly more complicated.
5. Time compression is changing the lifestyle of library patrons.
6. Over time we will be transitioning to a verbal society.
7. The demand for global information is growing exponentially.
8. The stage is being set for a new era of Global Systems.
9. We are transitioning from a product-based economy to an experience based economy.
10. Libraries will transition from a center of information to a center of culture.

In the December 9, 2005 issue of the *Chronicle of Higher Education*, James G. Neal, University Librarian at Columbia University, in an article envisioning the development of the academic library over the next ten years, stated these “musts” for libraries beyond what we do now:

1. We must expand our role as scholarly publishers.
2. We must expand our role as educators and become agents of literacy and information understanding.
3. We must evolve as robust research-and-development organizations.
4. We must leverage our assets as entrepreneurs in the information marketplace.
5. Libraries must represent public and academic interests in effective public-policy advocacy.

In addition, in March 2007, I sent a question to the GeoNet-L asking what members thought the geoscience library would be like in 2017. Let me briefly summarize the responses before I give you my predictions.

The responses from GeoNet-L can be roughly grouped into three categories: resources, library as place, and librarians/library staff. Some of the responses were wishes and some were predictions but I have grouped them together.

**Resources**

1. Streaming videos online and in-depth indexing of videos to include concepts, images, indexed as well as subjects.
2. Access material from anywhere and at anytime. Don’t have to return materials: they will simply disappear from the computer when the loan period ends.
3. Federated searching of everything.
4. Better catalog records for example: more analytics for series and tables of contents and maybe indexes for books, particularly for print materials in storage.
5. Date-stamped archives of electronic maps, either a print copy or archive digital copies, so there is a map of record for a place at a specific time.
6. Print maps and books will still be with us.

**Library as place**

1. More computers, better resolution display, more handheld computers.
2. Wireless, Internet2.0 or beyond.
3. Library as place will be more important than it is today.
4. Physical collection will be smaller with more digital access to materials.
5. The Library gateway is very important.
6. Large plotter printer/copiers for maps online.
7. Library will be a laboratory for access to geospatial information sources.
8. Library will be a place to get help, take refuge, and connect with people.

**Librarians/Library staff**

1. Will have to deal with licensing and copyright issues.
2. Provide technical training and assistance to customers
3. Help faculty (and students) deal with the integration of all the electronic “stuff” into courses.
4. Management of electronic resources – not sure what the online catalog will look like in 10 years or if there will be one.
5. Maintain “library as place” on the internet; provide filters to all the “stuff” on the internet.
6. Publication of primary data will be more and more important. Librarians should define their role in the process (data curators, managing systems, databases…).
7. Still will be teaching students how to use library resources to do research.
8. Librarians will be the guides through the information swamp.
9. Libraries will have digital preservation experts on their staff.

Two other trends we need to consider are:

1. The formation of the new Geological Society of America Geoinformatics Division approved at the 2006 GSA Annual meeting. “The new Geoinformatics Division of GSA with a mission of promoting Data to
Knowledge provides the GSA membership an opportunity to participate in the emerging field of cyberinfrastructure.” (Geological Society of America, Geoinformatics Division 2007)

2. The iSchool movement, “The iSchools are interested in the relationship between information, technology, and people.” (iSchools 2007)

So what will the Geoscience Library look like in 2017? What will librarians be doing? After reviewing all this information I have compiled my list of predictions and someone else in 2017 can present a paper about the outcome of these.

My predictions for 2017

1. One of the fundamental skills in library science is organization. This skill is going to continue to be needed; but what we organize, how we organize, what tools we use, and the end product will be different from our databases, web sites, and online catalogs of today. The online library catalog and federated searching as we know them today will evolve into something that is much more efficient.

2. Librarians will be involved with the management (organization and archiving) of data for researchers.

3. Geoscience librarians will be part of the Geoinformatics team.

4. Google Book Project will be just one of many projects; and as more and more information is digital, there will be a need for improved metadata to insure successful retrieval of the information and the new search engines.

5. Print materials will continue to be produced and the debate about archiving print copies of digital materials will be resolved. Digital archives will be accepted.

6. The “Library as place” will still be important, but library space will be used differently. Space will still be an issue but there will be more cooperation and coordination among book and serial depositories so that much duplication will be eliminated.

7. Copyright and intellectual property issues will continue as hot topics for a while but the issues will eventually be resolved. Open access and changes in scholarly communication will also continue to be debated; but as the copyright and intellectual property issues are resolved, this will move ahead or be replaced by some new model of knowledge exchange.

8. Human librarians will still be necessary. Our role of bringing the user together with the information they seek will expand and change as the technology of information changes.

9. The service expectations of our users will continue to increase. As we rise to meet their needs, they will expect more, faster, better service.

10. Change will continue.

REFERENCES


GOING VIRTUAL: OPPORTUNITIES AND CHALLENGES FOR GEOLOGY LIBRARIES AND USERS

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Abstract – At the University of Illinois, Urbana-Champaign, a new School of Earth, Society and Environment has been formed. The school incorporates the departments of Atmospheric Sciences, Geography, and Geology. The new school has expressed a need for the space that the Geology Library currently occupies. Initially, there was no other space available for most of the print material other than the off-site storage facility. The availability of off-site storage space for print material, electronic journals and books, and a digital repository provide opportunities for a new “virtual” geology library model, however, numerous challenges also exist. This paper examines many of the opportunities and challenges, and well as some of the planning necessary to move toward a new model.

INTRODUCTION

There are plans under consideration to move the Geology Library at the University of Illinois, Urbana-Champaign (UIUC) to a new location. One scenario under consideration would result in moving 90% of the print materials and most of the maps to off-site storage, and depending mostly on electronic format for journals and books.

The Catalyst for Change

The catalyst for this change is the creation of the New School of Earth, Society and Environment (SESE), which incorporates the departments of Atmospheric Sciences, Geography, and Geology. The departments of Atmospheric Sciences and Geography will be moving into the Natural History Building (NHB) which currently houses the Geology Department and the Geology Library, as well as some of the School of Integrative Biology. In addition, a large portion of the computing arm of the College of Liberal Arts and Science (LAS) will also be moving to NHB. The new School has expressed a need for the space that the Geology Library currently occupies. There is also strong prompting from both the campus administration and Library administration to take advantage of off-site storage and electronic resources, and move toward consolidation of facilities and staff Library-wide.

The History and Present Configuration of the UIUC Geology Library

The Geology Library at UIUC is one of 34 separate libraries, many of which are closely related to academic departments. A number of the 34 libraries reside within the Main Library building, but many others are housed in the same building as the associated academic department. The Geology Library is housed in the Natural History Building with the Geology Department. The Natural History Building was built in 1892. The Geology Library resides in one corner of the building on the entry floor. The Geology Library stacks consist of two rooms, two floors each. The stacks are quite old, and are not ADA (Americans with Disabilities Act) compliant. Adequate temperature and humidity controls are lacking. There is a separate map room in the basement, accessed from the stacks. There is a sizeable Reading Room/Reference Area, a small closed stacks area, a circulation/reserves desk, and work and office areas.

The print collection is superb. There are more than 107,000 bound volumes, and around 79,000 cartographic items in the Geology Library. There are many more volumes related to geology in other units (Rare Book and Manuscript Library, Main Stacks, Oak Street off-site storage, and the Engineering, Chemistry, Physics,
The Trend toward Digital Format and Off-Site Storage of Print Format

There is a trend in the library realm, in response to user demand, toward favoring digital format, and many libraries are building off-site storage units in response to shortage of existing shelf space for print collections. UIUC has enthusiastically added digital format whenever possible. Historically, the UIUC Library has not engaged in weeding the collection; even multiple copies have been retained. As the combined collection approached 10 million volumes and most of the libraries were at or exceeding recommended capacity, the university constructed a 1.9-million-volume storage facility at the edge of campus. The storage facility is nearly full, and the two-million-volume Phase Two addition is expected to be completed by summer 2008.

The trend toward digital format and the creation of off-site storage for print format makes going “mostly virtual” possible; however that possibility creates pressure to make the switch a reality when space shortage becomes critical. There is precedent for this change at UIUC because the Chemistry Library recently moved into a new space, and considerably downsized the on-site print collection by depending on electronic journals and moving redundant print volumes to the storage facility. Subsequently, the Institute of Labor and Industrial Relations Library was consolidated with the Business and Economics Library, and there are plans to consolidate the City Planning and Landscape Architecture Library with the Funk ACES agriculture library.

CHALLENGES AND OPPORTUNITIES RELATED TO “GOING VIRTUAL” AT UIUC

Challenges

Educating Non-Librarians Regarding Requirements of Libraries

During the past two years, there have been numerous meetings between library and SESE personnel regarding the future of the Geology Library. One of the most difficult aspects of the process has been educating non-librarians about

Space

The current geology library is not ADA (Americans with Disabilities Act) compliant. The collection is essentially “vacuum packed” and would require much more space, if moved. Several configurations were proposed for a new library space over the past year. Since the two stacks rooms are divided into two floors each, there are essentially four rooms of stacks; this fact has been difficult for SESE personnel to grasp when visualizing the space needed for the collection.

Finding a new location for the library was holding up decisions for configuration of the rest of the building. Given five choices, from staying with the current configuration, to becoming completely virtual and closing the library, the interim head of the School decided the most favorable plan, from his perspective, was to move as much print material as possible to the vacant vaulted museum area on third floor, and to rely mostly on electronic format and off-site storage.

The vacant vaulted museum area consists of one large room with a central vaulted ceiling, and three alcoves along each side. The area is raised above the outside hallway, and is currently accessed by stairs and a small lift, neither of which are ADA compliant. It will be necessary to add a ramp in the outside hallway for any new use of the area. The floor load in the vaulted space would allow for only 10% of the current geology print collection. The other 90% would need to be moved to off-site storage. Nearly all of the maps would need to be moved to off-site storage.

The library is currently in a highly visible area near two entrances and large classrooms; this would not be the case for the proposed new
space. During early discussions, the new library space would be located in the same area as the geology class rooms and offices, and near a computer lab that could incorporate GIS software. Subsequent plans have located the geology department and computer labs away from the proposed new library space, further isolating it.

Maps

There is currently no other space on campus for the 79,000 maps in the Geology Library map room which is in the basement of NHB. The Map and Geography Library, within the Main Library, is already overcrowded and cannot accommodate the geology map collection. The possibility of scanning many of the maps was considered, but the costs were too high, and there are other negative factors such as copyright. Phase One of the off-site storage facility cannot accommodate maps, but there are plans to include maps in Phase Two.

Browsing

For 90% of the print collection, browsing would not be possible since materials at the off-site storage facility are in a warehouse-type environment. This is especially a problem when attempting to identify an appropriate map, but also would hinder serendipitous finding of monographs. It is possible that virtual browsing tools, such as online tables of contents and the Google Books full text project would reduce the handicaps produced by lack of physical browsing ability. There would be a 12 to 48 hour turn-around time from off-site storage which would inhibit the ability to determine whether material was appropriate. It would no longer be possible to take students into the stacks to browse. Answering reference questions would be more difficult because the material would not be at hand. The extent that the lack of browsing capability and delayed retrieval would affect service would partly depend on the addition of digital resources and catalog enhancements.

Quality of Online Journals and Resources

There are currently problems with the quality of some electronic journal back files (Joseph, 2007). Also, some electronic journals do not contain everything that is in the print equivalent, thereby preventing cancelling the print format and making recall from off-site storage a necessity.

Timing and Staffing

Timing of the move and the transition to mostly electronic format is complex. There are issues of funding, renovation, and staffing during the transition, as well as completion of Phase Two of the off-site storage facility on time. Currently, funds have not been approved for renovation of NHB or hiring of extra library workers for processing, however it would take at least two years to process library materials for the move.

Archiving and Preservation of Electronic Format

The UIUC Library has been hesitant to convert to electronic-only format unless there is an assurance from publishers that there will be perpetual access to the material, and that publishers are taking some measures for archiving of the electronic format such as participation in Portico or CLOCKSS. Not all publishers, for example AGU, are currently participating in such endeavors. This makes decisions about going mostly virtual more difficult.

Costs

The costs for switching to a mostly virtual model would depend upon the unique circumstances of the individual library and university, as well as how adequately an institution would be willing and able to support the move. For example, costs would be less for a library that already had complete cataloging records and most of the available online resources. For the UIUC Geology Library, the costs for full support of the transition to a mostly virtual library would be large. Following is a summary of some of the anticipated costs necessary to make a successful transition at UIUC:

- Facilities and Operations: ~ $125,000 to box and move materials, and to purchase furnishings and IT hardware.
- Collection Management, Bound Volumes: ~ $164,000 for record enhancements, re-marking, cleaning, shelving, and/or other treatment of bound volumes.
- Collection Management, Maps: ~ $114,000 for stabilization, to purchase map cases and folders and
scanner/printer/pc at the off-site storage facility.

- Collection Building: ~ $315,000 one-time plus ~ $57,000 continuing (plus inflation on continuing) including one-time purchases over 5 years for electronic resources plus ongoing subscriptions. In addition, there will be inflation on the continuing subscriptions.
- Digital Service Development & Digital Content Creation: ~ $37,000 for portal projects, digitization, and metadata creation.
- Total estimated needed from outside sources: ~ $755,000 one-time plus $59,000 continuing (plus inflation on continuing).

Opportunities

More Commercial Online Resources

A successful change to mostly virtual resources would require funds to continually add electronic resources as they become available. Although the UIUC Library has been successful in adding many electronic resources, currently UIUC has not been able to afford some important, geological e-resources such as Geoscience World, the Lyell Collection, and others. The ability to add more electronic resources would be one positive aspect of the library move. Adding these resources without moving out of the current space would certainly be desirable, but unlikely due to lack of available funds.

Enhanced Cataloging and Finding Aides

If most of the print collection is moved to off-site storage, another positive aspect of the proposed move would be acceleration of enhanced cataloging and finding aids. Many of the geology series would need to be analyzed, i.e., titles of the individual volumes within each series need to be added to the online catalog. A survey of the geology collection indicates the following: 985 titles need to be fully analyzed, 163 titles have been only partly analyzed and need to be completed, 121 titles are already completely analyzed, more than 80 titles are multi-volume monographs needing contents notes, and 73 titles already have complete content notes. As a very rough estimate, the number of individual titles that need to be added to the online catalog is at least 43,827 plus all of the USGS Water Resources Investigation Reports and Professional Papers. Work already in progress to analyze series would be accelerated if funding was provided for the move to a more virtual library, resulting in improved access to the entire collection. The survey of the collection also identified 475 titles that could be scanned.

Many of the geology maps are either not in the online catalog, or have inadequate catalog records. Although this work is also in progress, accelerating the project would result in improved access to the map collection. Tables of contents could be scanned and added to the online catalog. Full text projects, such as Google Books, the Illinois Harvest Project, and others will most likely result in many serendipitous findings of monographs as researchers discover hidden gems in the older literature as it becomes digitized. A newer generation of online catalog will also likely improve access to the collection, possibly reducing the impact of moving print material to off-site storage.

Better Conditions For The Collection

Currently, climate control and shelf space in the Geology Library is inadequate. Window air conditioning units run year-round due to inadequately insulated steam heating pipes that run through the library. Even with the window units, temperature and humidity are outside acceptable limits year-round. Until recently, the collection exceeded 100% of shelf capacity. There have been numerous water incidents over the years, many from a biology lab located above the Geology Library, others due to fire suppression in other parts of the building, and a steam leak. Moving the print collection to a new or renovated space or to off-site storage would result in much better conditions for the collection.

Better “People Space”

With proper planning, another positive outcome could be better space for patrons and staff. Currently, the Geology Library has only three public computers, and it is not practical to add more under the current configuration without major rewiring and addition of network outlets or adding wireless access. However, wireless access in NHB is anticipated in the near future, as well as eventual rewiring. Currently, there is no adequate space for groups to work without
disrupting individuals seeking a quiet area to study. A few enclosed rooms are included in the proposed plan for the new area. More ergonomic staff work areas are also a part of the plan.

ANOTHER OPTION

The discussions about changes for the Geology Library have been ongoing since before February, 2005. As of summer, 2007, planning seemed to be solidifying around the idea of moving 10% of the print collection to the vaulted area, and the rest to the off-site storage facility. In November, 2007, at the urging of the Provost, the Library began considering new library service models, including consolidation of unit libraries to reduce costs.\(^1\) All library staff members were invited to submit ideas about any facet of library service and configuration.

Several ideas were submitted that would impact the Geology Library. One submittal proposed a merger of the Geology and Biology libraries. Since the Biology Library is larger, one fourth of the Biology Library stacks could accommodate one half of the Geology print collection, and the remainder of both collections would be removed to the off-site storage facility. This proposal would leave both collections near the academic departments that they serve, and keep a substantial amount of the print collections browseable. There is precedent for the combined collection; both collections were part of the Natural History Library before the collection was split and the Biology and Natural History Survey libraries were formed in different spaces, with the Geology Library remaining in the old space.

A second proposal called for moving the Map and Geography Library from fourth floor of the Main Library to the basement. This would allow for expansion of the Map and Geography Library, which is currently very space constrained, with room to include the geologic maps from the Geology Library. Ideally, the geology maps should be with the geology print collection, but moving them to the Main Library would certainly be preferable to storing them in the off-site storage facility where they could not be browsed.

After considering all of the ideas, 25 modified proposals were retained and presented to the campus for discussion in a number of town hall meetings.\(^2\) Currently, the idea of consolidating the Geology and Biology libraries is not at the top of the list for immediate implementation, however, other factors could move it up the list. Thus far, the idea of consolidating the Geology Library into the Biology Library seems favorable to other available alternatives.

SUMMARY

It would be great to have everything in the geology collection that is available in both print and electronic format, with the advantages and convenience of both. In the current reality of reduced budgets and competition for space, this is simply not possible at most universities. The trend, fueled by patron demand, is definitely toward the digital format. The availability of a library storage facility and large amounts of electronic resources helps free shelf space and increases access to material, but also may create pressure to close or merge unit libraries prematurely. This is especially problematic for disciplines such as geology that still experience regular use of print monographs and maps. Eventually, increased availability of electronic journal backfiles, full text projects such as Google Books, and new generation online catalogs will likely make a mostly virtual library more practical, however moving to a virtual model prematurely could be very disruptive.

Of the two plans currently under consideration for UIUC, the virtual library or consolidation with the Biology Library, consolidation seems the best option at this point in time. Success for the virtual library option would largely depend upon enhanced cataloging, increasing digital resources, and adequate turn-around time for delivery from off-site storage, all of which depend upon adequate funding. No matter what option is adopted, it is nearly certain that there will be major changes related to the geology collection at the University of Illinois in the near future, as well as for many other geology libraries at other institutions.

\(^{1}\)\text{<http://www.library.uiuc.edu/committee/budget plus/service_models.html>}

\(^{2}\)\text{<http://www.library.uiuc.edu/committee/budget plus/Numbered_NSM_Interim_Report_Novemb er07_Final.pdf>}.
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Part 2. GSA Poster Session

Geoscience Information/Communication

Abstracts and Posters

October 31, 2007
GEOLeGIC RESOURCE EVALUATION PROGRAM - PRODUCTS AND USES

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Abstract – The goals of the Geologic Resource Evaluation Program (GRE) within the National Park Service are to raise awareness about geology and the role geologic features and processes play in the environment. The GRE team provides 270 national area parks with a geologic coping meeting, digital geologic map data, and park-specific geologic report. These products are designed to enhance stewardship of park resources by providing valuable information about geologic formations, hazards, and links between geology and other natural resources. Park staff are currently using digital geologic data to identify and protect threatened plant and animal habitat, locate cave entrances, identify areas with potential paleontologic resources, plan for infrastructure, protect visitors from hazards, and educate the public. GRE reports identify key geologic resource management issues, geologic features and processes important to park ecosystems, and include a brief geologic history of the park area. As of May 2007, the GRE team has held 6 coping meetings for 183 parks, completed 96 map products, and 30 geologic reports.
Abstract – Recent detailed field mapping near the visitor center at Craters of the Moon National Monument and Preserve (CRMO) revealed proof for a missing cinder cone, named the South Highway cinder cone (SHC), partially swallowed during magma chamber collapse and rafted away by younger flows. To support hypothesis by previous workers at CRMO, we present evidence for five potential remnants of SHC. In addition to mapping the missing cinder cone, we present here a sequence of events explaining the creation and destruction of SHC.

A volume analysis of SHC was conducted to compare with previous volume calculations of rafted material near the mapping area that show the volume of rafted material is too great to be contained within existing cone edifices. The volume of SHC remnants would reduce the volume of excess rafted material by 10% and yet the total volume of SHC remains too large to be accounted for simply through rafted blocks. Thus, a collapsing magma chamber appears to be a reasonable mechanism for the removal of a moderately sized cinder cone.

Finally, we generated a 1:12,000 digital geologic map of our reinterpretations and a Points of Interest section. We identified previously unmapped eruptive and non-eruptive fissures that provide relative ages for cinder cones and vent complexes in the mapping area. The map and accompanying section promotes mapping and understanding of volcanic terrains by offering the reader a series of features with explanations for their formation. The publication is available to the public via the CRMO website (www.nps.gov/crmo) and encouraged for use by geology field camps.
INTRODUCTION

Geologic Setting

Craters of the Moon National Monument and Preserve (CRMO) surrounds the Great Rift on the eastern Snake River Plain (ESRP), Idaho (Figure 1). The ESRP formed as a result of the North American plate passing over the Yellowstone hotspot beginning 17-16 million years ago (Pierce and Morgan, 1992). Rhyolitic volcanism dominated the ESRP, including the CRMO area, and produced large calderas as the surficial expression of the hotspot track (Leeman, 1982; Pierce and Morgan, 1992). Recent seismic imaging places the current location of the hotspot beneath Yellowstone National Park (Waite, et al., 2006). Following rhyolitic volcanism at CRMO, Basin-and-Range extension dominated and allowed basaltic magma to rise to the surface. This rift-volcanism began at CRMO’s northern most lava field, the Craters of the Moon field, 15,000 years ago and became dormant 2,000 years ago. Twenty-five cinder cones and over 60 lava flows were produced during this period (Kuntz, et al., 1986a).

Figure 1. Shaded relief map showing study area (star) within Craters of the Moon National Monument and Preserve in relation to the Great Rift (dotted line), the eastern Snake River Plain (dashed line) and Yellowstone National Park. Map generated from Seamless Data Distribution System, Earth Resources Observation and Science (EROS), part of the U.S. Geological Survey at a scale of approximately 1:2,750,000. http://seamless.usgs.gov.

Previous Work

North Crater cinder cone (NC) is a monogenetic volcano whose northwestern flank has been breached by at least one high silica (54-64 wt. %) flow (Kuntz, et al., 1986a). Breaching of the NC flank demonstrates the ability of high silica flows to destroy cinder cones and carry off rafted blocks. These blocks are transported by the lava flows and can leave dissimilar piles of welded cinders standing high in the flows. Recognition of a potentially missing cinder cone first came from Brossy, Jordan, and Champion (2007a) during a volume analysis of the rafted blocks associated with NC in the Devils Orchard and Serrate Flows. In their research, the authors found that the volume of rafted material was 46 x 10^6 m^3; too great a volume to be contained.
within the modern breached wall of NC. The authors offer three explanations for the excess volume of cinder material. They explain that a very large paleo-NC could have existed, that the existing NC was built and destroyed several times, or one or more other small cones were constructed and rafted away. To further support their hypothesis, recognition of a dissimilar area along the northern flank of NC prompted the authors to take rock cores for paleomagnetic data analyses. The authors concluded from this data that other cinder cones could have existed to the north of NC and were most likely coeval with NC.

A study by Caress and Owen (2005) focused on dynamics of the Highway Flow, a trachyandesite block a’a flow with local pahoehoe. During field investigations, the authors extended the Highway Flow further to the east, noticing how the flow seemed to be channeled behind a now-missing cinder cone, which they termed the South Highway cinder cone (SHC). In the eastward extension, Caress and Owen found entrained rafted material and noted how the flow onlaps onto a potential SHC remnant at Campground Hill. The authors suggest that the entrained rafted material and in situ cone remnant may account for a portion of the excess volume of rafted material calculated by Brossy, et al. (2007a). Finally, Caress and Owen (2005) recognized an area at the southern boundary of the Highway Flow where the block a’a abruptly transitions to pahoehoe and drapes over the South Highway fault scarp. This led the authors to conclude that the flow and fault were contemporaneous and that the fault may represent the collapse of a magma chamber.

Our work presents additional evidence for the existence of SHC. Through detailed field mapping and the use of aerial photographs, we mapped five areas that are interpreted as remnants of SHC. We present a refined 1:12,000 geologic map for the area near the visitor center (Figure 2) which identifies these cone remnants, locates previously unmapped fissures and faults, and provides the reader with a series of geologic points of interest available for public viewing. The Points of Interest section (Appendix) offers readers the chance to learn about the formation and significance of a variety of unique features found in a volcanic terrain. Finally, we present a proposed sequence of events based on field evidence to assign relative ages to flows, cinder cones, features, and processes. This timeline is valuable to understanding the evolution of cinder cones and the volcanic processes that have created the Craters of the Moon landscape.
Figure 2. Geologic map of the visitor center area at a scale of 1:12,000 and accompanying legend. Map contains new interpretations and locations of geologic points of interest.
METHODS

Field mapping of SHC was undertaken by Geologist in the Park T.A. Rivera, Volunteer in the Park S.M. Keane, and Park Geologist D.E. Owen during the summer of 2007. Locations of cinder cone remnants and other features were determined using a handheld GPS unit set to UTM NAD83 Zone 12N datum. Aerial photographs were used to help with planning of field mapping and to better resolve areas that needed reinterpretation. Points of interest were collected using the same datum. The data were digitized and plotted on a 1:12,000 geologic map using ArcGIS 9 ArcMap version 9.2. Point, line, and polygon layers were added to the previous map to represent our findings. Original data files were not modified in order to preserve the integrity of pre-existing data.

RESULTS

Evidence for a Missing Cinder Cone

The largest independent area of reinterpretation is Campground Hill (Figure 3). Previously mapped as rafted blocks (Kuntz, et al., 1989), closer inspection shows that loose cinders comprise the majority of this hill and the area to its south. Extensive jostling occurs during rafting; it seems unlikely that such a large volume of loose cinders could survive transport. Additionally, no current edifice is in close proximity to this area, eliminating the possibility that these cinders were deposited from an eruption of another vent, such as Big Craters. The large amount of cinder material comprising these two areas leads us to propose that these are in situ pieces of SHC (Figures 3).

Figure 3. South Highway cinder cone remnants. A) Campground Hill; B) the area to its south (foreground). Both photographs show that loose cinders compose the majority of the two areas. The block lava in the upper photograph is the Highway Flow, which onlaps South Highway cinder cone.
The monoliths surrounded by the North Crater Pahoehoe Flow are interpreted as volcanic necks. These conduits may be one of several that contributed to the construction of SHC, which follows the interpretation of Maley (1994). This was the only area lacking loose cinders to be interpreted as part of SHC (Figure 4).

**Figure 4.** Volcanic necks, or possible conduits, that may have contributed to the construction of South Highway cinder cone.

Immediately south and southwest of the Highway Flow is another area with a large volume of loose cinders. Previously mapped as cinder mounds associated with NC, the welded cinders in this area do not resemble the material comprising NC, but more closely resembles the material in Campground Hill. The physical distance between NC and this area would require NC to be twice its current width.

The interpreted footprint of SHC is a minimum of 1300m long by 550m wide. Cinder cones within the immediate vicinity of SHC have comparable dimensions (Table 1). Big Cinder (Table 1) is the largest cinder cone within the lava field. If NC were twice its current width, it would fit within these dimensions. While a paleo-NC twice its modern width is possible, based on average sizes of cinder cones, it seems much more likely that SHC existed.
Table 1. Approximate dimensions for cinder cones in the vicinity of South Highway cinder cone (SHC). The length of SHC was measured east-west from the remnant south of the Highway Flow to the area south of Campground Hill. The width was measured from the remnant on the north flank of North Crater cinder cone to the South Highway fault scarp. The height was calculated as an average of heights for the four cinder cones in closest proximity to SHC.

<table>
<thead>
<tr>
<th>Cinder Cone</th>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Crater</td>
<td>1250</td>
<td>775</td>
<td>110</td>
</tr>
<tr>
<td>Inferno Cone</td>
<td>1600</td>
<td>800</td>
<td>100</td>
</tr>
<tr>
<td>Grassy Cone</td>
<td>1370</td>
<td>840</td>
<td>110</td>
</tr>
<tr>
<td>Paisley Cone</td>
<td>1100</td>
<td>780</td>
<td>80</td>
</tr>
<tr>
<td>Big Cinder</td>
<td>2600</td>
<td>1700</td>
<td>230</td>
</tr>
<tr>
<td>South Highway</td>
<td>1300</td>
<td>550</td>
<td>100</td>
</tr>
</tbody>
</table>

Platy jointing was found at several locations within the Highway Flow (Figure 5). This type of jointing is common in high silica flows and occurs when the flow cannot move naturally due to internal friction at the edges of the massive interior (White, pers. com). This feature suggests impingement and channeling of the Highway Flow against SHC, agreeing with Caress and Owen (2005).

Figure 5. Platy jointing in the Highway block a’a flow. This type of jointing occurs in high silica flows as a result of internal shear within the flow. It is probable that the Highway Flow tried to flow uphill when it encountered South Highway cinder cone, creating the platy jointing, then channeling to the east and west behind the cone.

Refined Mapping of Volcanic Features

Detailed field mapping shows several previously unmapped features and provides data for an alternate interpretation of the geology. A description of our findings follows. Refer to the geologic map (Figure 2) and Points of Interest.
Two Eruptive Fissures and a Series of Non-eruptive Fissures

Two eruptive fissures were mapped cutting the western flank of NC. The east fissure (minimum 130m long by maximum 11m wide) is partially filled by the North Crater Pahoehoe Flow, while the west (minimum 100m long by maximum 10m wide) fissure is completely filled by the Big Craters Slab-lava Flow. The east fissure is along strike with the Big Craters fissure system. This simple cross-cutting relationship may suggest that NC is older than Big Craters (Figures 6A and 6C). Identification of the west fissure was recognized from the presence of spatter capped cinder mounds (Figures 6A and 6D).

Several non-eruptive fissures are located along the west side of Big Craters (Figures 6A and 6B). The longest continuous fissure measures as a minimum of 50m long by a maximum 2m wide. These fissures are not part of the eruptive system; however, they are parallel to the main Big Craters fissure system. Although the physical size of the fissures is an order of magnitude smaller, the geometry is consistent with the pattern predicted by Kuntz, et al. (2002) who suggest that non-eruptive fissures, or tension cracks, form parallel to vent systems at regularly spaced intervals as sub-surface dike emplacement occurs.

Gravity Faults at Big Craters

Two gravity faults were recognized along the northwestern flank of Big Craters nearly perpendicular to the fissure system (Figures 6A and 6E). The larger of the two is more apparent as wildlife has used it as a game trail. The smaller mapped fault is topographically higher than the first; however, it is less prominent. The eruptive center for the Big Craters Pahoehoe Flow is just north of the faults. We propose that these faults represent slumping of the crater wall back towards the eruptive center and that the faults are associated with the eruption of the pahoehoe flow rather than with the creation of the Big Craters cinder cone.
Figure 6. A) Geologic map emphasizing locations of newly mapped faults and fissures (boxed areas). Solid thick dark lines represent both eruptive and non-eruptive fissures. Solid line marks the location of the gravity faults. Dashed line shows connection between eruptive fissure at North Crater cinder cone and the Big Craters eruptive fissure system. Refer to the legend (Figure 2) for explanations of other symbols and map units. B) Longest continuous non-eruptive fissure on the western flank of Big Craters. C) View looking northwest into the east fissure cutting the western flank of North Crater cinder cone. D) Spatter-capped cinder cones represent nearby fissure. E) Photograph showing the two newly mapped gravity faults along the northern flank of Big Craters. Photograph taken looking south from the eruptive fissure (foreground) that produced the Big Craters Slab-lava Flow.
Extending the Highway Flow

We mapped the Highway Flow extending 300m west beyond what is currently mapped, between SHC and cinder mounds of unknown source and age, beyond what is currently mapped. Caress and Owen (2005) previously recognized the extension of the flow to the east. Platy jointing is found only in the western lobe signifying impingement of the Highway Flow against SHC.

Geologic Points of Interest

This section (Appendix) is designed for use by visitors with a passion for geology and students of geology, such as geology field camps. Each listed feature has UTM coordinates, a photograph, and a brief description of its formation. This section is designed to familiarize the reader with volcanic landscapes and to understand the processes involved in creating this unusual terrain. Recognizing and mapping the geologic features presented here demonstrates the importance and need for large-scale mapping at CRMO.

Assessing the Volume Problem

Previously stated, Brossy, et al. (2007a) calculated an excess of rafted material in the Devils Orchard and Serrate flows having a volume of $46 \times 10^6 \text{ m}^3$. Using the equation derived by Brossy, et al. (2007a), we calculate the volume of in situ SHC remnants previously mapped as rafted blocks to be $4.4 \times 10^6 \text{ m}^3$, approximately 10% of the excess material. However, from measurements given in Table 1, the calculated volume of SHC is $71.5 \times 10^6 \text{ m}^3$. If the excess rafted material was derived only from SHC, there would still be at least $25 \times 10^6 \text{ m}^3$ of SHC that is missing. We suggest a collapsing magma chamber swallowed this volume of SHC, represented by the South Highway fault scarp. Shallow magma chambers can range in size and volume from small, several inch thick dikes to the massive Bushveld intrusion in South Africa, roughly $10^7 \text{ km}^3$ (Marsh, 2000). South Highway Cone’s much smaller volume can easily be accounted for through subsidence of an empty shallow magma chamber.

DISCUSSION

Compilation of evidence for the SHC, previously unmapped features, and geologic points of interest led us to determine a sequence of events slightly different from current thought but in partial agreement with one model proposed by Kuntz, et al. (1982). We believe that the events described below happened relatively close in time although the exact amount of time is not well constrained. The following events are listed chronologically, starting with the oldest event.

1. Construct North Crater and South Highway cinder cones. We could not determine which was built first as the contact between the two is not distinct.
2. Construct Big Craters cinder cone. The newly mapped eastern eruptive fissure on the western flank of NC suggests Big Craters is younger than NC. This is also supported by the Big Craters Pahoehoe Flow onlapping onto NC. Big Craters has a radiocarbon age of $2400 \pm 300$ years before present (Kuntz, et al., 1986a; Kuntz, et al., 1986b). While there is no absolute age for NC, we believe that these two cinder cones are relatively close in age (100 years or less).
3. Eruption of high silica Devils Orchard and Serrate Flows (not shown on map). These flows were capable of rafting away pieces of cinder cones and most likely originated in the NC neighborhood although vent locations have not been found.
4. Eruption of the Highway Flow. The flow was channeled behind SHC and impinged against the northern to create platy jointing in the high silica flow.
5. SHC and NC began to be torn apart by the three high silica flows mentioned above creating the rafted blocks strewn throughout the Devils Orchard and Serrate Flows. Either the Devils Orchard or Serrate Flow (or both) breached the northwest flank of NC.
6. Eruption of these high silica flows close in time emptied the underlying magma chamber.
7. The empty chamber collapsed back into itself, creating the South Highway fault scarp, draperies in the Highway Flow, and swallowing part of SHC.
8. Eruption of a lower silica North Crater Pahoehoe Flow from the previously breached wall of NC as an isostatic response to the collapse and addition of SHC material into the empty chamber, displacing residual magma.
Flows, flowed around rafted blocks of NC and SHC, and buried remaining evidence for SHC.

**Recommended Future Work**

In order to better examine the amount of time required to construct and destroy a moderately sized cinder cone, detailed absolute dating analyses on the flows and cinder cones are needed. Vent locations for the Serrate and Devils Orchard Flows need to be investigated. These flows are assumed to have surfaced from vents near NC but finding the actual vents may provide further evidence for SHC. Finally, geochemical analyses need to be preformed in order to determine compositional variability within individual cones and between several cones. If there is a significant difference between cones, trace element data would allow for identification of rafted block source and possibly refine volume estimations for the cinder cones.

**ACKNOWLEDGEMENTS**

Funding for this project came from The Geological Society of America’s GeoCorps America program. We are especially thankful to Cooper Brossy for his knowledge of the North Crater neighborhood and for improving this manuscript. The authors would like to thank Craters of the Moon National Monument and Preserve staff and Erika Colaiacomo, Celia Dubin, and Dylan Mikesell with their assistance in the field. This work relied heavily on the work by previous Geologists in the Parks participants Ben Brulet, Steve Chemtob, and Kate Wetherell and field assistants Rachel Clennon, Kim Truitt, and Nichole Hansen. Finally, T.A. Rivera would like to thank Dr. Craig White at Boise State University for useful conversations regarding volcanic features and processes.

**REFERENCES**


APPENDIX

Points of Interest section with photographs, UTM coordinates, and description of the feature’s formation. This section is preceded by general rules, regulations, and safety concerns for exploring CRMO geology. Accompanying this section are several pages of reinterpretation, along with the geologic map and legend (Figure 2), that complete the entire publication available on the CRMO website.
Geologic Points of Interest near the Visitor Center Area
Tiffany A. Rivera, Shaina M. Keane, and Douglass E. Owen

Before exploring Craters of the Moon geology, please be aware of the following rules, regulations, and safety concerns.

**UTM Coordinates**
The points of interest on the accompanying pages are given in UTM coordinates. This point data was collected using a handheld GPS unit and collected using NAD27 Zone 12 Datum.

**North End Permits**
We encourage the exploration of the North End of Craters of the Moon; however a day use permit is required and are available free of charge at the visitor center.

**Group Camping**
We offer group camping in the North End by reservation only. For groups up to 30 people we suggest camping here, rather than at multiple tent sites within the lava flow area. Availability and reservations can be obtained by calling Park Headquarters. Cost is $26 per night.

**No Collecting**
Many of the unique specimens you will see on your visit to Craters of the Moon may tempt you to collect them. All rocks must be left behind as there is no collecting permitted within Craters of the Moon without a research permit. Please leave specimens for future students and visitors to enjoy.

**Off-Trail Travel**
We prefer that our visitors stay on the trails as much as possible. However, we see exciting geology sometimes requires drifting from those trails. This is permissible in most areas throughout the park, but prohibited in these areas. Please stay on trails at the following areas:
- North Crater Flow Trail
- Big Craters Trail
- Spatter Cones Area

**Personal Safety**
Visiting Craters of the Moon in the summer poses several different safety concerns. In summer months we suggest at least one gallon of water per person per day. It is also wise to wear sturdy show shoes and protect yourself from the sun by wearing a hat and sunscreen. If you would like to explore caves nearest to our seven-mile loop road, we recommend bringing along a flashlight. Exploration of other caves may require multiple sources of light, a helmet, and caversmant.

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1. **Grassy Cone Crater Complex N 4814465 E 299839**
The crater complex at Grassy Cone is unique until one approaches the crater rim. This view looking at the south crater wall shows the area for the most recent flow; roughly 7260 years ago. Grassy Cone’s crater complex consists of five nested craters, each contributing to the building of the 100 meter high cone.

2. **Grassy Cone Flow Lava Channel and Cones N 4815326 E 2915734**
A well-defined lava channel, identified by its toes, and the Grassing Cone Flow arc ash layer can be seen from the crater area of Grassing Cone (upper photograph). A set of cones (lower photograph). The channel is oriented approximately east-west for 400m. It is about 100m wide, arc 3m deep. In the foreground, multiple pulses of lava can be identified. (lower photograph). The channel terminates just south of two cones that are surrounded by the Grassing Cone Flow.

3. **Sunset Cone Crater Complex N 4815689 E 292324**
The main crater of Sunset Cone can be seen from US 20 (left photograph); however, more spectacular views are from the crater rim (right photograph). Similar to Grassing Cone, Sunset Cone (ca. 12,000 years old) is composed of eight nested craters. The cone is roughly 140m tall and 1600m in diameter. Three craters are accessible from the group campsite or from a small access road along the south side of the cone.

4. **Overlook N 4915035 E 202316**
The overlook of the North Crater and Highway flows is just a short walk along an ad road that angles off US 20. It is best reached the way back on the parking lot, over the fault scarp. Intact boulders of the North Flow can be seen in the surrounding landscape. Position of the North Flow can be viewed from this viewpoint (see points of interest #7).

5. **Platy Jointing N 4814412 E 292154 and N 4814606 E 292127**
Platy jointing in the Highway Flow is a result of the high silica content allowing the flow to become extremely viscous during movement. This created an area of internal shear along the exterior of massive areas. The feature is most easily accessed by parking at the easternmost polished section of US 20 and walking eastward toward the visitor center. Use caution when walking along US 20. This feature is seen near mile marker 220.5.

6. **Monoliths N 4914913E 232617**
The monoliths along the North Crater Flow Trail have been interpreted in two different manners. First, they may be rift blocks, pieces of crater walls that were ripped away by a higher silica flow. Second, they are pinnacles or pillows for a now missing cone (dissolution). As off-trail travel is prohibited along the North Crater Flow Trail, please view the monoliths from the way-side area.
Squeeze-Ups N 481589 E 292361
If pressure is sufficient, lava can rise up the tensional fracture typically found in the top of an inflected flow ridge and squeeze out onto the surface. The squeeze-up seen here have then flowed down the sides of the flow ridge. An official trail is perpendicularly to the North Crater Flow Trail, the best viewing area for this feature is from the North Crater Trail, as seen below.

Andesite Xenoliths N 4813063 E 292307
Two xenoliths of possible andesite were collected on the North Crater Trail. Although the Snake River Plain exhibits a differentiated bi-modal volcanism (rhyolite and basalt only), the presence of intermediate volcanics has been noted at nearby Cevlar Butte. Andesite xenoliths may reflect pockets of magma with varying composition due to higher amounts of crystal fractionation or may reflect an area beneath the Snake River Plain basaltics which experienced a time of volcanism which created an intermediate composition. A third possibility is that these xenoliths represent underlying Challis volcanics. Since only two of these xenoliths have been found within Craters of the Moon, both have been collected for analyses, learning collection locations marked by a prominent rock pile.

Bomb Field N 4814543 C 292447
Many brecciated bombs can be found along the North Crater Trail. These bombs form as the gaseous interior continues to expand inside a cooled basin. This step prevents several of varying sizes, as well as a spectacular view across the North Crater Flow.

Pumice Xenoliths N 4814007 E 292308
Pumice xenoliths in the vicinity of North Crater may be derived from material deposited when the Yellowstone Hotspot was beneath Craters of the Moon ca. 1 Mya. These xenoliths show that basaltic magma was interacting with the pumice, as basalt is string through many of the pumice fragments. This alludes to assimilation of pre-existing rocks which would increase the silica content of the magma.

Granulate Xenoliths N 4814141 E 292369
Granulate xenoliths are present along the North Crater Trail. These xenoliths confirm that magma generation was occurring at greater depths, since geologists assume granulate is the composition of the lower crust beneath the eastern Snake River Plain.

Hyaloclastite Chips N 4814033 C 292197
An area just off the North Crater Trail contains many chips of what appear to be rhyolite. These are presumed to be xenoliths; however, a larger source for the chips could not be located. Rhyolite xenoliths could represent the deposits associated with Yellowstone eruptions prior to the formation of the Craters of the Moon lava-flow. Conversely, these chips may be derived from the Challis Volcanic Group which surfaced during the Tertiary; however, it is uncertain if Challis Volcanics can be this evolved. More thorough investigation of these chips is needed (photograph at top of right column).

Inferno Cone Vent N 4814344 E 293246
Many expect to find a vent at the top of Inferno Cone, but upon reaching the top, many are disappointed. The vent area for Inferno Cone lies to the south. As pyroclastics were emitted from the vent the majority of the conderes were deposited to the north, although a smaller conder cone was produced adjacent to the vent (right side of photograph). This may be due to strong winds blowing conderes to the north, an obstructed vent producing a fire hose effect, or a combination of both. The vent area is now filled in by the Blue Dragon Pumice. To view this feature, park at the Spatter Cones, then walk along the road back towards the loop road. Off-trail travel at the Spatter Cones is prohibited, please enjoy the feature from the roadside.

Spatter-capped Cinder Mounds N 4814622 E 291981
The presence of spatter-capped cinder cones (upper photograph) led to the identification of a previously unmapped eruptive fissure (lower photograph). The conder mounds have been incorporated as part of the North Crater complex; however the spatter mapping these mounds must indicate an eruptive fissure nearby. Presently, the fissure is filled in by the Big Crater Flow. For more information on this fissure and other newly mapped features, please see the New Interpretation section.

Non-eruptive Fissures N 4815059 E 292395
A series of non-eruptive fissures have been identified on the west side of Big Craters. These fissures are parallel to, but offset from, the main eruptive vents for Big Craters. The longest and most prominent fissure is at least 25 m long. This fissure is mapped on the new 1:12,000 geologic map accompanying this publication. The non-eruptive fissures can be accessed easily from the Big Craters Trail.
New Interpretation of the Geology in Proximity to the Visitor Center: Evidence for a Missing Cinder Cone and Refined Mapping of Volcanic Features

Tiffany A. Rivara, Shaina M. Koanc, and Douglass E. Owen

Refined Mapping of Volcanic Features

During the summer of 2007, detailed geologic field mapping of the area northwest the visitor center revealed several previously unmapped features and provided the opportunity to re-interpret the existing geology. Below is a description of our findings. For locations of these features, please refer to the accompanying geologic map and the Points of Interest section.

Two Eruptive Fissures and a Series of Non-eruptive Fissures

The two eruptive fissures were found cutting the western flank of North Crater cinder cone (Figure 1). The eastern of the two is now partially filled by the North Crater pahoehoe flow, while the western fissure is completely filled by the Big Craters slab-lava flow. The eastern fissure is along strike with the Big Craters fissure system suggesting that the North Crater cinder cone must be older than Big Craters. Identification of the western fissure was by recognizing spatter cone cinder mounds. As spatter represents the waning stages of eruption, the presence of spatter here must indicate a fissure nearby. Several non-eruptive fissures are located along the west side of Big Craters (Figure 1). Although these fissures are not part of the eruptive system, they are parallel to the main eruptive fissures.

Gravity Faults along Big Craters

Two gravity faults were recognized along the northeastern flank of Big Craters (Figure 1). The larger of the two stands out as it has been used as a game trail. The smaller mapped fault is topographically above the first, however it is less easily distinguishable. These features are nearly perpendicular to the fissure system and provide further evidence that slumping occurs along crater walls.

Evidence for a Missing Cinder Cone

Previous workers have speculated that a large cinder cone (termed South Highway cinder cone) once existed between North Crater cinder cone, Highway US 20, and the campground area. Recognition of a large missing cinder cone agrees with work by Bresoy, Jordan, and Champion (in press) showing the volume of material raised from the North Crater cinder cone cannot be contained within the modern North Crater breach. These authors also collected paleomagnetic data from a South Highway cinder cone remnant on the north flank of North Crater cinder cone. Their data shows that these two cones may have coalesced. The northern rim or South Highway cinder cone acted as a topographic boundary for the Highway Flow, diverting most of the flow eastward along the cone (Careessa and Owen, 2005). This project further reinterprets the existing geology to reflect the location of cone remnants and reestablishes a series of chronological events leading to the destruction of South Highway cinder cone. Figure 3 shows the location of South Highway cinder cone remnants.

- The campground hill area is the largest independent area of interpretation. This hill was previously mapped as a rhyolite block, as well as the cone remnant to the south. Inspection of these two areas show that loose cinders comprise the majority of these two areas. Extensive folding occurs during rifting, it seems unlikely that such a large mass of loose cinders could have survived transport. The large amount of cinder material comprising these two areas leads us to believe that these rhyolite blocks are in situ pieces of the South Highway cinder cone wall (Figure 4).

- The rhyolite blocks in the North Crater pahoehoe flow have been reinterpreted as volcanic necks (Figure 5). These conduits may be one of several that contributed to the construction of South Highway cinder cone. This interpretation agrees with that of Maloy, 1994. This was the only rhyolite block lacking loose cinders to be reinterpreted as part of South Highway cinder cone.

- The area immediately south of the Highway Pahoehoe lava flow preserves an area with a large volume of cinders. Moreover, the physical distance between North Crater cinder cone and this area did not seem feasible when considering the average size of the cinder cones within the Monument. Additionally, the welded cinders in this area do not resemble the material comprising North Crater cinder cone, but resemble the material seen in the campground hill area. These differences suggest that this is a remnant of South Highway cinder cone.

- The area on the northern side of North Crater cinder cone (Figure 3) also resembles the welded cinder material comprising the possible South Highway cinder cone remnants. It was along this flank that the paleomagnetic cores were sampled by Bresoy, Jordan, and Champion (in press). Their data suggests that South Highway cinder cone was coeval with North Crater cinder cone. These workers may have been the first to recognize the potential for a missing cinder cone.

- The area of South Highway cinder cone is measured as a minimum of 1300m long by 500m wide. The nearby North Crater cinder cone measures 1300m long by 750m wide. Intrada cone, whose vent is south of the cone itself, has a footprint area of 1300m by 1000m. The largest cinder cone, Big Cinder Butte, has a measured footprint of 300m by 1500m – nearly three times the size of South Highway cinder cone. The measured area of South Highway cinder cone is consistent with other cinder cones in the Craters of the Moon lava field, providing more evidence for its existence.
Sequence of Events

We present the following sequence of events from the creation to the destruction of South Highway cinder cone. This model is in partial agreement with one model proposed by Kunitz, et al. (1962). We believe that these events all happened relatively close in time although the exact amount of time for these events to happen is not constrained. Detailed absolute dating analyses on the flows and cinder cones are needed in order to more accurately determine the amount of time required to construct and destroy a moderately sized cinder cone.

1. Construct North Crater and South Highway cinder cone.
2. Reconstruct Big Craters cinder cone.
   - A newly mapped eruptive fissure suggests that Big Craters is younger than North Crater cinder cone. This model is supported by the Big Craters paloehoae flow (560±5 ka) encompassing the South Highway cinder cone. The amount of time by which Big Craters is younger has not been determined, however, we believe that these two cinder cones are relatively close in age (100 years or less).
3. Eruption of Serrate and Devils Orchard Flows (not shown on map).
   - High silica flows capable of falling away pieces of South Highway cinder cone. These flows most likely originated in the North Crater neighborhood although vent locations have not been found.
   - Flow was channelled behind South Highway cinder cone; incineration against northern wall led to plume jetting.
5. South Highway cinder cone and North Crater cinder cone began to be torn apart by the three fissures mentioned above creating the rolled blocks stranded throughout the Devils Orchard and Serrate Flows. Either the Serrate or Devils Orchard Flows breached the northern flank of North Crater cinder cone.
6. Eruption of these high silica flows close in time emptied the underlying magma chamber, leaving a "hollow" area
   - The empty chamber collapsed back into itself, creating the South Highway fault scarp, and swelling part of the South Highway cinder cone.
   - Collapse and addition of South Highway cinder cone material into the empty chamber led to the eruption of a lower silica North Crater paloehoae flow from the previously breached wall of North Crater cinder cone.
7. North Crater paloehoae flows from the previously breached crater wall of North Crater cinder cone flowed around rolled blocks of North Crater and South Highway cinder cones, partially covered Serrate and Devils Orchard flows, and buried remaining evidence for the South Highway cinder cone.

Panoramic view across the North Crater paloehoae flow taken from North Crater cinder cone.

The Visitor Center area was first mapped by M. A. Kunitz et al. (1962) through a series of publications by the USGS. The USGS published four separate 1:24,000 geologic maps that covered the northern portion of the Craters of the Moon lava field. These four quadrangles (025-1622, 1623, 1654, 1853) spanned to cover the boundaries of Craters of the Moon National Monument and Preserve. Detailed mapping of the visitor center area was undertaken by Tiffany A. Rivera, Shanna M. Knae, and Douglas R. Owen during the summer of 2007 as a continuation of the detailed Great Rift mapping that took place the previous three summers. The 1:12,000 map of the visitor center area will provide a more refined understanding of the volcanic history of the region. In addition, two pages regarding points of geologic interest and three pages on reinterpretation were published in the summer of 2007. The detailed descriptions with photos will allow visitors to conveniently locate and visit unique geologic features. The reinterpretation contributes to the understanding of the construction and destruction of cinder cones, events that have not been witnessed in recent history at Craters of the Moon.

ACKNOWLEDGEMENTS

Funding for this project came from The Geological Society of America's GeoCorps America program. The authors would like to thank Craters of the Moon National Monument and Preserve Staff, Erik Colicegamo and Celia Dibolin for their field assistance. Mary Caresa for her work on the Highway Flow, and Cooper Giroux for his knowledge of the North Crater neighborhood. J.A. Hewett would also like to thank Dr. Craig White, Boise State University, for his guidance, support, and for sharing his wealth of knowledge pertaining to unidentified basaltic features.
REFERENCES


http://www.nps.gov/orm/naturescience/upload/legend.pdf
Abstract — Rangelands, or land vegetated predominately by grasses, grass-like plants, forbs, or shrubs, comprises about 40% of the U.S. as well as significant portions of western Canada and other parts of the world. The Western Rangelands Partnership, a unique alliance of range scientists, librarians, and Extension personnel affiliated with land-grant universities, maintains a website that consolidates important information pertaining to rangeland ecology and management. This website ([http://www.rangelandswest.org](http://www.rangelandswest.org)) is used by professionals and practitioners for management of both public and private land and for the sustainability of western rangelands. Although the website’s content is largely agricultural, significant portions concern geoscience topics.

RANGELANDS

Rangeland is defined as land that is vegetated predominately by grasses, grass-like plants, forbs, or shrubs. This includes natural grasslands, shrublands, savannahs, wetlands, most deserts, tundra, and alpine meadows. Rangelands are the dominate types of land in arid and semi-arid regions. The Society of Range Management estimates that nearly 80% of the western U.S. but only 7% of the eastern U.S. are rangelands.

AGNIC

The Agricultural Network Information Center (AgNIC) is an alliance of nearly 60 institutions, mostly land-grant universities, coordinated by the National Agricultural Library (NAL). AgNIC members develop, organize, and present in-depth collections of electronic resources in a narrow subject area, related directly or indirectly to agriculture. The AgNIC alliance coordinates this presentation and maintains a website ([http://www.agnic.org](http://www.agnic.org)) where this material is centrally accessible. Each institutional member designates agricultural scientists, professional librarians, and extension experts to provide their contribution to the AgNIC web pages. This coordinated presentation of three areas of expertise appears to be unique in the information field.

RANGELANDS WEST

The Western Rangelands Partnership (commonly known as Rangelands West) is a major subgroup of AgNIC. Its institutional members are primarily the land-grant universities in the western U.S. As with the parent AgNIC body, its contributors include scientists, librarians, and extension personnel. Rangelands West is coordinated by the University of Arizona. Their website ([http://www.rangelandswest.org](http://www.rangelandswest.org)) consolidates important information pertaining to rangeland ecology and management. It is used by professionals and practitioners for management of both public and private land for the sustainability of western rangelands. Although the website’s content is largely agricultural, significant portions concern geoscience topics including state by state descriptions of soils, water, climate, drought and wildfire; land management practices; and policy issues such as mining, fossil fuel extraction, and watershed management. In addition, each state’s delegation adds content and web links for locally relevant material. For example, the Montana segment includes a digital archive of a noted range scientist’s field notes, photographs, and papers. Other state specific additions include several links to geospatial and climate websites, mineland restoration activities, topical bibliographies, and lists of academic theses.

(Poster presentation included screen captures from contributing institutions).
Abstract – Pluvial Lake Manly inundated Death Valley, California, during the Pleistocene. At its maximum extent, it was approximately 185 km long and 180 m deep. Fluctuating lake levels have been linked to regional climatic changes with the various lake stands collectively referred to as Lake Manly. Today, evidence of the former lake and its lake level fluctuations are recorded in paleo-shoreline deposits and/or erosional scarps throughout Death Valley. The purpose of our ground penetrating radar (GPR) study was to investigate a Lake Manly coastal depositional feature located at one of the higher lake stands (50 m asl). The barrier deposit which is cut by Beatty Junction Road within Death Valley National Park is approximately 500 m long, 50 - 100 m wide, and 5 - 6 m in height. Prior geophysical studies on the barrier suggested that higher frequency GPR datasets be collected to provide higher resolution stratigraphic images of the barrier's interior. We utilized a pulseEKKO 1000 GPR system with an automated odometer along two shore parallel and seven cross barrier transects. GPR data sets were topographically corrected with laser leveling equipment and georeferenced with a Trimble ProXR GPS unit. Transects show the general framework of the shoreline deposit, 225 MHz data were collected along all nine transects while higher frequency antennae (450 and 900 MHz) were used along selected lines to provide higher resolution images. The lines varied in length from 41 m to 266 m with traces collected every 0.1 m to 0.03 m depending on antennae frequency. A common midpoint survey provided a near surface velocity of 0.142 m/ns. Based on this velocity, the depth of penetration was 1.8 m for the 225 MHz antennae, 0.9 m for the 450 MHz, and 0.45 m for 900 MHz. Using radar stratigraphic analysis, the GPR transects show continuous to semi-continuous, horizontal reflection patterns. Along selected locations on cross barrier profiles dipping reflection patterns can be observed with dip angles ranging from 6.1 to 26.6 degrees. Exposed stratigraphy where the road-cut bisects the barrier bar deposit correlates well with the interpreted GPR data.
COLORATION AND DIAGENETIC HISTORY OF JURASSIC NAVAJO SANDSTONE AT COYOTE BUTTES, VERMILION CLIFFS NATIONAL MONUMENT, ARIZONA

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Abstract – The Coyote Buttes, in Jurassic Navajo Sandstone straddling the Arizona and Utah border at the northern margin of the Vermilion Cliffs National Monument, is renowned for its stunning diagenetic coloration expressed within delicately sculpted, cyclic eolian cross-strata. The wide range of red, orange, pink, and purple hues is largely due to iron oxide grain coatings and cement that is predominantly hematite. Yellow to brown coloration is indicative of goethite. White (bleached) color occurs where some of the iron-oxide coatings have been removed. Coloration is constrained by both sedimentary and tectonic structures at microscopic to outcrop to regional scales.

Sandstone coloration is categorized into four main, large-scale (10's m thick) diagenetic facies: 1) a primary, basal red facies; 2) a red and white banded transition facies; 3) a bleached upper facies; and 4) a secondary red facies associated with the re-introduction of iron-rich fluids along a fault trace. Both the red and white banded and bleached facies are commonly overprinted with two cross-cutting, Liesegang-related zones (m's thick): one of numerous, narrow, cm-scale, multi-colored Liesegang bands, and the second containing multiple orange chemical reaction fronts including iron oxide micro-concretions.

Stratigraphic relationships of reaction fronts show that large-scale diagenetic facies are due primarily to advective fluid flow and iron mobilization within the host rock. Small (cm-scale) and large (10's-m scale) bleaching patterns in the outcrop clearly indicate the upward migration and accumulation of a chemically reducing and bleaching fluid. Smaller-scale, Liesegang-type reaction fronts are due to diffusive mass transfer causing the chemical precipitation of iron oxide mineralogies.

The location draws thousands of wilderness enthusiasts and photographers each year, primarily to a unique geomorphic feature – “The Wave” – where impressive colors accent cross-strata resembling a resting ocean wave. This study contributes to a better understanding of the intense diagenetic coloration and fluid flow history that distinguishes the Coyote Buttes as an exceptional geologic resource.
NEW GEOLOGIC MAP OF THE LOWER DIRTY DEVIL RIVER-HITE CROSSING AREA,
GLEN CANYON NATIONAL RECREATION AREA, SOUTHERN UTAH

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Abstract – For several years, the Utah Geological Survey, in cooperation with the National Park Service, has been working on a series of detailed geologic maps covering Glen Canyon National Recreation Area (GCNRA). Accurate, detailed geologic maps are essential to the management of the fragile desert lands because of their proximity to Lake Powell, which receives about 1.8 million recreation visits per year. We recently completed a geologic map of the largest remaining insufficiently mapped part of GCNRA, the Dirty Devil River-Hite Crossing area in the northern part of the recreation area. The map covers an area of about 400 km² near the north end of Lake Powell where the Colorado River enters the lake (depending upon lake level). Exposures range from the Pennsylvanian Honaker Trail Formation, exposed in the bottom of lower Cataract Canyon, to the Middle Jurassic Page Sandstone, which caps a few remote mesas. Exposures are unusually good, permitting detailed examination of the 3-dimensional relationships of map units. The southwestern pinch-out of the Permian White Rim Sandstone and the western pinch-out of the Triassic Chinle Sandstone are both within the area, presenting the opportunity to understand how these units correlate with adjacent strata. The Triassic Chinle Formation is extensively involved in and mantled by massive landslide complexes that extend the length of the outcrop belt. Nevertheless, sufficient exposures reveal rapid lateral variations over distances of just a few tens to hundreds of meters. These changes, which include lithologic changes, channeling, and pinch-outs, make mapping of the Chinle members challenging, but also reveals much about the terrestrial depositional setting of this formation. The area is cut by a northwest-trending fault zone consisting of over a dozen small fault splays, most having less than 5 m of displacement, that trend oblique to the major structural fabric of the area. This zone has been the focus of vertical hydrocarbon migration as evidenced by bleached zones and “dead” interstitial oil residue.
TIMELINE INTERPRETATION AND TIME SCALE COGNITION EXPERIMENTS FOR THE TRAIL OF TIME AT GRAND CANYON NATIONAL PARK

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Abstract – The Trail of Time is a walking timeline trail now under construction along the South Rim of Grand Canyon, from Yavapai Observation Station to Grand Canyon Village. It will extend 4.5 km, with each meter marked to represent one million years of geologic time. Interpretative resources on Grand Canyon geology and culture will be deployed along its route. The Trail of Time will be the world's largest geoscience exhibit at the world's grandest geoheritage site. A Time Accelerator Trail (TAT), a logarithmically scaled timeline approximately 250 m long and appended to the main Trail, will help visitors adjust their temporal frames of reference from personal or familiar time scales (years to decades), through historic and archaeological time scales (centuries to millennia) to deep time (millions of years), by periodic changes in scale enroute, from one meter per year to one meter per million years. The time interval marked by the TAT begins at the present and ends at 6 Ma, when Grand Canyon downcutting started.

While linear timelines are constructs commonly used to teach about geologic time in formal and informal settings, their effectiveness has not been fully assessed. The logarithmic time scale introduces complexities that should be understood before the TAT is implemented. The TAT also represents a unique laboratory for the study of learning about deep time. We are implementing off-Canyon studies of the proposed TAT, in which different subjects recruited locally represent typical Grand Canyon visitors. The experimental setting is a scaled-down (74 m), portable rolled paper version of the TAT, on which realistic time markers and placards can be readily placed and adjusted. Research questions include: (1) Do subjects understand the purpose of the TAT?; (2) What happens cognitively when subjects walk the variably-scaled timeline?; (3) Can subjects correctly identify the time represented at any point along the TAT?; and (4) What cognitive challenges will subjects reveal while traversing the TAT? More than 50 subjects of diverse age, ethnicity, and background have participated. The experiments have yielded useful pedagogical recommendations for the full-scale TAT, especially clarity of scale changes and comprehensive labeling of time markers. Coding and analysis of recordings for time cognition studies are in progress.
FIELD MAPPING AS A TOOL IN PUBLIC EDUCATIONAL OUTREACH: A CASE STUDY FROM THE FAMOUS CHAZY REEF ALONG GOODSELL RIDGE, ISLE LAMOTTE, VERMONT

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Abstract – The Isle LaMotte Preservation Land Trust has recently turned an 81 acre portion of Isle LaMotte, Vermont (northern Champlain Islands), into a nature preserve with a visitor center/museum. The Goodsell Ridge Natural History Preserve provides public access to the world famous Middle Ordovician reef exposures in the Chazy Group. A primary goal of this preserve is to convey the significance and geologic history of these rock exposures to the general public. Several challenges exist for visitors exploring the site; among them are troubles with identification of fossil and sedimentary features. First, unlike many dinosaur fossil sites where large bones have been excavated for view, the general public is largely unfamiliar with the three-dimensional forms of the fossil invertebrates involved. Second, the calcium carbonate fossils are preserved within limestone, so many of the reef features contrast poorly on weathered surfaces and require close examination. Third, glacial erosion and post-glacial weathering of the limestone has created many irregular, two-dimensional transects through both the reef structures and their component features.

An undergraduate-led mapping project of seven exposures designated as “discovery areas” aids visitors in recognizing integral features within the fossil reef strata. A detailed survey of the “discovery areas” provides maps for the location of fossil, sedimentary and modern landscape features that tell portions of the geological history of this site. Interpretive text explaining specific features within each “discovery area” is linked to exhibits within the farmhouse/museum that attempt to answer important questions, such as: 1) What are fossils and how do they preserve?; 2) What are reefs and why are they important to us?; 3) Why are these fossil reefs so important to our understanding of Earth history?; and 4) How did ancient reefs come to be exposed in a farm field in a northern cool-temperate climate area well away from the ocean? Care is taken to insure that museum concepts and text provided is both scientifically accurate and clear for the preserve visitors, as well as the local volunteers who are actually constructing the museum displays on a small budget.
DEVELOPMENT OF LANGKAWI GEOHERITAGE INFORMATION SYSTEM FOR CONSERVATION AND SUSTAINABLE USE

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Abstract – The Langkawi islands have many valuable geoheritage sites. To date, 91 geosites have been identified and 28 of them have been scientifically evaluated in detail. These geosites are made up of a diversity of rocks, fossils, structures and landforms. In order to conserve and develop the geoheritage sites in a sustainable manner, we compiled a comprehensive Langkawi Geoheritage Information System (LGIS). This study focuses on a geoheritage-resources information system consisting of general information, geoheritage characterization, and geosite management components. Prior to the development of these components, data from previous studies and geoheritage mapping were collected and categorized. The general information parameters give details of the locality and size of each geosite area. Characteristic information focuses on detailed descriptions of geosite diversity as well as evaluation for scientific, aesthetic, recreational and cultural values. Geosite management data include land ownership, threat, condition and legal status. The LGIS can be used systematically to determine the value of each geosite through comparability and ranking. It can also be used directly for conservation purposes based on its scientific value. From the collected LGIS information, the most suitable approach to conserve geoheritage resources in Langkawi would be to create 3 geological parks, 6 geological monuments, 26 protected sites, and 59 landscapes of scenic beauty.

The Forestry Department of Peninsular Malaysia will conserve geoheritage resources in their permanent forest reservations. Currently 6 geological monuments, 7 protected sites and 4 landscapes of scenic beauty from LGIS are located in the Langkawi permanent forest reservations. All these geosites are suitable to be developed for geotourism purposes, especially those that have recreational, aesthetic, cultural and educational values. Twenty-one geosites are located in tourist areas mainly along the coast and in caves and hills; these should be publicized for geotourism by promotional activities such as the creation of geotrails on land and water for rock and fossil collecting.
VISITOR PRECONCEPTIONS AND MEANING-MAKING AT PETRIFIED FOREST NATIONAL PARK

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Abstract – When observing the spectacular natural landscapes of our National Parks, how do visitors make meaning of the geology? Deeper understanding of visitor preconceptions can inform the design and implementation of more effective geoscientific displays and interpretative programs. We investigated visitors’ ideas about geological processes, features, and history at Petrified Forest National Park in northern Arizona, a place renowned for its colorful badlands and fossil wealth. With the cooperation of Park staff, data were collected from semi-structured interviews of 80 visitor groups (n = 235) encountered at a popular viewpoint locality. Volunteer subjects were asked to explain the formation of the landscape, describe the depositional environments coded in the rocks (including the origin of fossil logs) and account for the present high elevation of the Colorado Plateau. These results were analyzed using the Verbal Analysis methodology of Chi (1997). In the absence of accurate geological understanding of the landscape, visitors frequently used familiar-place knowledge, based on specific places with which the visitor has had prior experience. Qualitative analyses indicate that visitors variously make meaning by (1) relating landscapes to familiar places; (2) building on religious explanations; (3) superimposing past landscapes on modern ones; and (4) patching together bits of information from media sources. Visitors were also found to have difficulty in visualizing climate changes. We recommend that future exhibits and interpretative programs incorporate content and activities that directly address these preconceptions.
USE OF INFORMAL EDUCATION SITES TO FACILITATE PALEOENVIRONMENTAL INTEGRATION IN A NATION-WIDE ONLINE PALEONTOLOGY COURSE

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Abstract: To circumvent problems encountered with limited fossil specimens and lack of environmental context in a nation-wide online paleontology class, an individualized application exercise was developed for practicing Earth Science teachers (N=16). Teachers were required to select and visit informal education sites, such as national parks and museums, and locate fossil specimens that represented a variety of phyla. A discussion of each species’ morphological characteristics, geographical ranges, and depositional environments was required. The teachers utilized this information to identify and research the paleoenvironments represented by a minimum of three informal education exhibits. Their research was incorporated further into the design and development of mini-units with paleoeducational activities for their individual middle or secondary classrooms. Anonymous surveys revealed that approximately 70% of teachers selected the informal site activity as their favorite course assignment. Content analysis of students’ anonymous comments (n=14) revealed three consistent findings: 1) paleoenvironmental investigation at informal sites integrated the course material; 2) informal site investigation had great value and impact on formal geoscience learning; and 3) teachers perceived that their own students’ interest for this type of activity was very high. All practicing educators identified that in formal science education, through fossil field excursions and informal education sites, was relevant to traditional geoscience instruction.

ACTIVE LEARNING IN ONLINE SETTINGS

Many “traditional” geology courses are taught with an accompanying laboratory component. Mineralogy, petrology, and paleontology courses often involve long laboratory hours outside of the classroom, and students dedicate hours to familiarize themselves with numerous samples and specimens. Geologists have long recognized the value of direct learning when it comes to Earth materials, and although we often rally around the slogan that “geology is best taught in the field,” sometimes professors must “bring the field into the laboratory” to facilitate learning.

Science education research affirms the benefits of student-centered active learning (Michael and Modell, 2003; McConnell et al., 2003; Lawrenz et al., 2005). Active-learning strategies involving fossil specimens have been shown to engage students, as well as the public (Burr et al., 2003). However, in order to incorporate active learning and student-centered activities in online classes, additional constraints must be circumvented.

Online learning environments can provide successful learning environments for our students, even within scientific disciplines (King and Hildreth, 2001). Parker and Gemino (2001) reported greater success with online delivery of material when measured with conceptual assessment items. Not all online courses are equal, however. The quality of online instruction will determine how effective learning is within the classroom, and online instruction necessitates the development of new learning and teaching techniques (Tallent-Runnels et al., 2006). New learning and teaching techniques, however, should still follow guidelines of quality instruction, such as those promoted by the learning theory of human constructivism: less is more, quality should be emphasized over quantity, and understanding should be emphasized over awareness (Gowin, 1981;
Mintzes et al., 1998). The constraints of online paleontology classes include more limited use of specimens, and lack of face-to-face student corroborative activities. Whereas geology students work together in the traditional laboratory setting and often assist each other with specimen identification, student interactions involving specimens in online classrooms is accomplished primarily through electronic Discussion Boards and the sharing of photographs. The lack of numerous specimens, combined with a lack of group activity in the laboratory, make paleoenvironmental context of organisms more difficult to convey in an online classroom.

Therefore, this application activity was designed to integrate fossils within their appropriate paleoenvironmental context in our online paleontology course. Although it would be highly impractical to design an activity for online students involving one particular geographical site, there exist a variety of local informal educational sites that can be utilized by students within their given geographic location. Informal education sites, such as national parks, museums, and fossil parks, can provide rich learning opportunities for students outside of the classroom (Anderson et al., 2003). Field experiences can provide environmental context and land ethic (McLaughlin, 2005), and facilitate understanding of the research process (Hemler and Repine, 2006). Field-based introductory geology courses resulted in significant geoscience concept gains for the students (Elkins and Elkins, 2007).

In an earlier field study, students reported satisfaction with an autonomous online paleontology activity that involved fossil procurement from local field sites (Clary & Wandersee, in press). This activity was designed to tap into established informal education sites, such as national parks and museums, within students’ geographic areas.

METHODS

The History of Life course is a graduate level paleontology course specifically designed for practicing Earth science teachers. The course is taught entirely online at a research university in the southern US. Because of our earlier success with an application activity (Clary and Wandersee, in press), we incorporated application exercises in each of the quarterly homework assignments. For the final quarterly assignment, students (N = 16) were required to apply their content knowledge and integrate paleoenvironmental settings through self-selected local informal education sites. Students located a minimum of two unique informal sites, including national parks, museums, or nature centers, within traveling range (Figure 1).

Figure 1. Geographic distribution of informal education sites chosen by students enrolled in the History of Life course, Spring 2007 semester
Students were required to locate a minimum of 18 specimens, representing 18 unique specimens within 5 phyla. Each specimen had to be photographed using a yellow wooden pencil and the Mississippi State Geosciences’ “Bully” logo for scale. All specimens had to be identified to the species level, and a description of the distinguishing features, geographic range, and geologic age had to be included in the final report. Students then analyzed the depositional paleoenvironments represented by their selected fossils, with a minimum of three paleoenvironments required. The second part of the assignment involved the design and development of a Mini-Unit with paleontology activities for each teacher’s individual classroom. The current classroom had to be described, including student composition and whether any special-needs learners were present. The teachers had to include objectives, benchmarks, and the national and/or state benchmarks that their activities addressed. A minimum of two learning styles had to be incorporated within the activities, and higher order thinking skills must be included. Finally, all teachers had to develop an assessment tool for their Mini-Unit. Final projects were submitted electronically on the course website.

**DATA AND RESULTS**

**Fossils and Paleoenvironmental Identifications**

Teachers selected a variety of informal education sites, which yielded a variety of fossil specimens of plants, marine invertebrates, both terrestrial and marine vertebrates, and trace fossils. Our teachers interpreted several different types of depositional paleoenvironments, including deep marine, nearshore marine, reef, swamp, lacustrine, and terrestrial grasslands and mudflats. Analyzed paleoenvironments also ranged in geologic age from Precambrian to Pleistocene (Figure 2).

![Figure 2.](image)

Figure 2. Selected representative samples of fossil specimens procured and photographed by students, including (2a) a Texas stromatolite (Precambrian), courtesy of Debbie Gilbert; (2b) a Bahamian coral photographed at 75’ depth, *Stephanocoenia michilini* (Neogene), courtesy of Nancy Albury; (2c) a teleost predator, *Xiphactinus audax* (Cretaceous), nicknamed the “Bulldog Fish,” courtesy of Amy Carpinelli; and (2d) a Puerto Rican rudist (Cretaceous), courtesy of Janette Stewart.
Classroom Activities

Students produced a variety of classroom activities and assessments involving their informal sites and the associated paleoenvironments (Figure 3). Some teachers developed activities involving sedimentation, deposition, and fossilization processes.

Submitted activities included Venn diagrams, Podcasts, mural designs, Paleo “menus” and time travel brochures. Assessments for these activities were likewise varied, and included student-produced portfolios, dioramas, paleoenvironmental pictures, slide presentations, and quizzes (Figure 3).

Figure 3. Selected representatives of student-developed classroom activities using fossil specimens and/or paleoenvironmental context. Students developed creative endeavors, including these activities involving fossil descriptions and morphological similarities across geologic time (3a, courtesy of Amy Carpinelli). Other students utilized principles of relative age dating, including fossil succession and stratigraphic context (3b, courtesy of Lee Hawkins).
Assessment of Information Educational Activity

The informal education projects were graded using a rubric posted with the assignment guidelines. Earlier research (Clary & Wandersee, in press) revealed higher grade correlation with an application field activity when compared with traditional laboratory manual activities. However, all quarterly homework exercises in the Spring 2007 semester incorporated at least partial application activities. Statistical analyses resulted in acceptance of null hypotheses for comparisons between the 4th Qtr informal education activity and other quarterly assignments. Nonetheless, projects were excellent, with lower scoring projects the result of penalties incurred for late submission.

TEACHER PERCEPTIONS OF INFORMAL EDUCATION ACTIVITIES

At the end of the semester, all but three students (81%) chose to participate in an optional, anonymous survey designed to elicit feedback about application projects. Of the survey participants, 70% identified the informal site activity as their favorite assignment. Content analysis (Neuendorf, 2001) revealed three consistent findings: 1) paleoenvironmental investigation at informal sites integrated the course material; 2) informal site investigation had great value and impact on formal geoscience learning; and 3) teachers perceived that their own students’ interest for this type of activity was high. Many students remarked that this was a course highlight that integrated earlier content material. One student remarked, “I liked the informal site the best because it brought everything in the course together and it made more sense. It was like a light bulb coming on.” Other students remarked “It really made alot [sic] of these species ‘real’ to me to see them displayed together with other time species of a similar time period and environment,” and “The informal sites were a good way to tie together all the information covered in the course.”

Several teachers remarked that they would use the informal sites and/or the material developed from the informal site activity within their own classrooms. One teacher stated, “Awesome. When I showed my kids the rough draft of the slides . . . they loved it. I think they learned so much about the history . . . but very little about the geology and paleobiology. I think that this is just as important especially in the world we live in today. They can see it first hand, touch it, walk on it. Very cool thing for a kid in science class to do.” Other teachers verified that the preparation time involved in this assignment for the online paleontology class is directly transferable to their own classroom settings.

Comments in the anonymous survey include “I’ve done a lot of advance work in setting up some pretty cool field trips. . . Students learn a lot from seeing fossils (other than the few invertebrate fossils I and the school own) first hand. I still have students who (through ignorant parents?) actually believe that extinct animals never existed;” and “I did a lot of research to gather all the information I thought was required to present the fossils correctly. . . I have learned a lot that I can carry directly into my classroom.”

CONCLUSIONS

Instruction in online courses encounters barriers not found in traditional classroom settings, particularly in the implementation of laboratory exercises and hands-on activities. However, through individual fossil specimen kits and informal site investigations, we believe that paleoenvironmental integration is possible for students enrolled in paleontology courses taught in an online format.

The use of informal education sites circumvents potential problems that students encounter for fossil procurement in the field. Students did not have to obtain permission to access sites, nor were the field conditions a primary concern. Although the fossils were typically identified in national parks and museums, the students still encountered application and synthesis of content knowledge by the additional requirements of identifying the important characteristics of each specimen, and integrating specimens encountered into a minimum of three paleoenvironments. Students reported that the exercise required research prior to informal site visits. Students also reported that the presentation of the research in a clear and concise manner was no simple feat. Although some Earth science teachers felt that the amount of research and time involved in the informal assignment was extensive, all survey participants remarked that the interest level of their own students for informal site investigation would be high. All practicing educators identified the value and impact of informal science education—through fossil field
excursions and informal education sites—as great and relevant to formal geoscience learning. We think that informal education site visits, such as those to museums, national parks, fossil parks, and nature centers, can serve as valuable tools to help online students synthesize paleontology content knowledge. Our practicing teachers also readily identified the future impact that these assignments will have within their own classrooms.

REFERENCES


Clary, R.M., and Wandersee, J.H., in press, Earth science teachers’ perceptions of an autonomous fieldwork assignment in a nationwide online paleontology course: Journal of Geoscience Education.


Abstract – This abstract offers access to over 2600 images of geologic features, mostly from U.S. national parks, which can be copied without charge for educational use. These images were scanned at high resolution and placed in an archival collection which can be used by permission for publications. The collection was also saved at lower resolution for use in Powerpoint or other presentation software for classroom use. It can be accessed at: http://cdm.lib.uiowa.edu/cdm4/browse.php?CISOROOT=/geoscience.

The screen that comes up shows the first 20 images in the collection. Select (click on) an image, and an enlarged view appears with metadata provided below. The collection is searchable in several ways. Choose the park name in the metadata, and all images will be shown for that park. Alternatively, select an item listed after, for example, the subject categories, and all images on the subject will be shown, regardless of park. A specific search engine is also available by selecting Advanced Search at the top of the page. Click “Selected Fields” and choose a field to search. Choosing “Show Terms” will provide a list of topics under each field. Select a term and then click on search, and you will see all items fitting that term.

Once you have an image you wish to use, you need only to copy and paste it into Powerpoint or other presentation program.
Abstract - Since 2001, the National Snow and Ice Data Center’s Glacier Photograph Collection has aided researchers and students by providing Internet access to the collection of historic glacier photographs. The online database now contains over 4,000 images. Many of these photographs are currently accessible through a Google Earth file, which enables users to view the photographs in a virtual context. Our efforts to update the collection and to work with users involve collaboration between different departments within NSIDC and our digitization contractor.

Collaborating with internal departments to fulfill user requests is our primary activity at NSIDC. The Photographs of the Franz Josef Glacier provide an example of the life cycle of one such request. A person contacts our User Services Office (USO) to request the Franz Josef Glacier photographs because she saw them on our All About Glaciers web site. Since they are not in the Glacier Photograph Collection, USO contacts the information services staff who locates the original prints in the archives and scans them. USO then sends them to the user. Ultimately, these photographs are sent to the specifications of the glacier photograph digitization project and added to the queue of glacier photograph updates. Once this process is completed, more users will be able to access these images via the online collection.

Learn about the latest images in the collection, what’s next in terms of updates, and how NSIDC is working to create a multifaceted online collection.

INTRODUCTION

A user request for glacier photographs on the National Snow and Ice Data Center (NSIDC) web site drove the digitization of a set of photographs held within the NSIDC analog archives collection. Held within the archives are historic glacier photographs, historic maps and ice charts, expedition notebooks, and manuscript materials. Much of the historic glacier photograph collection is in the process of digitization, a project that began in 2001. This request exemplifies NSIDC’s efforts to make these glacier data available to researchers and the public.

PROJECT HISTORY

William O. Field began the historic glacier photograph collection to establish one collection for glaciologists to visit to access the data. (Field, 2004) Largely because of this collection, in 1957 the World Data Center (WDC) for Glaciology was established with Field as the first director. In 1971, the WDC was transferred to the United States Geological Survey (USGS), and in 1976, moved again to the University of Colorado where it now exists as part of NSIDC.

Until 2001, users had to visit NSIDC to access the historic glacier photographs. The images were not cataloged, and metadata records did not exist. In 2001, NSIDC was awarded a grant through the National Oceanic and Atmospheric Association’s (NOAA) Climate Database Modernization Program (CDMP). This grant funds the digitization of the materials and shipment of the materials to contractors conducting the work.

The photographs were prioritized by the amount of data available in the image. For example, photographs that showed the entire glacier, the terminus of the glacier, or other glacial features were a higher priority. Photographs that could be repeated were also a higher priority. The
collection went live in 2002 with 201 glacier photographs.

**DIGITIZATION**

As the project gained popularity, the selection process changed. Photographs were evaluated using archival criteria. Whole collections were shipped for scanning, such as the Harry Fielding Reid collection. The oldest photographs in the collection were sent to expand user access to these rare images. The collection was expanded beyond Alaskan glaciers to include local Colorado collections, Greenland glaciers, and other less represented areas.

In addition to the Glacier Photograph Collection, NSIDC maintains a gallery of glacier images on the All About Glaciers web site. This gallery was created before the Glacier Photograph Collection and contains images that are not found within the newer collection. These images are also available to the researchers or other users but cannot be requested through the photograph database. Also, they were scanned in house and have only minimal metadata in the form of a caption.

Glacier photographs may be requested using the online form at the bottom of the search results page in the Glacier Photograph Collection database. The requests are filled by the User Services Office (USO) at NSIDC. Any questions about metadata or rights are referred to the analog archivist. Questions about images not found online are also forwarded to the analog archivist. The Franz Josef Glacier photographs demonstrate such a request.

**Franz Josef Glacier, New Zealand**

Illustrating the story of glacier retreat is a pair of Franz Josef Glacier photographs. (See: [http://nsidc.org/glaciers/story/retreat.html](http://nsidc.org/glaciers/story/retreat.html)) The two photographs are part of a 13-image series showing Franz Josef Glacier from the same vantage point over a period of 15 years. Perhaps due in part to the popularity of the Repeat Photography of Glaciers special collection, current glacier photographs paired with historic glacier photographs (see: [http://nsidc.org/data/glacier_photo/repeat_photography.html](http://nsidc.org/data/glacier_photo/repeat_photography.html)), and also the timely topic of climate change, several users expressed an interest in this series of photographs. Prompted by this interest, and also by our desire to expand the collection beyond Alaska, the set of 13 photographs was sent to be digitized.

**Collaboration**

The first step in this process is for USO to pass the request to the analog archivist. Once the analog archivist locates the images in question, the metadata is gathered from the photographs and the images are shipped to the contractor. The images are scanned and three files are created – master, reference, and thumbnail. These digital images are returned to NSIDC, along with the other images in the batch. Operation Technicians conduct a quality check of the digital files, and finally, NSIDC database engineers load the photographs, along with their metadata, into the Glacier Photograph Collection database. Once the images are loaded, they are immediately available to the user. USO then contacts the original user to complete the request.

In addition to database access, all of the images in the Glacier Photograph Collection are also accessible through Google Earth. The Google Earth files are updated periodically, allowing researchers to choose their method of access.

**UPDATES**

The database is continuously updated with new images and special collections. In 2007, 1,595 glacier photographs were added to the collection, bringing the total number of images in the collection to 4,895. In January 2008, a second special collection was created featuring Rocky Mountain National Park Glacier Survey Reports. (See: [http://nsidc.org/data/glacier_photo/glacier_reports.html](http://nsidc.org/data/glacier_photo/glacier_reports.html)) Also during 2007, the Glacier Photograph Collection web site was updated to improve the look and navigation. Updates to the database, including the navigation and search functions will continue in 2008.

**CONCLUSION**

The Glacier Photograph Collection is one of the most popular data sets at NSIDC. Scientists have used these data to research the long term change of glaciers all over the world. Students use the images to illustrate and explain their research. Politicians have used the images to highlight their view points on climate change. Historians use the collection to learn more about
past expeditions. Anyone who is interested in glaciers and glacier history is free to access and download the images.

NSIDC is responsive to user requests. The Franz Josef glacier request is one example of how different departments within NSIDC collaborate to accomplish a user’s request. The analog archivist selects compelling glacier photographs for digitization and takes into account suggestions from others. The Glacier Photograph Collection is available through an online database and through a Google Earth file. This allows users to choose their preferred method of viewing the photographs. NSIDC hopes to collaborate in the future with photographers and scientists who are interested in sharing their glacier photographs. The plan is to continue digitizing more glacier photographs and to expand the collection to include a broader selection of glaciers worldwide.

REFERENCES


APPENDIX

Web Sites

All About Glaciers
http://nsidc.org/glaciers/

Glacier Photograph Collection
http://nsidc.org/data/glacier_photo/
Abstract – Librarians from the Richard T. Liddicoat Gemological Library & Information Center at the Gemological Institute of America (GIA) led the initiative to establish a cross-departmental task force to digitize, preserve, and provide access to its geoscience visual resources.

GIA's mission is to ensure the public trust in gems and jewelry through education, research, and laboratory services. For over 75 years, photographs of gemstones, mining areas, and gemology have been vital to GIA staff meeting this mission through teaching gemology and publishing its research journal Gems & Gemology.

In 2004, librarians with 14 departments launched a digital asset management (DAM) system for the increasing number of digital resources. For the first phase, the task force began with digital images, since a DAM system is key to maintaining our images.

With a collection of over 50,000 35mm photographic slides, the first concern was the conservation of the slides by scanning them. Another concern was accessing the images in an international organization with campuses in 11 countries. Also, how to meet the needs of those seeking to license images for publications, websites, and other electronic media.

The key to successful implementation lies in planning the policies and procedures. Many questions need to be answered before searching for the right software solution and the required computer equipment.

Another step in the planning process is consideration of the metadata requirements. Information is vital to identify the content of an image, give useful details such as the photographer and copyright information, and provide access to the images during searching. A thesaurus of keywords is essential to aid in a database search.

Future expansion of GIA's DAM system will provide access to more geoscience resources as digital video and audio files, maps, books, articles, and gemology databases are included. These will enhance GIA's outreach via its web presence as it educates an ever-expanding public and supports scientists and policy makers of the international community.
Abstract -- This project was intended to provide the Virginia Division of Mineral Resources (VDMR) in Charlottesville, VA with a plan of action for increasing the effectiveness of their library. The VDMR library should be the premier Geology library in the Commonwealth of Virginia, but they have not had a full-time librarian on staff since the mid-1990s, and very little has been done to maintain the library since that time. In this plan of action, basic library procedures have been outlined, along with a list of recommendations for maintaining and improving the library’s services.

INTRODUCTION

The Virginia Division of Mineral Resources (VDMR) Library (Figure 1) is a special library that is not reaching its full potential. This library, housed in a grand wing of the Virginia Department of Mines, Minerals, and Energy in Charlottesville, Virginia, contains a working collection of books, technical papers, journals and maps to support the research of geologists working for the Division of Mineral Resources. The facility is modern with the materials carefully organized in the shelves and drawers, and the professional geologists in the department are proud of their collections. However, the Division of Mineral Resources lost its funding to keep an in-house librarian in the mid-1990s. Since that time the small special library has not been able to keep up with the technological trends of its library peers. In this paper I will describe my consultations with the staff of the VDMR, and the procedures, workflows, and recommendations that I will present to VDMR as the culmination of my project.

In the United States, each state has its own state geological survey, or state survey, which is run by the state government. This division of the state government is usually responsible for providing information about the natural resources, hazards, and conservation issues for each state. It employs professional geologists to do field, lab, and literature research, which is then published in a number of series. Most state surveys publish open file reports, special reports, investigations, field trip guides, topographic maps, and other literature that may be purchased by other state surveys, libraries, or interested citizens. In Virginia, the state survey is part of what is now called the Virginia Department of Mines, Minerals, and Energy, Division of Mineral Resources. The VDMR’s library is officially the state geology library of Virginia.

Since the library has no full-time staff, the doors are usually kept locked so that the geologists must let themselves in when they want to borrow something. They take what they need from the shelves and keep it in their offices until they are finished with it. Most of the patrons work in the Division, although the library also serves the needs of local genealogists who come to look at old topographic maps for family research, after making arrangements with VDMR staff members who can let them into the library. Until the day the last librarian retired, new books were assigned Library of Congress Classification call numbers and a card catalog was maintained, but no one kept up the cards after he left. Today the shelves are each labeled with a number and a letter, and library patrons may use a “Quick Index” to figure out in which general area they should search. There is no searchable catalog available for researchers; the holdings are kept in simple Excel spreadsheet inventories in a folder on the Division’s network drive. There are many geologists from the department who work in field stations across Virginia who have to call people in the Charlottesville office to ask if the library has a certain volume. The geologists would like to have a proper catalog available online, but they lack the budget and manpower to put such a system in place. Most of the day-to-day operations of the library have been neglected over the past 10 years, so that now the books are in a complex order according to what collection they belong to, and there are no complete inventories of what exactly is on the shelves and where. Some of the books and maps are more than a hundred years old, and an archival committee has recently been established to address preservation issues. No one person is responsible for the library, and there is no budget or set process for acquiring new books.

Several of the VDMR geologists asked that I help them create a plan of action for organizational improvements in the library, involving recommendations for workflows, designing a budget, and creating an online catalog, among other things. I visited the library
several times and communicated with many of the staff members to determine the needs of the library and the Division of Mineral Resources. After evaluating the strengths and weaknesses of the library, reviewing library science literature, and talking with many geology librarians, I have assembled a set of ideas for the VDMR Library. This “plan of action,” most of which is included in the body of this paper, highlights ongoing responsibilities and short- and long-term projects that staff members should address in order to keep their library functional, relevant, and useful.

Figure 1. VDMR Library 2007 (All photos by S. Z. Hodkinson, 9-15-2006)

Informal discussions with geologists who work in the libraries or resource centers of other state surveys showed that most of VDMR’s peers are in similar situations. State governments have been allocating less and less money for their geological divisions and as a result many state geological surveys have had to cut money from the library budgets. Compared with other agencies, VDMR is fortunate to have such a grand, fairly organized library facility, and also to have several staff members who still care about the fate of their library.

The final product of this project was a binder containing a variety of useful materials for VDMR. Along with my checklists, instructions, and recommendations, I included some relevant articles, pamphlets, and notes that will help them get started on their library renaissance project. The geologists at
VDMR have a superior facility, and this project will help them get closer to realizing the potential of their own library with the resources that are already available to them.

PROCEDURES AND WORKFLOWS

One of the main concerns of the VDMR staff is the lack of set library procedures. In this section I will describe some simple low-maintenance processes for keeping up the library, and list responsibilities for each process so that they may be formally divided among staff members. Even if most of these tasks are regularly taken care of, it is important that they are formally designated as the responsibilities of specific people so that the library can continue to operate smoothly without a librarian. The processes of acquisition (Figure 1), circulation (Figure 2), inventory (Figure 3), collection development (Figure 4), and reference service (Figure 5) for the VDMR are described in detail below, followed by a step-by-step list of actions. “Type of Action” refers to how much effort or thought must be put into each task, which may help in the delegation of responsibilities.

Acquisition of Books

Division geologists may find throughout the course of their research certain books that they believe would be important to own. When this happens, someone in VDMR should have the responsibility of deciding to purchase it and then allocating the proper funds for the purchase. The order must be placed and recorded, and when the book arrives, it should be “checked-in” before it is sent to the geologist who requested it originally. As soon as it arrives in the mail, it should be stamped to show that it belongs to the VDMR Library, and then someone needs to decide where it will fit in the organizational scheme of the library. If it is a series book, like a state survey publication, then this decision is easy because it will fit into the numerical scheme of the existing series on the shelves.

If the book is just an individual title, then someone will need to determine its call number. Most books that are published now have a Library of Congress Classification (LCC) call number on the back of their title pages under the subject headings, so it should not be too hard to find. LCC call numbers have a letter or two followed by a few numbers and letters, based on the subject of the book; for example, the call number for a book about Virginia Minerals would look something like “QE375.D54.” If you can’t find a call number on the back of the title page, you can also search catalogs of other libraries to see how they have cataloged it (given it call number). The best place to search is a comprehensive database called WorldCat, at www.worldcat.org. This site allows you to simultaneously search the catalogs of more than 10,000 libraries across the world. Type the title of the new book in question into the search box, and then click through the results to find a call number that another library has assigned to it.

After determining the call number, make a small label with just the call number, and place at the bottom of the spine, or at the bottom left side of the cover if the spine is particularly thin. Be sure to record the book in the library’s database or shelf list too, and include the Title, Author, Publication Year, Call number or Series, and any other pertinent information in a note. Finally, make sure the geologist who wanted the book originally knows that it is available.

<table>
<thead>
<tr>
<th>Potential Acquisition Process for the VDMR Library</th>
<th>Type of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Staff member recommends a book to purchase</td>
<td>Open</td>
</tr>
<tr>
<td>2. Decide if VDMR should buy it for the library</td>
<td>Administrative</td>
</tr>
<tr>
<td>3. Decide which fund will pay for the book</td>
<td>Administrative</td>
</tr>
<tr>
<td>4. Place order</td>
<td>Technical</td>
</tr>
<tr>
<td>5. Receive book</td>
<td>Technical</td>
</tr>
<tr>
<td>6. Stamp inside cover with VDMR library property stamp</td>
<td>Technical</td>
</tr>
<tr>
<td>7. Decided where book should eventually go in the library</td>
<td>Administrative</td>
</tr>
<tr>
<td>8. If not a series, find call number for the book</td>
<td>Technical</td>
</tr>
<tr>
<td>9. Put call number or identifier on the book's binding</td>
<td>Technical</td>
</tr>
<tr>
<td>10. Record information in shelf-list or database</td>
<td>Technical</td>
</tr>
</tbody>
</table>

Figure 1. Potential acquisition process for the VDMR Library
Circulation

Without a librarian or assistant to sit at the “circulation desk” all day, circulation procedures do not need to be too elaborate. A simple sign-out sheet on a clipboard should suffice, with columns for the title, author, geologist’s name and extension, and the date. This is important because all the books in the library should be accounted for at all times. If people take books at will without recording them, then someone else may come looking for a specific book, not be able to find it, and potentially order a second copy. A sign-in sheet allows staff to see who has what, and coordinate sharing the book if necessary.

Since there are probably a lot of VDMR library books hiding in bookshelves in offices across the building, it would be a good idea to send an email to all employees of the Division asking them to please submit a list of the books they have. If they could simply send a quick reply with the names and authors of the library books they have, then these could be added to the circulation sheet and later accounted for in the inventory.

<table>
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<tr>
<th>Potential Circulation Process for the VDMR Library</th>
<th>Type of Action</th>
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<tbody>
<tr>
<td>1. Type up sign-out sheet and sign with instructions</td>
<td>Technical</td>
</tr>
<tr>
<td>2. Place sign-out log and sign in prominent spot</td>
<td>Technical</td>
</tr>
<tr>
<td>3. Email to staff about new policy and asking for info</td>
<td>Administrative</td>
</tr>
<tr>
<td>4. Record precisely checked out books on sign-out log</td>
<td>Technical</td>
</tr>
<tr>
<td>5. Add new pages to sign-out log as necessary</td>
<td>Technical</td>
</tr>
</tbody>
</table>

**Figure 2.** Potential circulation process for the VDMR Library

Inventory

The VDMR Library should do an inventory of their holdings every year or two to make sure that the books are in order and that the library has an accurate record of the holdings. If several staff members can be involved, it should only take about a week of work. The library inventory event may be organized like the annual inventory of the store: any members of the staff are invited, and encouraged to participate with incentives such as free coffee and doughnuts. Each member of the inventory team should be given a printed list of a section of the stacks, and then s/he will be able to read through the shelves and check off the presence (or note the absence) of each book or serial.

<table>
<thead>
<tr>
<th>Potential Inventory Process for the VDMR Library</th>
<th>Type of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Decide date for inventory</td>
<td>Administrative</td>
</tr>
<tr>
<td>2. Solicit volunteers (remember incentives/compensation)</td>
<td>Administrative</td>
</tr>
<tr>
<td>3. Print out lists of books from the spreadsheets or database</td>
<td>Technical</td>
</tr>
<tr>
<td>4. Explain process to volunteers and delegate responsibilities</td>
<td>Administrative</td>
</tr>
<tr>
<td>5. Go through each shelf with the lists and check off what is are present</td>
<td>Open</td>
</tr>
<tr>
<td>6. Compile inventory results in database or spreadsheets in “Notes” field</td>
<td>Technical</td>
</tr>
</tbody>
</table>

**Figure 3.** Potential inventory process for the VDMR Library

Collection Development

There is no apparent collection development policy in place at the VDMR library, most likely because the library does not have its own budget. If there were more money available, however, relevant books and materials should be ordered as soon as they are available, rather than on an as-requested basis. Ideally, there should be a policy that states the specific subject areas that the library wants to collect, and then someone would be responsible for searching print and online catalogs for relevant books, state survey publications, or theses and dissertations. With as little as $5,000 a year allotted for collection development, VDMR could greatly enhance the quality of their collection with up-to-date publications and would be able to provide geologists with important resources before they even need to ask for them.

There are many sources for finding information about new publications. First of all, it may be helpful to look
through the publications of other state surveys. The website of the American Association of State Geologists has links to all the state surveys, which may lead to some important publications: www.stategeologists.org. There are mailing lists of GSA, AGU, or other societies that publish relevant texts, and they will send catalogs of their featured publications. To learn about new theses and dissertations, it may be best correspond with the geology departments themselves. Departments’ websites usually describe current research, and it is often possible to request copies of interesting theses directly with minimal cost.

Another facet of collection development is weeding, which may or may not be an important task for VDMR. Currently there is plenty of space for older books, but the library may find in the future that they would like to keep only the newer or more relevant resources in the library. As it is, the old books are fine where they are, so this is not a task that needs to be addressed immediately. However, if VDMR decides on a more aggressive collection development policy and space becomes limited, it is appropriate to discard old volumes that no one is using. Most libraries have to weed their collections every few years, though it is usually a process that is not talked about very much.

<table>
<thead>
<tr>
<th>Potential Collection Development Process for the VDMR Library</th>
<th>Type of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Determine collection development policy and budget</td>
<td>Administrative</td>
</tr>
<tr>
<td>2. Search for new or important publications</td>
<td>Administrative</td>
</tr>
<tr>
<td>3. Recommend purchases</td>
<td>Administrative</td>
</tr>
<tr>
<td>4. Address weeding</td>
<td>Administrative</td>
</tr>
</tbody>
</table>

**Figure 4.** Potential collection development process for the VDMR Library

**Reference Questions**

A small but important responsibility for VDMR staff is answering questions about the library’s holdings. While this has probably been addressed already, one person should be designated as the official contact person to answer questions about the library. This person’s email address and phone number should be listed on the website as well. When any questions come from community members or VDMR staff about library holdings or services, a designated public service representative should answer them.

<table>
<thead>
<tr>
<th>Potential Reference Process for the VDMR Library</th>
<th>Type of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Designate one person to answer reference questions</td>
<td>Administrative</td>
</tr>
<tr>
<td>2. Provide this person’s contact information on the website</td>
<td>Administrative</td>
</tr>
<tr>
<td>3. Have any library-related questions referred to the contact person</td>
<td>Technical</td>
</tr>
</tbody>
</table>

**Figure 5.** Potential reference process for the VDMR Library

**RECOMMENDATIONS**

The VDMR library is fortunate to have such a good facility and concerned staff members, and it appears to have been well maintained for a special library with no librarian. The 10 recommendations tasks and projects listed below for would significantly improve the quality and effectiveness of the library. They are described in greater detail in the following section. This list is in order of urgency and feasibility, with the simplest and most important first.

1. Delegate responsibilities.
2. Have one VDMR staff member join GSIS and Geonet Listserv.
3. Create a database of library holdings.
4. Inventory holdings.
5. Create a simple webpage for the library.
6. Address security and archival concerns.
7. Scan old maps and slides and create a “digital library.”
8. Establish partnership with UVA for staffing and document delivery.
9. Reorganize books according to LCC.
10. Hire a professional librarian.
Delegate Responsibilities

Currently there are several geologists who are concerned about the state of the library, but no one is specifically responsible for it according to their job descriptions. The concerned geologists should meet as a team to decide who is willing to accept which responsibilities. They may use the lists of workflow procedures listed in the previous section to designate tasks. Also, the fewer people directly involved with regular upkeep of the library, the better, because there should be a centralized workforce. If library responsibilities can be added to specific staff members’ job descriptions, that will also help people from feeling that they are being overburdened with too many expectations.

Join the Geoscience Information Society

The Geoscience Information Society (GSIS) is a well-established organization for geology librarians and information professionals. The society was organized in 1965 and is part of AGI and GSA, and they meet annually at the GSA conferences. They are an extremely friendly and supportive group of people, and some of the members are professionals who also are not technically librarians but who work in state survey libraries. The cost of membership is not prohibitive, and it would be very useful if someone at VDMR joined the Society. More information and instructions on how to join can be found online at www.geoinfo.org.

GSIS also runs a listserv called Geonet, which (as of 2007) does not require membership to join. On Geonet, librarians, geologists, and publishers post all kinds of information, from requests for advice about specific projects to announcements of new publications or the availability of free extra copies of books or serials. It is a wonderful resource, and it would be wise for at least one of the VDMR geologists to sign up to receive these messages. It is very reassuring to be part of a network of people who are dealing with the same sorts of issues and opportunities in other geology libraries.

Create a Database of Materials

In order to help the library reach its full potential, there needs to be a searchable database that can be used by any Virginia geologist. There should be a simple database in which one may search for author, title, or keyword (any word mentioned in the record). This should be accessible from any of the field offices in Virginia in a password-protected online location. By importing Excel spreadsheets into a MicroSoft (MS) Access database, this can be done with minimal effort. There is probably someone at VDMR who has a technical understanding of database design and would be able to accomplish this. MS Access should allow someone to make a relational database that is updatable through a user-friendly form, and easily search for particular records. MS Access is a good program to use because it does not require any outside purchases, and there is a vast amount of support for it readily available on the web. A lot of the other state survey libraries have made Access databases for their holding records and have been pleased with the self-sufficiency that it provides.

There are many other options for creating a catalog if there were more money or time available. Many information technology companies sell programs for small, independent libraries who want to “automate their systems,” and one may find vendors of these programs at the Special Library Association annual conference. One such company used by a few small geology libraries is Inmagic™ (http://www.inmagic.com/). They can help create a database that would be searchable online (a webpublisher), and are supposedly one of the least expensive companies to provide this service, from as low as $5,000. Their representatives say that the main product, Inmagic Genie, can cost from $3,000 to $15,000 to implement, depending on the system. Spectrum 5.3 (http://www.sagebrushcorp.com/tech/spectrum.cfm) is another “library technology solution” that is used by at least one other state survey library.

Inventory Holdings

This is one of the processes that I described in the previous section, but it needs to be reemphasized here. The holdings of the library must be kept in order, and it is very important that the Excel spreadsheets or database have an accurate picture of what materials are currently in the library. Inventory should be done every few years, but it should not be too intimidating a task. One of the main advantages of having a number of geologists helping out with the inventory is that they will get an opportunity to see what the library has to offer, and they may be encouraged to use it more often. A group inventory project may provide VDMR with a new and well-deserved sense of pride in their library, which is always healthy for an organization.

Create Library Webpage

A lot of the state survey websites have a simple page of information about their library facilities. I think that VDMR would do well to create something like this, whether or not they wish to draw in non-geologist patrons. Since the VDMR should be the premier
Geology Library in the state, there needs to be a more information about it on the web. A half-page would suffice, with some basic information such as the scope of the library, who to contact for more information, and a sunny-looking picture of the reading area. Some of the states with good examples of simple library webpages are California (http://www.consrv.ca.gov/cgs/information/publications/library/), Illinois (http://www.isgs.uiuc.edu/library/), Maryland (http://www.mgs.md.gov/library/), and Washington (http://www.dnr.wa.gov/geology/library.htm).

Address Archival and Security Concerns

As is already apparent, there are many issues involved in preserving the valuable materials housed in the stacks of the VDMR Library. VDMR has done well already to have established an archival committee, and the work and brainstorming of this group should be continued and encouraged. The Geoscience Information Society, which was mentioned in the second task, has a Preservation Committee that could be a good source of advice in this work. They have a very helpful website (http://www.libraries.psu.edu/emsl/guides/gsis/default.html) which has links to a variety of useful materials for archiving geology-related materials, finding funding for such projects, and other relevant links.

When evaluating security, it will be important to develop a plan for protecting some of the older and more valuable materials. One might consider keeping some of the classic USGS publications and other treasures in shelves in the library office. Many libraries keep older volumes in locked “storage” areas or even in shelves in the regular library with “cages” around them that have to be unlocked and opened for access. It will certainly help the library’s security to keep a geologist working in the library office. As soon as some circulation procedures are established and the inventory is current, everyone should feel much more confident about the safety of the special materials.

Create a “Digital Library”

There are all kinds of important materials housed at VDMR, and it would be a great service to the Commonwealth if they were digitized and made available online. Maps, slides, mineral and fossil descriptions and other documents could be scanned and organized so that they could be accessible to educators and citizens across Virginia. Once they are scanned, the original documents may be sent to Richmond to be stored permanently at the Library of Virginia. This would be a great project for VDMR, and could probably be accomplished with the help of a few dedicated summer interns and some grant money from the state. All of the old topographical maps could be scanned and made available for purchase as a CD-ROM along with the other Virginia geological publications.

Establish Partnership with UVA

Many of the state survey libraries work as partners with their neighboring state universities, and it might be good for VDMR to look into establishing a closer relationship with UVa’s library system. Sometimes state geology libraries that are near universities can collaborate on projects and share resources. UVa has several branch libraries serving different departments, and they might be willing to work with VDMR if they thought it would be advantageous to have access to VDMR’s collection. UVa’s library administrators might be open to the idea of sharing their catalog system, and the VDMR library could benefit from the expertise of their cataloguers. Certainly UVa is an excellent source of student employees or interns.

Reorganize Books According to LCC

The previous librarian at VDRM apparently classified books according to the Library of Congress Classification System, and the rest of the books should be organized according to these call numbers as well. The numbered-shelves system seems to be adequate now because most people know where to find what they want, but the library would be a lot more accessible if the books and publications were in LCC order. LCC (like the Dewey Decimal System) is organized according to subjects, which makes browsing much easier. It would take some effort to reorganize the books, but I am certain that that would be one of the first concerns of a librarian if one were to be hired. Labels should be made with LCC numbers for each book and put on the spines (see the notes about acquisition procedures). Then materials should be rearranged in the proper order with new signs for the shelves. The unpublished materials that do not have call numbers could be kept in their existing collections, and the government documents could be kept “SuDoc” order (http://www.gpo.gov/su_docs/fdlp/pubs/explain.html).

Hire a Professional Librarian

Finally, since VDMR did ask a librarian for advice, my last recommendation is to hire someone with an MLS degree. The VDMR library can be (and has been) maintained without a librarian, but there are many things that could be improved with the help of a full time professional employee. People with a Master’s of Library Science degree have been trained to deal with
many different kinds of issues, and they know how to use available resources and professional networks to find solutions. A good librarian can help a whole organization to thrive by providing patrons with the resources that they need and by encouraging creativity and continual learning. Librarians have many skills that can bring vitality to a library like VDMR’s, especially now that so much information is available on the web. Obviously VDMR would have a librarian if they could afford it (the minimum for a professional librarian is usually $40,000), so for now VDMR will have to do the best they can with the present staff. The employees who do care about the library should be encouraged in their efforts and given the time they need for library-related work throughout the year. It might be useful to contact library and information science schools around the area to advertise a “field experience opportunity” for an MLS student who could devote a summer to the library. UNC-Chapel Hill, Catholic University, and the University of Maryland are the closest to Charlottesville and there is always a chance that there are students at those universities who would be eager to accept an opportunity to live in Albemarle County for a few months. If there ever is enough money, however, a full-time librarian will be a wise investment for VDMR.

CONCLUSION

The VDMR library has taken a brave step in facing their shortcomings and asking for help. Even though they have not been able to provide the resources necessary for large-scale improvements in the past decade and probably won’t for several more years to come, the people in charge of this library sincerely care about the future of the library. They understand that a number of improvements could be made to their library services, especially in the way it has been run from day to day. With a well maintained library and a functional, accurate catalog, VDMR could help their field geologists across the state to find the information resources they need, the genealogists of the community to know what materials are available to them, and the geologists who work in the department to know about all the great resources just down the hall that are there especially for them.

REFERENCES


Bryant, P., 1997, Making the most of our libraries: library catalogue access – the issues and opportunities: Library Review v. 46, n. 8, p. 554-560.


ACTIVE LEARNING TECHNIQUES TO TEACH INFORMATION LITERACY SKILLS

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swoger@geneseo.edu

Abstract — Traditional methods of  software and database instruction normally rely on extensive demonstrations of these tools. Students are traditionally passive, or instructed to follow along with the instructor through a series of pre-determined examples.

Librarians used active learning techniques to teach chemistry students to locate substance information using “SciFinder Scholar,” a user-friendly platform for Chemical Abstracts. We found that students responded enthusiastically to the lesson and were less likely to engage in other online activities during class. Working with classroom faculty, librarians prepared a lesson geared specifically to an assignment presented at the beginning of the class session.

Demonstrations by the librarians were very short, and only offered an introduction to the basic features of the tool. Students were then asked to work in groups, answering broad, open-ended questions that encouraged and led them to explore the SciFinder Scholar interface. Each group was asked to explore a slightly different aspect of the SciFinder Scholar search interface and to select a member of their group to present their findings to the class. Group presentations were highly variable, allowing instructors and librarians to emphasize the features that would have traditionally been presented in a lengthy demonstration.

After completing the assignment, students were asked to complete a brief survey assessing learning outcomes and students attitudes. While most of the students had not used SciFinder Scholar before, a majority responded that they would use it in the future. Usage statistics for the database indicate a large increase in usage following the instruction sessions.

The active learning techniques and group-work methods used in this class can be applied to instruction with other software or research databases. Mineralogy, Geochemistry, and other geology classes will also find SciFinder Scholar useful for locating chemical data.
THE PURDUE UNIVERSITY EARTH AND ATMOSPHERIC SCIENCES LIBRARY HISTORY

Carolyn J. Laffoon, Chris C. Miller, and Michael Fosmire
Purdue University Libraries
West Lafayette, IN
carolyn@purdue.edu; ccmiller@purdue.edu; fosmire@purdue.edu
POSTER HYPERLINK: http://docs.lib.purdue.edu/lib_research/77/

Abstract – A history of the Purdue University Earth and Atmospheric Sciences Library is presented through annotated pictures, maps, and aerial photos of campus. Originally presented April, 2007, at the 40th Anniversary Celebration of the Department of Earth and Atmospheric Sciences, Purdue University.

On July 1, 1967, the Department of Geosciences was formed in the School of Science; it was previously a part of the School of Engineering. The geology library materials were stored in the basement of the Chemical and Metallurgical Engineering Building and were a subset of the Civil Engineering Library collection. Dr. Wilton “Bill” Melhorn, the first department head, was instrumental in establishing the Geosciences Library.

In 1970, the department and library moved across the street into the old Pharmacy Building (line 1, photo 1). Located on the first floor of the Geosciences Building, the fire exit doors overlooked the old fountain situated in front of Hovde Hall of Administration. The library consisted of the main room, as well as a large room to the immediate southwest. Original built-in wooden shelves and several rows of old army-green surplus shelving housed the entire collection. As the collection grew, the library accessed the surrounding rooms, adding 3 additional rooms before moving to the newly constructed current location. The library title morphed from “Geosciences” to “Earth and Atmospheric Sciences” when the department changed names in 1986. In 1988 the Library moved, with the department, to its current location in the Civil Engineering Building (line 1, middle photo).

After one year in the Mathematical Sciences Library, Carolyn J. Laffoon assumed the position of library assistant in 1971. In 1986, upon obtaining her Master’s in Library Science from Indiana University, she was promoted to her current position of Professional Librarian of the Purdue University EAS Library.

Stewart Center Special Collections with the second campus map collection held by the Department of the Earth and Atmospheric Sciences.

Over the course of the existence of the EAS library, several faculty librarians have overseen the library, including: Richard Funkhouser, 1970-1980; Martha Bailey, 1980-1982; Dennis Parks, 1982-1986; D. Scott Brandt, 1987-1989; Robert “Pat” Allen, 1990-1997; and Michael Fosmire since 1998. Additionally, in August, 2006, Chris Miller joined the Purdue Libraries as its first GIS Librarian. Chris provides GIS services to the entire campus community.

The 34,000 volume collection consists of research materials primarily for geology, atmospheric sciences, geophysics, geochemistry, hydrogeology and environmental ecology. The EAS Library is a U.S. government depository collecting documents and maps dealing with geology and meteorology. An official depository for the U.S. Geological Survey, the library also collects state survey materials. The map room consists of over 204,000 maps and 140,000 aerial photos, including historical aerial photos of Tippecanoe County.

The most unique items in the collection are 4 volumes published as "Mosaic of Wabash River and Valley" by the U.S. Army Corps of Engineers in 1929 containing aerial photos of the Wabash River Valley and the topographic maps derived from them by a Philadelphia firm named "Brock and Weymouth, Inc." The photos are mounted on cloth, which has helped maintain their integrity. Dr. Robert Miles, retired Purdue University Civil Engineering professor, donated the 4 volumes to the library in 1988.
Interestingly, he retrieved them from the trash at the U.S. Army Corps of Engineers office in Louisville, KY. A 1940 article by Claude H. Birdseye notes that "the first commercial use of aerial photographs in making topographic maps in the United States seems to have been by a firm in Philadelphia that later became known as Brock & Weymouth." We believe Birdseye was describing this "Mosaic...", and he goes on to mention the Wabash and White rivers by name. The volumes therefore represent an early stage in the trajectory of remote sensing and mapping that came to drastically impact earth science (Birdseye, 1940). Wabash and White River Valley were chosen because Purdue University has the first university-owned airport (Purdue University Data Digest, 2006-2007). The US Army Corps of Engineers used the Purdue University Airport as their base from which to fly out. Recently digitized, they have been added to the GIS server (Miller, 2007).

The newly installed GIS lab, carved out of the map room, contains 4 GIS terminals with scanners and a 55" flat-map scanner (line 2, photos 3-5).

As the library looks toward the future, many potential changes both in services and facilities are possible. As materials become increasingly available electronically, sometimes to the exclusion of print, the storage needs of print materials will drop, and the library space might be repurposed for enhanced study and productivity among users. Alternatively, consolidation of physical spaces, for example, collapsing the nine science and engineering libraries into one main location would allow for users to get information in a physical format from many disciplines at one location, and would consolidate expertise of library staff, so we don’t need to refer questions and patrons to other libraries. Consolidating expertise may also allow the libraries to try out innovative services that cannot be handled by individual librarians, but with several energetic librarians in the same physical location, the ability to collaborate and innovate increases considerably. As time passes and the information landscape continues to transform, who knows what the physical EAS library will look like, or even if it will exist, but certainly the spirit of enthusiasm and service to our earth and atmospheric science users will continue on.

PURDUE UNIVERSITY GROWTH AS VIEWED THROUGH AERIAL PHOTOGRAPHS (1929-2005): (line 3 of poster)

Note these aerial photos have been cropped to show campus north of State Street and up to and including the football stadium.

Photo 3 (1929) is the first campus aerial photo ever taken using stereoscopic phototopographic mapping technology. (See description above.)

Photos 4 – 7 show campus growth progression from years 1939-1990. (See captions for more information.)

Chris C. Miller created this aerial photograph (photo 8) by rectifying the 1939 aerial photo against 2005 data and displaying both in Google Earth. Since this photo was created, a team at Purdue's Envision Center has generated much more complex, textured 3-D building models that can be zoomed in and rotated 360º (Purdue School of Engineering).

REFERENCES


PART 3. Geoscience Information Society Forums
## SCHEDULE OF EVENTS

*Note: GSIS Committees – Meet separately as arranged by committee chairs*

### Saturday, October 27
- 9:30 a.m. – 4:00 p.m.: Geoscience Librarianship 101  
  - Location: Auraria Campus
- 6:00 p.m. – 9:00 p.m.: GSIS Executive Board Meeting  
  - Location: Hyatt Regency, Quartz AB

### Sunday, October 28
- 9:30 a.m. – 12:30 p.m.: GSIS Business Meeting  
  - Location: Hyatt Regency, Mineral Hall BC
- 2:00 p.m. – 5:00 p.m.: GSIS Collection Development Forum  
  - Location: Hyatt Regency, Mineral Hall BC
- 5:30 p.m. – 7:30 p.m.: Exhibits Opening & Welcome Reception  
  - Location: Colorado Convention Center

### Monday, October 29
- 8:00 a.m. – 12:00 p.m.: GSIS Topical Papers Session:  
  - Topic: Geoscience Information – making the earth sciences accessible for everyone  
  - Location: Colorado Convention Center, Room 603
- 5:00 p.m. – 11:00 p.m.: Alumni Receptions  
  - Location: Hyatt Regency

### Tuesday, October 30
- 9:00 a.m. – 12:00 p.m.: GSIS E-Resources Forum  
  - Location: Hyatt Regency, Capitol Ballroom 5
- 12:00 p.m. – 2:00 p.m.: GSIS Luncheon and Awards  
  - Location: Hyatt Regency, Mineral Hall E
- 2:00 p.m. – 4:00 p.m.: Special Session: USGS Library – Looking forward  
  - Location: Hyatt Regency, Capitol Ballroom 6
- 6:00 p.m. – 9:00 p.m.: GSIS Reception and Silent Auction  
  - Location: Hyatt Regency, Granite A

### Wednesday, October 31
- 8:00 a.m. – 12:00 p.m.: GSIS Poster Session: Park your Public Lands by your Library  
  - Location: Colorado Convention Centre
- TBA: GSIS Executive Board Meeting  
  - Location: Exhibit Hall E/F
GEOSCIENCE LIBRARIANSHIP 101

A SEMINAR PRESENTED BY THE GEOSCIENCE INFORMATION SOCIETY

Saturday, October 27, 2007
Jerry B. Robinson Library Instruction Lab, Room 245
Auraria Campus Library
1100 Lawrence Street
Denver, CO

9:15 a.m. – 9:30 a.m. Check in and continental breakfast (in the adjoining break area)

9:30 a.m. – 9:40 a.m. Welcome and introductions
Moderator: Andrea Twiss-Brooks

9:40 a.m. – 11:00 a.m. Reference and Instruction
Instructor: Andrea Twiss-Brooks
• Overview of reference in geosciences, including instructional role
• Demo/exploration of some specific resources – GeoRef, but also low cost, readily available resources

11:00 a.m. – 11:10 a.m. Break

11:10 a.m. – 12:30 p.m. Collection Development
Instructor: Lisa Dunn
• Overview of collection development
• Managing electronic resources – e-journals, GSW, USGS publications, usage statistics/management, e-only vs. retaining print, State geological surveys, open access journals

12:30 p.m. – 2:00 p.m. Lunch and networking

2:00 p.m. – 4:00 p.m. Maps and geographic information systems (GIS)
Instructors: Linda Zellmer and Adonna Fleming
• Introduction to maps
• Overview of spatial geoscience information and GIS
  ○ GIS and the library’s role – Demo of GIS software? Where to find more help? Sites to visit
• GIS data sources and applications

4:00 p.m. – 4:30 p.m. Feedback and wrap up
Moderator: Andrea Twiss-Brooks

Thank you to Springer and the Auraria Library for their generous support of Geoscience Librarianship 101.
COLLECTION DEVELOPMENT FORUM

Sunday, October 28, 2007
Hyatt Regency, Mineral Hall BC

2:00 p.m. – 2:10 p.m. Introductions and Welcom
Chestalene Pintozzi, Chair
Collection Development Issues Committee

2:10 p.m. – 2:50 p.m. Geological Society of London Presentation of developments and changes in their electronic products
Neal Marriott, Director of Publishing
Geological Society of London

2:50 p.m. – 3:30 p.m. Springer overview of their electronic products focusing on electronic books
• content relevant to geosciences
• unique features
• plans for the future
Cynthia Cleto, Global Manager for eBooks
Springer

3:30 p.m. – 4:30 p.m. Panel of Librarians discussing aspects of their experiences implementing electronic books
• John Hunter, Rice University
• Mary Scott, Ohio State University
• Andrea Twiss-Brooks, University of Chicago
• Nancy Sprague, University of Idaho

4:30 p.m. – 5:00 p.m. Identification of issues for investigation by the committee

Thank you to the Geological Society of London for their generous support of the GSIS Collection Development Forum.
COLLECTION DEVELOPMENT FORUM REPORT

Moderated by Chestalene Pintozzi, Collection Development Issues Committee Chair

Originally published in GSIS Newsletter, Number 229, December 2007

The Forum held on Sunday, Oct. 28, 2007 from 2-5 pm was well attended. The agenda included: 1) Michael Noga’s serials pricing update; 2) a presentation by Neal Marriott, Director of Publishing, Geological Society of London; 3) a presentation by Cynthia Cleto, Global Manager of Springer eBooks; and 4) a panel discussion on implementation of e-books in member libraries.

To begin the session Michael Noga, Collection Manager for the MIT Science Library, presented his most recent analysis of geoscience journal prices. He distributed a list of prices and percentage increases for 229 print editions of geosciences journals. The average price change per title for 2008 is 9% and the average overall price change is 7%. In addition, Michael distributed a comparison of the average number of citations between Nature Materials and Nature Genetics articles and articles on similar topics in Nature Magazine. The Geoscience Journal Prices information will be published in the Newsletter.

Neal Marriott’s presentation focused on the Lyell Collection. He presented an overview of new developments and a series of responses to questions that have been raised and summarized library subscription options. Neal noted that some books will be added, that there are a few gaps in runs of serials at this point, and that more content will be added in 2009. The option to phase out print will be made available then. He encouraged members to set up trials and noted that the collection doesn’t require a license as they are supporting the SERU (Shared E-Resource Understanding) initiative developed by NISO. Neal’s presentation will be posted on the GSIS website and more information about the collection is available at http://www.geolsoc.org.uk/gsl/publications/lyellcollection. Neal may be contacted at neal.marriott@geolsoc.org.uk.

Cynthia Cleto presented an overview of the Springer e-book collection. She noted that all Springer e-books are available on SpringerLink directly and through agents and also available title by title through third party vendors. However, series and textbooks are not available through third party vendors. Theirs is an ownership model with libraries buying a copy of an e-book in the same way as they would buy a print volume. Springer also offers 13 subject collections with discounts available for purchase of annual packages. Geoscience books are included in the Earth and Environmental Sciences collection. Additional information about the e-book collections is available on the Springer website at http://www.springer.com/west/home/e-content/ebooks?SGWID=4-40791-0-0-0&SHORTCUT=www.springer.com/ebooks under the “For Librarians” link. Cynthia noted that pricing is tiered and based on two variables: size (FTE) of the institution and research intensity. She also reported that Springer believes the problem with time lag between print and electronic editions has been resolved and that there will be no time lag in 2008. She also noted that they are contracting with OCLC to provide MARC records with a lag time of only one month. Cynthia may be contacted at cynthia.cleto@springer.com.

John Hunter, Rice University; Mary Scott, Ohio State University; Nancy Sprague, University of Idaho; and Andrea Twiss-Brooks, University of Chicago participated in a panel discussion of their experiences implementing e-books. John reported that Rice’s experience had both positive and less than positive aspects noting that many MARC records didn’t match the titles. He also noted that pricing issues continue to be problematic. Their users want materials at the desktop but encounter downloading limits and requirements to print materials page by page. He noted that Rice continues to monitor quality of their e-books. Mary noted that Ohio State is part of OhioLink so decisions were out of their hands. She reported that they currently have a number of e-book collections including Safari for computer science, Oxford University Press, ebrary, and that they had NetLibrary although they had problems with maintaining accurate catalog records. They find that they have to keep a file of Springer books and check timeframe for electronic
editions. Andrea talked about the University of Chicago collections where they have centralized their science libraries and have tried every type of model for selecting and obtaining e-books. They prefer direct orders for discounts. Some of the problems they have encountered include licensing, restrictions on use, building internal agreement among bibliographers to cancel pricing. She reported that a major issue is how to integrate e-books into the user search and discovery process. They have two records – one for print and one for electronic and are considering collapsing them into one. Nancy talked about the University of Idaho experience in terms of the library being a small institution with a limited budget. They have a high interest in online resources because of the scattered locations of their users. They added NetLibrary, Books 24/7 and ebrary and are now at a point where they plan to stop and look at usage. She said that they are assessing how well science e-books are being used and noted that it is not easy to compare usage statistics across packages. They are trying to break down their data by subject in order to have an LC breakdown correlated with use. Some discussion followed with the issue of discipline emerging as a key concern for many.
GEOSCIENCE INFORMATION SOCIETY AWARD WINNERS 2007

Mary B. Ansari Distinguished Service Award
John G. Mulvihill
   Vienna, Virginia
   American Geological Institute GeoRef System, Retired

Mary B. Ansari Best Reference Work Award
Scott A. Elias, Editor-in-chief
   Royal Holloway, University of London

Best Website Award
Robert Steward
   Texas A&M
For his website “Ocean World”
   http://oceanworld.tamu.edu

Best Paper Award
Lura E. Joseph
   University of Illinois at Urbana-Champaign

Best Guidebook Award
Spencer G. Lucas
   New Mexico Museum of Natural History and Science
Kate E. Ziegler
   University of New Mexico
Virgil W. Lueth
   New Mexico Bureau of Geology and Mineral
Donald E. Owen
   Lamar University
   (http://geoinfo.nmt.edu/publications/nmgs/guidebooks/56/NMGS_56.pdf)

Carol S. Prentice
   U.S. Geological Survey, Menlo Park
Judith G. Scotchmoor
   University of California Museum of Paleontology
Eldridge M. Moores
   University of California, Davis, emeritus
John P. Kiland
   KPW Structural Engineers, Oakland, California
Editors for their publication *1906 San Francisco earthquake centennial field guides*, Geological Society of America, Field trips associated with the 100th Anniversary Conference, April 18-23, 2006.
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