Three-Dimensional Geological Mapping

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Conveners:

H.A.J. Russell,
R.C. Berg,
and L.H. Thorleifson

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INTRODUCTION – THREE-DIMENSIONAL GEOLOGICAL MAPPING

Russell\(^1\), H.A.J., Berg\(^2\), R.C., and Thorleifson\(^3\), L.H.
\(^1\)Geological Survey of Canada, \(^2\)Illinois State Geological Survey, \(^3\)Minnesota Geological Survey.

This workshop is the seventh in an ongoing series primarily designed to share insights among geological mappers who are maximizing the use of variable and often voluminous subsurface information in order to produce 3D models that map sediment and rock, with an emphasis on the needs of groundwater management. The first workshop in this series was held in Normal, Illinois, ten years ago this past April, (Berg and Thorleifson, 2001). This year’s workshop reflects the evolving focus of the series from issues of data quality, datasets, and methods for data collection to a focus at the Geological Survey Organization level on institutional implementation of modelling standards at state, provincial, and national scales.

Since the 2009 workshop in Portland two notable outcomes of the workshop series have been published. Firstly, Thorleifson et al. (2010) discussed the emergence of 3D mapping at Geological Survey Organizations (GSO). Secondly, Berg et al. (2011) edited a collection of papers on approaches to 3D geological mapping at several geological survey organizations from Europe, North America, and Australia.

This year’s workshop continues the trend of increased focus on work at GSOs with 11 of 15 contributions focused on this subject. The four remaining papers, however, maintain the essential link to research on methods.

1. GEOLOGICAL SURVEY ORGANIZATIONS

The 11 papers from national, state, and provincial GSOs reflect the differences in organization scale, human and financial resources, and mandates. Also evident are the different challenges presented by geographic scale, population density, and breadth of natural resource issues. Mathers from the BGS provides a brief overview of the edited volume by Berg et al. (2011) and continues in more detail on activities at the BGS. BGS work on an integrated modelling environment is further detailed by Peach. Four papers from Europe highlight activities in France (Gabalda et al.), Holland (Stafleu), Germany (Diepolder) and Denmark (Thomsen). Gabalda et al. highlight work in sedimentary basins and an increasing demand for deeper models to support resource decisions. Stafleu presents an up-to-date account of modelling developments in Holland from existing surface models (DGM, REGIS-II) to voxel models (GeoTOP, NL3D) and database developments, as well as model dissemination via the web. Diepolder provides an overview of the responsibilities of GSOs in Germany and reviews work in various national and international modelling activities (GEOMOL, GST, and ProMine). Thomsen highlights a national program of groundwater investigation in Denmark, database development (GERDA) and the importance of data standards and geophysical data collection to provide a framework for groundwater protection.

The remaining GSO papers are from North America and review the situation at national, state, and provincial geological surveys. From the United States Geological Survey, Glynn reviews the scope and scale of demands for 3D geological information and also integrates the emerging need for data, modelling, and visualization in the fourth (time) dimension. A paper by Keller et al. highlights a collaborative effort between Manitoba and Minnesota and demonstrates what can be achieved with only minimal financial and human resources. Bajc et al. review progress in Southern Ontario and put emphasis on data collection (gravity) and modelling developments. Russell et al. provide an overview of work at the Geological Survey of Canada toward development of a hierarchical framework to support groundwater investigations in support of Canadian federal government priorities.

2. METHODS DEVELOPMENT

Four papers address methods development and concentrate on data collection and geostatistical approaches to modelling geological scenarios. Abraham and Thomason & Keefer both discuss survey design, processing, and integration of three-dimensional data from airborne electromagnetic surveys, Abraham in Nebraska and Thomason & Keefer in Illinois. The value of airborne EM surveys is also discussed by Thomsen and the important contribution it is making to Danish subsurface modelling and to Russell et al. for the buried valleys in the prairie provinces of Canada. Gabalda et al. note the challenge of integrating geological heterogeneity into models and Dunkle et al. and Quinn & Moores both address this challenge through different geostatistical approaches. Dunkle presents a case study from Wisconsin applying multipoint geostatistics to map
preferential flow paths, and Quinn considers a number of questions regarding spatial heterogeneity in glacial sedimentary systems and effects of data quality and geostatistical approaches.

3. **SUMMARY**

The proceedings content provides an overview of the rapid evolution in three-dimensional geological mapping methods at government agencies. It is becoming clear that societal needs, particularly for effective groundwater management, are leading to more research and progress in areas of 3D data collection, modelling techniques, and data management.

**References**

