FY 2015 FINAL TECHNICAL REPORT

NATIONAL GEOLOGIC AND GEOPHYSICAL DATA PRESERVATION PROGRAM

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Preservation and Digital Conversion of Minnesota Geological Survey Geophysical Logs

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ABSTRACT

The Minnesota Geological Survey (MGS) proposed to update the digital infrastructure of our geophysical logs for preservation and accessibility under the National Geological and Geophysical Data Preservation Program (NGGDPP) FY 2015. Based on our original estimates from our existing geophysical log database (as of March, 2015) we proposed to organize, scan, convert and create metadata for nearly 7,650 logs. Out of that collection we estimated that 2,600 of those logs existed only on paper and needed to be scanned before logs were lost or damaged. A select number of the PDFs of the scanned paper logs were digitized using the automated digitizing software from Neuralog to create the x,y,z data allowing us to recreate the original data from the paper log and save logs in the Log ASCII Standard (LAS) file format. The other 5,050 logs existed in proprietary software and needed to be converted into LAS files and also saved as a PDF image to aid in our mapping projects and to more easily distribute the data to the public and geoscience community. The MGS organized and updated our existing geophysical log database, scanned 2,954 paper logs, converted and made PDFs of 3,860 digital logs and recreated the data for 102 scanned logs using Neuralog. Metadata records for 6,850 individual boreholes were uploaded. The data is available on Science Base Catalog (Collection of Borehole Geophysical logs from MN) and by request. Future web access on our web site is currently being evaluated.

INTRODUCTION

The Minnesota Geological Survey (MGS) is a research and service arm of the Newton Horace Winchell School of Earth Sciences at the University of Minnesota. It investigates the geology of Minnesota and provides basic public information on the geology of the state. The survey works with state, county, and regional offices to set up geologic data bases and provide technical guidance for water resource planning, land management and mineral exploration policy, energy system development, and other planning and resource management activities. MGS collects, archives, and provides access to collections of geologic materials from Minnesota including rock and unconsolidated sediment specimens, thin sections, core samples, and well cuttings. We also have collections of geologic maps, aeromagnetic and gravity datasets, geophysical and geochemical datasets, and scanned manuscripts and publications.

Our geophysical log collection (as of March, 2015) contains data from nearly 7,650 logs in 6,300 separate boreholes drilled throughout the state. This is equal to over 2 million feet of sediment and rock. This collection continues to grow as MGS gathers new data. Geophysical logs are imperative for mapping the subsurface where outcrops do not exist. The majority of logs in Minnesota are located over Paleozoic rocks, which contain the major water supplies for our state. The logs are currently being used by MGS scientists for ongoing mapping projects on a daily basis; they use 1-20 logs a day depending on where they are in their mapping process. Having PDF images of these files that can be accessed on the computer or in the field rather than file cabinets will be extremely valuable and help make our mapping process more efficient. In addition to MGS scientists, potential users of these logs includes water- and mineral-resource geologists, academic and other state agencies (i.e., MN Department of Natural Resources (DNR), MN Department of Health (MDH), etc.), environmental planning and public health professionals, water well drillers and the general public. We currently mail 15-30 printed logs a week to

other state agencies and water well drillers who request copies because we do not have log files stored as PDFs to send via email.

Logs are from boreholes, usually water wells, or holes drilled for scientific purposes. Logs measure a variety of properties of the rock and sediment exposed in the borehole wall, and water within those materials. Most of our logs measure natural gamma radiation. This is a naturally occurring phenomenon and the intensity of radiation is generally related to the concentration of uranium, thorium, and potassium in the materials penetrated by the borehole. The gamma radiation levels help us identify the rock types penetrated by the borehole or well. This allows us to acquire very reliable interpretations of the subsurface geology at a very low cost. Other logs measure electrical properties, the shape of the borehole, and the movement and temperature of water in the borehole.

Recognizing the need to preserve this collection aligns with our state's long range data preservation plan. The long range data preservation plan completed in 2009 identified the highest priorities in relation to applications such as groundwater management and mineral resource assessment, including 1) reprocessing of the aeromagnetic database, 2) enhancement of gravity station location precision, 3) vertical georeferencing of the rock property database, 4) cataloging and georeferencing of rocks and thin sections, 5) standardized formatting of existing metadata databases, 6) scan and web enable publications, 7), scanning, digitizing, and enhanced cataloging of borehole geophysical records. Objective 1, 2, and 3 were completed with State of Minnesota support. The final phase of addressing Objective 4 is underway with NGGDPP support. Objective 5 is ongoing on a self-funded basis. Objective 6 was completed with University of Minnesota Library support. Objective 7, regarding borehole geophysical records, is currently being supported by this NGGDPP grant.

Our objectives were to increase the ease and usage of the MGS geophysical log collection both for our staff and for the public by creating a PDF image for all of our geophysical logs and converting the digital data to standard LAS files. We had to accomplish this through several different steps because the data exists in several different formats ranging from

paper copies to proprietary digital log files. Of our 7,650 logs, we proposed to scan 2,600 logs that existed only on paper before the logs were lost or damaged. A select number of the PDFs of the scanned paper logs deemed most important based on areas of low data density, deep drill holes and active mapping projects were digitized using the automated digitizing software from Neuralog to capture the x,y,z data and allowing us to recreate the original data from the paper log. These Neuralog files were then exported in the Log ASCII Standard (LAS) file format. The other 5,050 logs existed in proprietary software and needed to be converted into LAS files and also saved as a PDF image to aid in our mapping projects and to more easily distribute to the public and geoscience community.

ACCOMPLISHMENTS

As a result of this funding we were able to:

- Sort through our geophysical log database and all of our geophysical logs to make sure they are in agreement. All water wells in the state of Minnesota have a unique number associated with them. This is how we identify where the well and log is located, so it was important to make sure each log had a unique number associated with it that matched our geophysical database and also the state of Minnesota's water well database (CWI).
- Sort through our logs to determine if it only existed as a paper log and have them scanned and saved as a PDF on a feed through scanner at the University of Minnesota Libraries.
- Develop a method for our undergraduate student workers to convert our proprietary Century log files into both LAS and PDF files. We were not able to develop a method for batch processing these, so in the early stages of the project it became apparent that the proposed goal of 5,050 digital conversions was optimistic given the time required to create a pdf for each log. Due to this factor we prioritized converting and making PDFs for only the gamma-ray and electrical resistivity logs used most often for rock identification. All of the

caliper, multi-tool and flow logs have not been converted and saved as a PDF yet.

- Files for 3,931 logs that were collected from the 1990s-present were converted to Log ASCII Standard (LAS) and saved as a PDF image. The majority of these are gamma-ray logs. We found that several log files were corrupt and were not able to be converted—although these cases were rare.
- Records for 2,954 geophysical logs that existed only on paper and collected from the 1950s-1990s were scanned and saved as a PDF. We ended up finding more logs to be scanned in our filing system than we had originally accounted for in our geophysical log database. These logs were scanned and added to our database.
- 102 of the scanned paper logs that were deemed most important based on areas of low data density, deep drill holes and active mapping projects were digitized using the automated digitizing software from Neuralog to create the x,y,z data and allowing us to recreate the original data from the paper log. These files were then exported in the Log ASCII Standard (LAS) file format. This will be an ongoing task on a case-by-case basis as we continue to sort through the newly digitized paper logs and take on new mapping projects across the state.
- We tracked down other geophysical logs from Minnesota's Department of Natural Resources. They have stopped collecting geophysical logs now and we were able to rescue and properly store some of the logs that they had collected in the past (< 50 logs).
- We developed a method going forward for the MGS to continue this process of saving LAS files and making a PDF for all new logs we collect.
- We uploaded 6,850 metadata records to the USGS in the CSV file format at the close of the FY2015 grant year. PDFs are available through a URL link within our metadata file in the Science Base Catalog (Collection of Borehole Geophysical logs from MN) and by request. Future web access on our web site is currently being evaluated.

Table 1 shows the current status of Minnesota's data collections in the USGS Science Base Catalog and indicats the number of uploaded records for each of the collections.

Table 1

NGGDPP Collection ID	*Brief Collection Name*	*Number of collection inventories or metadata records uploaded to the National Digital Catalog in previous years*	*Year uploaded*	*Progress Summary (Did work include digital infrastructure or rescuing data at risk?)*
1553845	Field notebooks	322 items	2010	Entire collection cataloged
1553847	Rock hand samples	823 trays	2010	Rocks were placed in numbered trays; major restructuring of the collection
1553848	Thin sections	7870 items	2010	Specimen ID catalog 98% complete
1553847	Rock hand samples	41,806 items	2014	Complete specimen ID catalog, pilot work on locations and descriptive metadata
1553848	Thin sections	13,997 items	2014	Complete specimen ID catalog, link to hand sample in database
1553847	Rock hand samples	41,806 items	2015	Compete location and descriptive metadata
1553848	Thin sections	13,997 items	2015	Complete link to hand sample in database
	Geophysical logs	6,850 items	2016	
Total		127,471 items		

SUMMARY

MGS continues to recognize the importance of data preservation. Already our scientists are using the PDF images of the geophysical logs for mapping purposes every day. We've been able to more easily share PDFs with other states for regional research projects, as well as water-well

drillers and scientists from other state agencies, including the Minnesota Department of Health and the Minnesota Pollution Control Agency.