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THE DGGS GEOLOGIC DATABASE: PUTTING GEOLOGIC DATA MODELING INTO PRACTICE

In October 2000, the Division of Geological & Geophysical Surveys (DGGS) started a project to create a geologic database system. The system architecture will facilitate consistent data and information archival input, organization, and storage. System features will provide data identification and retrieval functions that will guide and encourage users to access appropriate data on-line.

WHAT IS THE GEOLOGIC DATABASE PROJECT?

The first objective of the Geologic Database Project is to implement a spatially referenced geologic database system that will maintain a centralized data and information archive. The system will also provide consistent input, organization, and storage infrastructure for new geologic data. The second objective of this project is to create a functional on-line system that allows the casual user to find and identify the type and geographic locations of geologic data available from DGGS. The user will be able to view and download the data in usable formats to a personal computer using web-based applications.

WHAT IS A SPATIALLY REFERENCED GEOLOGIC DATABASE?

A spatially referenced database includes geometry and location information as well as other data (Brodaric, 2001). Examples of spatially referenced features in the database include a geologic sample location, a fault trace on a geologic map, or a polygon representing the surface extent of Cretaceous granite. Each of these real-world features has a geometry and location; the database relates the geometry to other data about the feature. Relationship of data and geometry to geologic concepts allows classification, description, and cartographic expression of the feature (fig. 1). Geologic data to be contained in the database includes geologic map features, field observations, sample descriptions and analyses, minerals resource data, information for evaluating geologic hazards, bibliographic information, and definitions of terms used to communicate geologic information

WHY DOES DGGS NEED A DATABASE?

DGGS already has a database, of sorts. There is a wealth of information in published DGGS maps and reports and in unpublished information contained in file folders, boxes, hard drives, and floppy disks. At present, these data are stored in project files in the charge of individual project leaders. Turnover of DGGS personnel puts the "mental catalogs" of these data at risk. Digital data files stored on individual hard drives, CD-ROMs, Zip disks, and outdated media are all at risk for corruption, loss, and storage media obsolescence. A unified, centralized data storage, entry, and retrieval system will plug this data drain.

Reliance on digital data and demand for distribution over the Internet is increasing as part of the digital age. Users of DGGS data are turning to digital solutions for analyzing data and making decisions. Many of DGGS's customers are making use of GIS (Geographic Information System) technology. The variety of software and hardware platforms in use is a challenge for providing that data. With this database project DGGS will store spatially referenced data in a feature-oriented system rather than in a map- or project-oriented system (GIS) that is software dependent. Storing geologic features and their attributes in a relational database will allow DGGS to deliver digital data that are independent of projects, hardware, and software.

The volume of data and information gathered, stored, and published by DGGS is significant—more than 2,400 documents, 3,000 maps (Daley, 2000), 100,000 samples, and the list goes on. The quantity increases each year. In the past, there was no easy way for DGGS geologists or the public to search that large body of knowledge. Finding a desired piece of information required knowledge of the projects and history of DGGS. Integration of all geologic information at DGGS in a single relational database structure will provide the knowledge base to facilitate a community member's search and access of specific information.

WHAT IS THE STATUS OF THE PROJECT?

During the first year, project personnel have identified, gathered, and modeled geologic data for inclusion in the database. A conceptual data model was created to determine the architecture of the database system. DGGS is implementing that database system through a contractor that will design, program, and install the system hardware, software, and data loading utilities. By May 2002, when this phase of

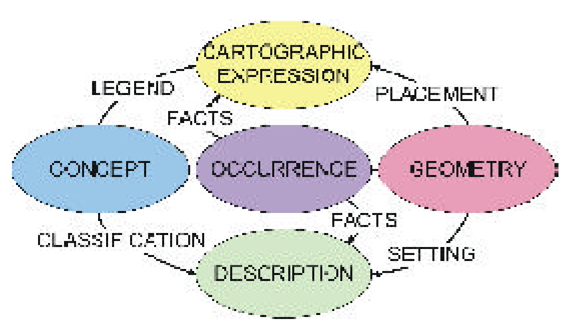

Figure 1. *Conceptual geologic data model (modified from Brodaric, 2001).*

(continued on page 2)

the project is complete, DGGS will have the database infrastructure in place and will load data into the system.

DGGS Data Model

The initial step in DGGS's database design process was an internal needs assessment, consisting of interviews with individuals and working groups mostly within DGGS. These interviews resulted in a long list of function statements such as, "DGGS geologists record coordinates, an accuracy estimate, date, place name, project, and comments for each field station." Part of the assessment process included gathering examples of forms, reports, tables, maps, and legacy databases. Lists of data processes, entities and attributes, relationships, and rules were distilled out to create the initial data model.

The second step of the design process was verification of the initial model. The entire DGGS staff participated in multiple focus group discussions, multi-part surveys, and a request for examples of specific geologic questions. The group discussions were used to rewrite the original model, the surveys were used to prioritize the model, and the questions will be used to check that all the data entities, attributes, and relationships are present. The prioritized functions list can be viewed at <http://wwwdggs.dnr.state.ak.us/download/rfp_2002_1000_2669_app5.pdf>.

Data Groups and Relationships

The database model resulting from this process is subdivided into seven major data groups classified by function and type. The groups are field data, sample data, geologic map objects, spatial dataset inventory, reference/legend information, publications database, and thematic databases. A preliminary entity-relationship diagram illustrates the relationship and data groups of the conceptual model (fig. 2). The full diagram can be viewed at <http://wwwdggs.dnr.state.ak.us/download/rfp_2002_1000_2669_app5.pdf>.

Field data include location, descriptive, and instrumental data recorded by geologists in the field. Field data locations include three types: outcrop observations, measured sections, and well logs. All descriptive and instrumental data is organized in separate entities (tables) that are related directly to a point location. This data model allows flexibility between different field methods of the various disciplines represented in DGGS.

Sample data comprises descriptive, instrumental, and chemical analyses completed after the end of the field season. Samples are identified by a sample number and are always associated with a field station location. Laboratory information and cited references are related to each sample analysis as well.

Geologic map objects include polygons and lines. They are generally located through analog means on hard-copy maps and then digitized in ArcInfo or MapInfo. Attributes of map objects in the DGGS model should be compatible with both the North American Geologic Map Data Model (Johnson and others, 1999) and with the data model being used to digitize 1:250,000-scale maps in Alaska (for example see Wilson and others, 1998) but still serve DGGS needs. Storing spatial defi-

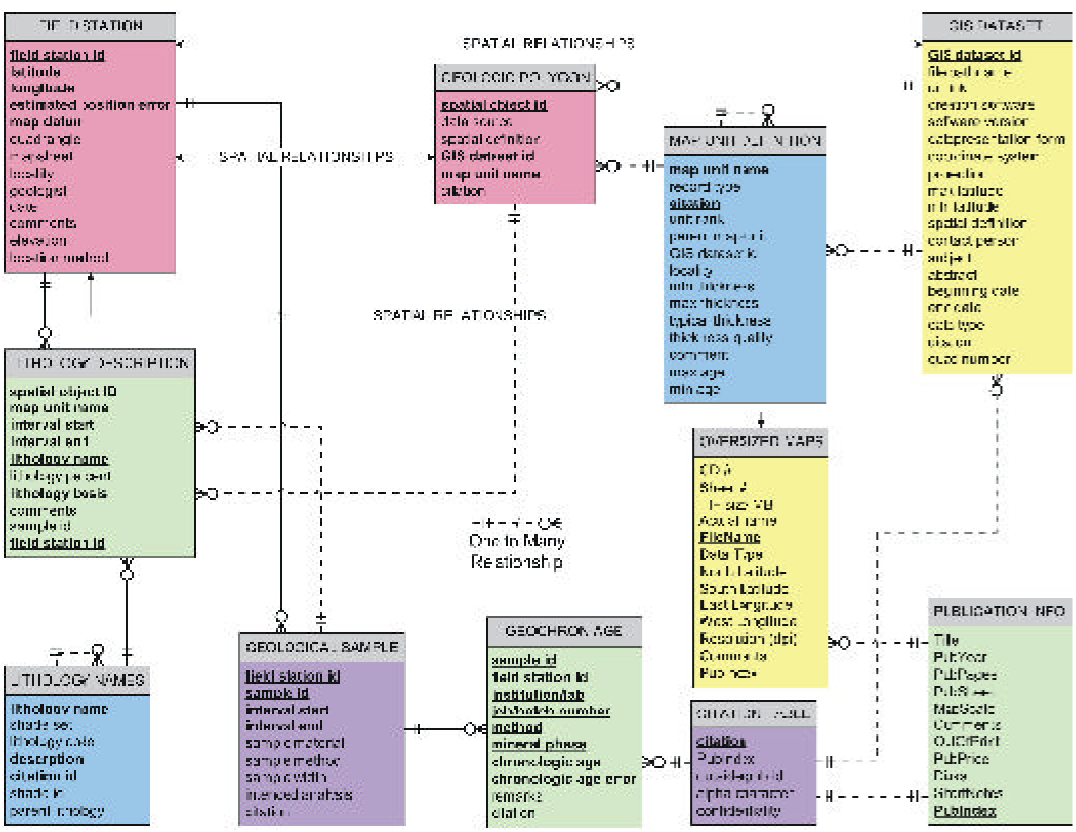

Figure 2. *Selected preliminary entities and relationships from the DGGS conceptual relational database model entity-relationship diagram. The colors refer to the conceptual data model in figure 1. (Extracted from* <http://wwwdggs.dnr.state.ak.us/download/rfp_2002_1000_2669_app5.pdf>*)*

nition of geologic map objects in a relational database system will allow statewide data searches based on geologic map features.

The spatial dataset inventory will hold or link to metadata elements of GIS datasets created or housed in the DGGS system. The attributes of the inventory will be compatible with Federal metadata standards (Federal Geographic Data Committee [FGDC], 1998) and the National Geologic Map Database (NGMDB) (<http://ngmdb.usgs.gov>. Each record will include a file path name so that DGGS staff can locate selected dataset files in the network.

Reference information includes all the nomenclature, terminology, bibliographic information, and spatial definitions of attributes used throughout the database to classify objects. This information can also be used in making map legends, compiling metadata, and defining data search criteria. In essence, this information will be our digital reference library and the foundation of a digital geologic knowledge base.

The publications catalogue is, in part, a subset of the reference information but contains additional information specific to DGGS publications.

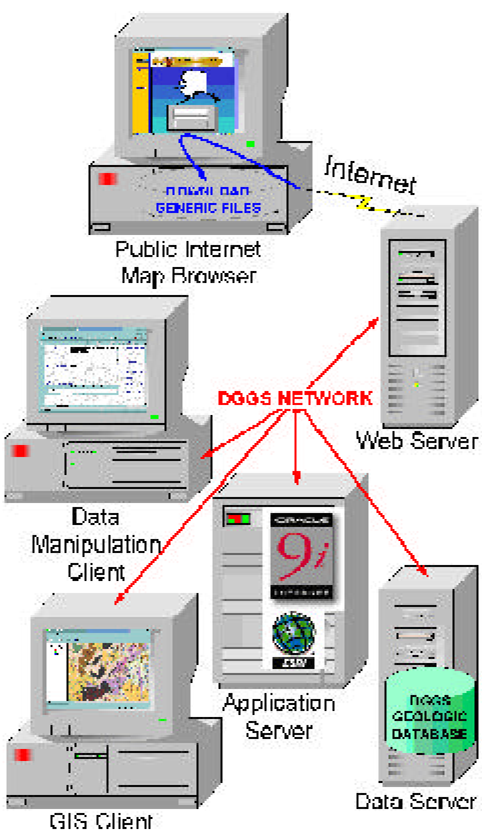

Figure 4. *DGGS Database system architecture.*

The publications database will help manage data access, sales, distribution, and production of our publications.

Thematic data include information specific to minerals resources and geologic hazards. Some of the thematic data will only contain index information and provide links to databases at other agencies. Data subjects will include mines and prospects, coal resources, minerals industry activity, active faults, seismic events, active volcanoes, and geotechnical boreholes. The thematic objects will be related to the geologic sample, cited reference, and field data databases; they will be related to geologic objects through the spatial definitions.

Data System

The database system infrastructure will consist of a data server, relational database management software, and connections and utilities to interface with the DGGS LAN and GIS. The database will be available to multiple users on Sun workstations and on Windows computers through the DGGS LAN (fig. 3). Oracle and Oracle Spatial data files will be stored on a Sun or Windows NT data server. DGGS will add ArcSDE to ArcGIS to facilitate transfer of spatial data between project files and the database. DGGS intends to continue to use ArcInfo GIS as a project level geologic mapping, analysis, and cartographic tool.

What is Next? Public Data Interface Design

By mid-2002, DGGS will have a database system infrastructure, and will be loading geologic data. How will the public have access to that data?

A primary set of concerns in designing this database system is that data access is not limited by software or hardware constraints. The selected data infrastructure has Internet data search and download capabilities. There are, however, limitations to universal access. Telecommunications infrastructure limitations affect the volume and the speed of data access. Information technology is expensive. Another concern is that ongoing database and system maintenance has a cost; we need to provide the service without impacting DGGS's basic mapping programs.

The solutions to these challenges need to be identified and prioritized as DGGS plans to meet the second objective of the Database Project— public Internet delivery of the data. DGGS is starting the needs review and conceptual design phase for Internet delivery of the database. Over the next six months, DGGS will be seeking public involvement to help prioritize public interface functions of the database system. If you are interested in commenting on the Database Project or have any questions please contact Larry Freeman at DGGS.

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Daley, E.E., 2000, DGGS Scanning Project: Alaska GeoSurvey News, v. 4, n. 2, p. 1-2, <http://wwwdggs.dnr.state.ak.us/download/0006news.pdf>

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Wilson, F.H., Dover, J.H., Bradley, D.C., Weber, F.R., Bundtzen, T.K., and Haeussler, P.J., 1998, Geologic map of central (interior) Alaska: U.S. Geological Survey Open-File Report OF 98-133, 1:250,000 scale, <http://wrgis.wr.usgs.gov/open-file/of98-133-a/>

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NEW PUBLICATIONS

IC 32. **Directory of aggregate, rock, and soil producers in Alaska,** by D.S. Pinney and E.S. Duenwald, Updated October 2001, 19 p. Free.

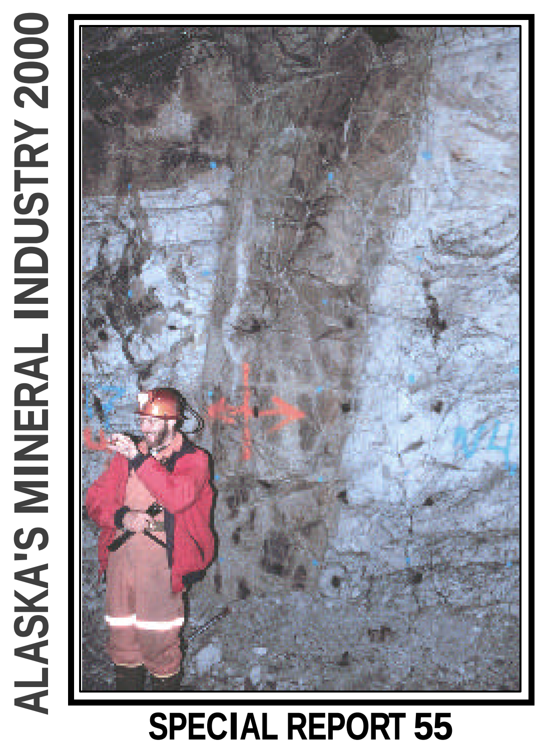
UPDATED

RDF 1999-2. **Chulitna district paleomagnetic study,** 1998, by David Stone, Howard Scher, and Chad Schopp, August 2001, 4 p. $2.

MP 43. **Preliminary map of industrial minerals occurrences in Alaska,** by D.S. Pinney and E.S. Duenwald, 2001, 69 p., 2 sheets, scale 1:2,500,000. $33.

MP 44. **Preliminary bibliogaphic database of Quaternary faults and folds in Alaska,** by P.A. Craw, J.L. Mayer, and R.A. Combellick, 2001, 1 CD Rom. $10.

SR 55. **Alaska's mineral industry 2000,** by D.J. Szumigala, R.C. Swainbank, M.W. Henning, and F.M. Pillifant, 2001, 66 p. Free.



Dear Readers:

I am happy to report that all DGGS field parties returned safely after meeting their summer project objectives. In spite of zero-visibility weather days and storms that, in some field camps, left snow on the ground in July, the work got done. The dedication of DGGS field geologists in practicing their profession in general, and serving Alaska in particular, is truly outstanding. I sincerely thank all of them for their efforts this past year.

The Survey is now settling down to the data analysis phase of our ongoing projects, and there are many of them. We have outlined the current DGGS program in one-page summaries that can be found on our web site at wwwdggs.dnr.state.ak.us. At last count there were 29 active projects. This number varies throughout the year as some studies are concluded and others begin. Last year we began a new project to develop a geologic information management system for DGGS. The status of that project is the main topic of this fall newsletter. During the months ahead we will undertake another new endeavor for DGGS—learning to incorporate modern remote sensing technologies into the division's geologic investigations. Our first effort will use high-resolution digital elevation data to enhance an assessment of the placer mineral potential of the Council mining district.

There are some new faces at DGGS. Many of you will get to know Dawn Roberts, who has joined us to work directly with our customers to see that they receive the geologic information on Alaska that they seek when contacting DGGS. Cheryl Cameron is returning to work with us during the coming year to compile geologic information on the proposed natural gas pipeline corridor. We also have five student interns from the University of Alaska who will assist our staff throughout the winter. We are pleased that Emily Duenwald, Russ Kirkham, Simone Montayne, Lauren Staft, and Carol Galló will be part of the DGGS family this winter.

Sincerely,
Milton A. Wiltse
Director and State Geologist

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