

Chapter 16
Grey Literature in Karst Research:
The Evolution of the Karst Information Portal (KIP)

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16.1 Introduction

The Karst Information Portal (KIP) is a digital library linking scientists, resource managers, and explorers with quality information resources concerning karst. Beginning in 2006 as a partnership between the University of South Florida Libraries, the National Cave & Karst Research Institute, the University of New Mexico Library, and the Union Internationale de Spéléologie (UIS), the KIP initiative has expanded to include databases concerning cave minerals, speleothem dating, and coastal cave surveys. This chapter outlines the project's evolution and describes efforts to improve information access and preservation for karst researchers, a globally distributed research community characterized by a highly interdisciplinary knowledge base often drawn from and memorialized in grey literature.

16.1.1 What is Karst?

Karst is a globally distributed terrain resulting from the dissolution of soluble rocks, such as limestone and dolomite. This dissolution occurs when rain water infused with carbon dioxide passes through layers of soil and bedrock (see Figure 1). Karst regions contain aquifers and geological structures, such as sinkholes, springs, and caves, many rare and endangered species, as well as significant archaeological and paleontological resources (Culver et al. 2000; Culver et al. 2001; LaMoreaux 2005; Northup, et al. 2003; Straus 1979).

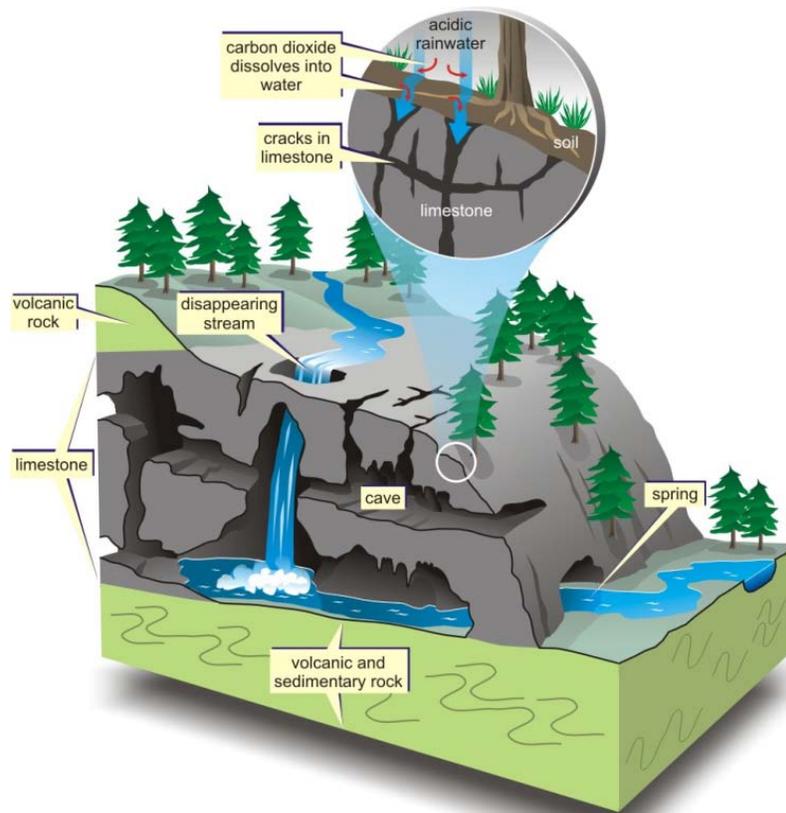


Figure 1. Karst Terrain (Natural Resources Canada).

Globally, approximately 1.6 billion people depend upon the health of karst terrains and aquifers for drinking water (Drew and Hotzl 1999; Ford and Williams 2007). Geologic hazards in karst cost billions of dollars each year (Cobb and Currens 2001), yet karst is the least studied and most vulnerable type of terrestrial landscape (Williams 1993). The full potential of karst for benefit or hazard to the global ecosystem, including humanity, remains poorly understood. The karst research community seeks to facilitate better, science-based management practices in karst terrains worldwide (Veni et al. 2001).

16.2 Project Background

In 2005, an interdisciplinary group of faculty, librarians, and graduate students at the University of South Florida (USF) met to discuss global information needs. This group prioritized meeting both institutional and community challenges facing water resource managers and more specifically those concerned with karst terrains, a complex and vulnerable type of geologic landform common throughout Florida. The group decided to construct an information portal centering on karst research that the USF Libraries would host and maintain in collaboration with related academic departments.

In January 2006, a group of 29 scientists, information specialists, and policy makers representing 18 organizations from across the globe met in Carlsbad, New Mexico, to explore development of the Karst Information Portal (KIP) to serve as a repository for karst information,

to advance collaboration among the international community of karst researchers, and to promote knowledge discovery through innovative applications of metadata.

16.2.1 Who is Engaged in Karst Research?

Karst researchers come from a variety of established disciplines, including anthropology, biology, chemistry, geology, and geography. Engineers have a pressing need to understand karst environments in order to mitigate geohazards, such as sinkholes, and to appropriately manage water resources. Space scientists' recent interest in the potential for extraterrestrial caves to shelter and support Mars explorers led to increasing focus on terrestrial cave environments. Finally, land use and resource managers as well as policy makers depend on the work of this diverse cadre of scientists for an appropriate foundation for best management practices in karst terrains.

All of these scientists bring unique discipline-based theoretical frameworks and methodologies to the challenge of understanding karst environments. USF Department of Geography Chair Robert Brinkmann summarized the challenge to the consumer of this important research during his 2007 presentation to the International Congress on Karst Hydrogeology & Ecosystems:

“The karst community and its knowledge base are in some ways similar to French cheese – and not because of the amount of time each spends in caves. Rather it is a fragmented community, often identified with a region or a specific cave or discipline. And so goes the information that services the research. Given the example of the US wherein we typically limit ourselves to consuming just four varieties of French cheese, how can we learn about the other types without affirmative efforts to share and collaborate in research and in the production, dissemination, and preservation of karst information resources?”

16.2.2 What Does Karst Research “Look” Like?

Historically, early karst research fell into a “marginal” category of scientific inquiry and has only recently migrated from those margins of traditional disciplines to positions of more central concern and inquiry (Veni 2007). Today, the karst research community's information environment is as highly interdisciplinary as those engaged in the research. An understanding of this environment is an important part of any attempt at a comprehensive solution to an array of global social, environmental, and health challenges.

NCKRI Executive Director George Veni describes the pre-1950 period as the “Curiosity” phase during which the term “karst” was unknown; minimal data concerning the geomorphology and hydrology of caves and karst existed; caves were curiosities found on the remote margins of human population centers; and karst aquifer behavior was at variance to known hydrologic principles. Beginning in 1950 and extending to roughly 1980, the “Experimentation” period saw significant increases in the quantity and diversity of cave- and karst-data collected through exploration and surveying activities, although scientific understanding of the emerging concepts

were largely confined to a small cadre of individuals. One of the reasons for the marginalization of karst research concerns the involvement of non-academics in data collection and exploration. Like ornithology and astronomy, cave and karst research benefits from involvement of a significant number of “amateurs” who are passionate about caving and preservation of these resources (Palmer 1996). Many of these individuals joined the ranks of the academically trained scientists in the 1950s, thereby increasing interest in karst research topics.

A significant proportion of the information produced during the “Curiosity” and “Experimentation” periods found its way into the grey information realm. Few established scientific journals published these dedicated amateurs’ work, so their findings were reported in such grey channels as cave club (“grotto”) newsletters, personal reports circulated to a narrow audience, and vertical files in organization offices.

Veni refers to the years 1980-2009 as the “Application” period, a time when karst became broadly known – perhaps as a result of pressures to improve land and water resource management and to understand climate change – but remained poorly understood. Karst topics more frequently began to appear at non-karst conferences and increasing numbers of non-caving scientists became interested in karst environments and published their work in the “white” literature. This was confirmed in a recent study of four widely-used scientific indices, where searches using 632 karst-related terms determined that, over the period 1980-2005, publication on cave and karst themes increased substantively (Florea, Fratesi, and Chavez 2007).

Because karst researchers are faced with discovering and evaluating relevant information sources and obtaining and preserving “grey” karst information sources, an online, open-access portal that contained grey information useful to karst researchers was suggested and a needs assessment performed.

16.3 Defining the Karst Information Portal’s Grey Information Mission

Modern geological research depends as much, if not more, on previously known information than on new data. Yet, a significant proportion of the findings generated by formal and informal research fail to find its way into the published scientific literature, instead becoming part of the growing body of grey information. Grey information is a critical research element in many scientific disciplines (see Aina 2000; Bichteler 1991; Cordes 2004; Dunn 2004; Gelfand 1998; Hanner 1990; Musser 2003; Noga 2004; Sulouff et al. 2005; Trivelpiece et al. 2000; Weintraub 2000), and thus its importance for karst researchers must be accurately assessed.

Planning the Information Needs Assessment

In 2006, information specialists from the University of South Florida Libraries and the School of Library and Information Science planned and conducted a global information needs assessment for the KIP. The survey elicited responses in three information need categories: 1) information content (e.g. format, subjects, and organization); 2) services (e.g. blogs, newsfeeds, and tagging

services); and 3) research tools (e.g. data-mining and computational utilities) (Chavez, et al. 2007).

Respondents received the definition of grey literature adopted during the Third International Conference on Grey Literature:

"[T]hat which is produced by government, academic, business, and industries, both in print and electronic formats, but which is not controlled by commercial publishing interests and where publishing is not the primary activity of the organization." (Farace 1998)

The phrase "non-refereed and self-published documents generated by speleological groups and other non-governmental groups/individuals such as expedition reports," was appended to the core definition to accommodate known grey information types of specific relevance to the karst community.

Consuming, Producing, and Accessing Grey Information Concerning Karst

Respondents (n=66) reported heavy consumption and production of grey information resources, with 96.6 percent reporting regular use of a variety of the 46 grey information formats listed in the survey. Conference proceedings/papers, trip and cave reports, theses/dissertations, and maps in any format were the most common. Responses to subsequent questions identified the aforementioned as the most commonly produced grey information resource, plus images, records of speeches or invited talks, and research proposals. All respondents reported difficulty locating all grey information types (except audio files), and the survey results reflected a strong correlation between the grey information types consumed/produced and difficulty locating same. For example, even though 86.2 and 80.8 percent of respondents reported consuming and producing conference papers, respectively, 47 percent reported difficulty in locating this information (Chavez et al. 2007, 9-11).

In terms of grey information consumption and production relevant to karst research, academic researchers account for a significant percentage (74.1) of respondents who report producing grey information in some format. Roughly 69 percent of the researchers contribute to conference proceedings, deliver speeches/invited talks, or generate images, while 55 percent produce trip and cave reports, and 51.7 percent create or contribute to cave registries or entrance databases. Reflecting the important role that non-academics play in karst exploration and research, the study concluded that 84.6 percent of self-identified cavers report producing grey literature, with trip and cave reports and cave registries or entrance databases the most frequent contributions. Responses also indicate that five of the six college or university student respondents produce grey information, including conference papers, theses/dissertations, trip and cave reports, images, datasets, and maps (Chavez et al. 2007, 8).

The survey confirmed previous usage studies as well as anecdotal reports, and it demonstrated that trip and cave reports are a significant special case of grey literature for karst researchers and cavers. This finding illustrates the importance of studies that focus on specific knowledge domains (e.g. Bichtler 1991, Corbett 1989, Derksen and Sweetkind-Singer 2003, Haner 1990, and Walcott 1990). Commonly called geological field trip books, trip and cave reports are

produced by local experts to support excursions into specific field locations. The reports typically include coverage of transportation resources and relate information about local cultural, geological and geographic features, and conditions at a specific point in time (Bichtler 1991, 41-42). Both grey and “white” publications often contain citations to trip and cave reports or field books, but, because they are often published by organizations lacking an infrastructure to facilitate wide distribution, librarians are hard pressed to acquire copies, and, once in hand, cataloging is a challenge (Haner 1990, 166-7; Walcott 1990).

Archiving Grey Information for Karst Researchers

Eighty-nine percent of the respondents to the survey reported that they produce grey information in some form, but 28.3 percent do not formally archive their output (Chavez et al. 2007, 11-12). Despite the clear need for a systematic archival and preservation strategy, the survey revealed an important consideration as the KIP emerged: data sensitivity. Respondents to the survey and participants in all of the subsequent presentations concerning the KIP initiative have expressed concern for the security of cave entrance location data and water-tracing information.

Additional Findings

Several survey questions focused on KIP’s potential for promoting collaboration via services or capabilities, such as file sharing, RSS feeds, blogs, data management tools, web indexing, and directory services. It is notable that, even with the advent of Google, a large percentage of respondents continue to rank searchable link collections and search tools (83.9 and 60.7 percents respectively) as important for inclusion in the portal. This suggests that domain-specific information portals are valuable tools for information discovery in specialized areas such as karst research.

Respondents generally supported social networking services to improve connections among those interested in karst issues. Non-academics generally supported but academic resisted allowing KIP managers to serve as evaluators of grey information . Regardless of their feelings about social networking or evaluation services, respondents indicated that grey information should be a key function of the portal, with 99 percent considering grey literature’s inclusion very or somewhat important and 96 percent rating grey literature digitization very or somewhat important (Chavez, et al, p. 14). These conclusions informed the KIP’s design as well as collection building priorities.

16.4 The Karst Information Portal

The Karst Information Portal (KIP) went online in June 2007 at www.karstportal.org. As of October 2009, KIP’s electronic collection contains 4,756 records. These items include 28 distinct document types, including images, maps, grey literature works, peer-reviewed journal articles, and raw data organized into databases. To remain current with developments in the field, graduate students in the geosciences and library and information science assigned to the KIP initiative systematically scour the Internet for karst-related resources. Researchers and authors are encouraged to upload their own work. This happens less frequently, but noteworthy content submissions deposited in this manner have occurred.

Access to KIP is freely available to the public; however, registration is required to take advantage of certain features and benefits. As of October 2009, 137 individuals from 12 different countries have registered. Upon registration, users are asked to indicate their areas of research interest or specialization. To date, users have self-identified 30 distinct areas of karst focus.

In 2007, KIP project partners met with representatives of the Union Internationale de Spéléologie (UIS), the international body for caving and speleology, to formalize an international partnership. As a result of the relationship, UIS members now collaborate on website design and governance as well as contribute to the growing collection of information resources.

Project planners initiated KIP's "soft-launch" in June 2007, with 1) a collection of nearly 3,000 bibliographic references to key karst information sources; 2) a small collection of scanned electron photomicrographs; 3) social networking applications, including RSS feeds, news services, community forums for online discussions, and a directory of relevant organizations and registered users; and 4) a collection of images and oral histories of key karst researchers. In July and August 2007, the project partners attended one national and three international conferences, in all cases presenting papers and leading discussions concerning KIP and its mission. User registrations increased 74 percent following these meetings.

In October 2007, a 1.0 FTE faculty line, designated "Assistant in Karst Information Management," joined the KIP team to drive portal expansion. The incumbent was a recent graduate of the doctoral program in geography with specialization in karst hazards and land use. In January 2008, a graduate student in the field augmented the faculty position. Both lines fell victim to a budget reduction in late 2009, but the project continues with support from a librarian.

16.4.1 The KIP Content Collection

The KIP collection emphasizes grey information and retrospectively digitized content from both the grey and white information realms. This strategy provides a valuable service to the karst community, given the considerable effort expended in pursuit of primary sources. It also alleviates the issue of effort duplication that occurs when researchers tackle problems that have, unbeknownst to them, already been addressed by other. This lack of awareness is often the direct result of important karst literature's inaccessibility.

Table 1 describes the collection in detail. The left column lists currently held information formats. The "Records" column details the number of records in that format. The "Digital Objects" column refers to the number of those records that link to internally held digital objects. The "Grey Information" column records the number of the records that meet the established definition of grey information (see Farace above) regardless of whether the item is locally held or available in print.

Table 1. Characteristics of the KIP Content Collection, October 2009.

Information Formats	Records	Digital Objects	Grey Information
Monographs	2774	14	817
Articles	624	58	0
Serials (Analytic)	364	312	109
Technical Reports	370	112	312
Newsletters	148	148	148
Trip & Cave Reports	126	57	126
Archival Materials	74	0	74
Proceedings	74	35	52
Internet Resources	51	0	0
Theses & Dissertations	40	3	40
Maps & Cartographic Materials	38	11	26
Databases	22	3	22
Oral Histories	14	14	14
Article Preprints	8	8	0
Visual Materials / Images	7	7	7
Book Chapters	7	0	0
Bibliographies	5	4	4
Power Point Presentations	4	4	4
GIS Data	3	0	3
Microforms	1	0	1
Speeches & Invited Talks	1	0	1
Computer Software	1	0	1
TOTALS	4,756	790	1,761

The preponderance of monograph records and the limited selection of locally held digital objects reflect KIP's initial upload strategy. A bibliographic database created by karst scholar and KIP partner Diana E. Northup for her monograph *A Guide to the Speleological Literature of the English Language, 1794-1996* was subsequently donated to the project and helped "jump-start" the collection. Although locally held digital content is the preferred strategy, the survey encouraged KIP's contributions to information discovery and bibliographic control. On a national and global level, important information resources essential to karst research are elusive. Sometimes their existence is unknown outside a small circle of karst researchers. The most comprehensive collections are usually in private hands and are generally focused on one or two specialized karst topics, regions, or features of primary interest to the collector.

16.4.2 Areas of Collection Emphases

In 2009, citation analysis, institutional research intensity (USF), and estimates of potential community impact identified three areas of collection emphasis both within KIP and to support a more comprehensive library collection initiative.

Karst Hydrology

Karst aquifers provide drinking water to between one and two billion people worldwide (Veni et al). Groundwater contained in these aquifers is easy contaminated because surface water receives no filtering from the hard limestone bedrock as it rapidly makes its way downward to recharge the aquifer. For this reason, any contaminants or pollutants on the surface are rapidly washed into the groundwater. This can have serious public health implications for populations relying on that groundwater for drinking water supplies, especially in developing areas that lack strong health care and water utilities infrastructures. Greater understanding of these complex systems can lead to more effective contamination mitigation strategies and technologies for karst aquifers.

Paleoclimatology

Carbonate rocks often contain important clues to localized climate conditions in the distant past. Many caves are isolated or difficult for the average person to access and therefore can be particularly valuable sources of unspoiled paleoclimate data. Samples extracted from stalactites and stalagmites are less subject to influence by outside forces than data collected from, for example, sediment cores taken from lake beds. Understanding how and why climate conditions changed in the past can help identify the best means to address current and future climate change issues.

Policy Innovation and Development

Policy solutions for karst-related environmental and public health issues have been implemented in various locations throughout the world; however, this is an underdeveloped sub-field of karst studies. There are many locations where such solutions likely would be appropriate but have never been attempted. Even for those locations where policy-driven approaches are taken, those approaches vary wildly in structure and regulatory strength. There is currently no universally accepted approach to policy development with regards to karst and the human activities that threaten it. By making policy innovation a collection priority, the USF Libraries help facilitate education on the importance and feasibility of policy-based approaches generally, as well as the development of specific policy-based techniques for managing karst lands.

16.4.3 New Collection Directions

Since the 2007 “soft-launch,” collection building has expanded in five directions, with early emphasis on serials, bibliographies, oral histories, database development, software applications, and modeling and research.

Serials

The National Speleological Society has emerged as a strong KIP partner and source of important information, both grey and white. The USF Libraries digital collections unit has digitized entire runs of the *NSS News* (1958 to present), the *Bulletin to the National Speleological Society* (1940-1958), and select issues of the *SpeleoDigest*. Future plans call for completing the *SpeleoDigest*

back files, exploring ebook publication, and incorporating the “NSS Volunteer Value Database” in KIP.

KIP digital serial content includes the Association for Mexican Cave Studies newsletters (full runs of three distinct titles), *Espeleo Informe Costa Rica*, *GEO2* (in progress), *Helictite: Journal of Australasian Speleological Research* (in progress), the *Proceedings of the International Symposium on Vulcanospeleology*, and the *Proceedings of the National Cave and Karst Management Symposia*. As of October 2009, negotiations to host the *International Journal of Speleology* and the *Journal of Cave and Karst Studies* as open-access journals are in the final stages. The journal *Studia Universitatis Babeş-Bolyai Geologia* is already part of the collection. The later established scientific journals have become distinctive components of the KIP collection because of their value to karst researchers and the potential benefits created by joining forces to limit costs and raise visibility.

Bibliographies

In 2008, KIP project managers initiated discussions with the creators of three important bibliographic resources concerning karst: the *Bulletin Bibliographique Spéléologique = Speleological Abstracts* (Centre de Documentation UIS), the Texas Speleological Survey Bibliographic Database, and *Speleogenesis'* KarstBase database. A merger should permit each entity to meet stated goals, with KIP providing an organizational and infrastructure “umbrella” to facilitate those activities. Participants in these important endeavors report pressures that, unless alleviated, could endanger their survival –print publications’ sky-rocketing costs, technology migration pressures, and long-term preservation. KIP was established to manage these pressures within the workflows of an academic library collection. KIP presents a viable alternative to publication cessation or to taking these projects commercial.

Karst Oral Histories

In conjunction with the USF Libraries’ Oral History Program, KIP managers conducted oral history interviews with leading names in a variety of karst science fields, including exploration, cave mapping, and applied ecology. The karst oral history project seeks to preserve for future researchers the experiences, thoughts, and insights of prolific karst researchers and authors Alexander Klimchouk, Derek Ford, and William and Elizabeth White. The complete audio recordings of these interviews are available for download via KIP, along with a written transcript for each.

Database Development

The karst researchers require increased capacity to create databases relevant to their areas of study. The infrastructure to support these resources must be user-friendly, established on best practices/standards, powerful, capable of efficient/unmediated data exchange, and archived for future access. On numerous occasions since KIP’s launch, potential partners have approached the project team to solicit input and assistance in designing and implementing novel databases relevant to karst research. A selection of specific examples illustrates the need for this capacity.

The Cave Mineral Database (CAMIDA) is a collaborative project of the USF Libraries, UIS’s Cave Minerals Commission, the Karst Information Portal, “Emil Racoviță Institute of Speleology

(Romania), and the Karst Research Group at University of South Florida. CAMIDA is an open-access collection of geological, mineralogical, crystallographical, and protection/conservation information on all minerals discovered in caves around the world.

Professor Donald McFarlane (Scripps College) is collaborating with KIP Project Manager Todd Chavez and others to create *The Bibliography of Speleothem Research*, an archive of peer-reviewed speleothem research papers specifically intended to be searchable by geographic and/or geochronological parameters.

Professor John Mylroie (Mississippi State University, Department of Geosciences) and caver Mike Lace propose collaboration to create a database and repository of all known information on sea caves and dissolution caves in coastal settings and to make these data web accessible.

Future projects include a dye-trace database for the eastern United States (Karst Waters Institute); a joint collaboration to migrate the National Karst Map to a web-accessible database (USGS); a digital world karst map (USGS and the World Wildlife Fund); a karst geo-wiki to serve as the basis for informal science education and community participation (USF Professor Robert Brinkmann and collaborators from the National Park Service and the University of New Mexico); a joint archive of SEM images that supports user commenting (University of New Mexico); and a database of isotope data for southeast European cave fossils (USF).

Software (Freeware) Applications

As in many “small-science” research areas, individual karst researchers are often required to develop “just-in-time” software applications to support their work, usually without specialized training or concerns for future usability/functionality. In concert with database development described above, KIP project managers plan to develop web-accessible freeware software applications to facilitate karst-related research.

Karst Modeling and Research

Web-accessible scientific modeling tools (statistical, geospatial, etc.) that can efficiently incorporate and manipulate data resident in the USF Libraries’ karst databases are natural extensions of the current collections. Using USF Libraries-developed software applications, users can collect and organize data subsequently imported into a USF Libraries-developed database and extracted to be included in models developed using USF Libraries-developed modeling tools.

Similar efforts to develop these capacities in the geosciences include two NSF-funded projects GEON (volcanology, seismology) and CHRONOS (earth history) – the leaders of both projects were early contributors to the KIP planning process. The projects represent significant advances in creating an integrated cyberinfrastructure serving the geosciences, and their experiences help guide KIP collection directions.

16.4.4 Services and Programming

Collections cannot exist in a vacuum. Context is important and contributes significantly to collection visibility and use. To that end, the initiative's strategic plan includes developing public programs, facilitating scholarly communication around KIP, and developing instructional collaborations.

In the long-term, the health of karst environments is dependent on enhancing understanding of karst environments among researchers outside of the informal karst community and among members of the public -- from K-12 teachers to politicians and homeowners. Although the initiative is strongly digital in emphasis, non-web public programming facilitates the overall goal of increasing the impact of karst research and KIP's visibility. Partnerships with museums, television stations, and K-12 educators can serve to promote public understanding of karst environments. These avenues are being pursued, with the first radio and television spot highlighting the KIP and affiliated faculty due to air in November 2009. A YouTube video called "What is Karst?" was produced and posted in 2008, and as of October 2009 the video was viewed over 1,500 times.

Hosting conferences relevant to karst research also should increase KIP's visibility and impact. The first such conference is scheduled for May 2010. Members of the KIP team are formalizing instructional collaborations and course offerings that combine librarians and faculty from relevant academic departments to give graduate students hands-on experience with the concepts, techniques, and tools of library and information science relevant to their particular thesis and dissertation research. A recent collaboration involving the USF Libraries and Department of Geology can be replicated and expanded to include additional disciplines.

16.5 Conclusion

The Karst Information Portal grew out of a sense of the importance of grey literature to karst researchers and consumers of that research. Consistent with Professor Irwin Weintraub's oft quoted article, "The Role of Grey Literature in the Sciences,"

"In a world in which free trade and instantaneous communication have eliminated many of the barriers to information flow, grey literature is gaining greater importance as a source of information for much of the world's population. It is an indispensable resource for an informed and enlightened public and will undoubtedly continue to serve as a necessary supplement to journal literature well into the future."

An information needs assessment conducted by USF researchers confirmed this assertion and the use of the KIP since implementation supports Weintraub's general characterization in the specific case of the interdisciplinary domain of karst science. Geoscientists generally, and karst research specifically, regularly use and (less frequently) cite grey literature (Butkovich and Musser 1994). Interdisciplinary research domains, including library and information science (Aina 2000), the health sciences (Alberani et al. 1990; Dunn 2004), marine and fisheries science (Cordes 2004), economics (Mili 2000), and transportation studies (Osif 2000), increasingly reflect intense use of grey literature, though not to the exclusion of traditional published research. The pattern is clear.

Other conclusions drawn from the study were not well supported in the intervening two years. Analysis of KIP usage patterns since implementation has necessitated reconsideration of the resource's social networking applications and community aspects. The discussion forums, in particular, have generated little interest, and user registration lags behind use. According to a report tracking usage during one six-month period, KIP was serially accessed by 189 different users from eight countries, but the directory only includes 137 registered users. All of these uses, with 14 exceptions, were tracked as coming from Google searches, a positive development that demonstrates success in efforts to increase the visibility of karst research content via KIP.

In the fall 2009, USF Libraries' personnel began to migrate the existing Karst Information Portal content to a new infrastructure. The previous architecture was visually appealing, and the content management system supported most basic metadata requirements, but refinements were needed. A decision to adopt the NSF-funded National Science Digital Library's Collection Workflow Integration System (CWIS) as the KIP's new content management system followed extensive testing and comparisons of several alternatives. A further decision to cease the resource's forums and other community aspects and to focus on KIP's digital library characteristics followed.

In the information needs assessment report, the authors suggested that, "When implemented, the KIP can serve as a model for similar studies of global interdisciplinary communities and the gathering and synthesis of literature to support the research needs of that community" (Chavez et al. 2007, 16). Events during the two years since KIP's implementation have emphasized the value of a library-led collaboration with global research communities.

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