Chapter 1: Overview

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An increasing number of societal decisions are based on spatial data in general, and geoscience in particular. Fulfillment of several sustainable development goals regarding health, wealth, safety and heritage will require optimized geological information. Around the world, geology therefore is increasingly being used to facilitate societal objectives regarding energy, minerals, water, hazards, and infrastructure design.

This information is being built and provided by the entire geoscience community, including the geological survey organizations (GSOs) that play long-term roles in documenting the geology of entire jurisdictions, through their ongoing research, mapping, monitoring, synthesis, and dissemination. As data accumulate, as technology advances, and as societal expectations escalate, all fields of endeavour are moving from established practices to new approaches that deliver benefits more efficiently and effectively.

In the world of GSO activity, therefore, systematic documentation of geology is undergoing a transition from static, 2D, paper publications to digital 3D reconstructions that can be integrated with temporal monitoring and thus directly support the modelling and management that facilitate societal objectives. GSOs thus are responding to issues, and supporting unanticipated needs, by beginning to produce what is meant to eventually be jurisdiction-wide, multiple-resolution 3D geology that will be a queryable replica of their landmass.

GSO geological mapping by necessity is often conducted on the basis of sparse data, relative to industry practice, where 3D is the norm. At least for this reason, geological mapping by GSOs has tended to be limited to 2D cartographic products. This began to change in the 1980s, as data and technology permitted initiation of an evolution from 2D geological mapping toward production of 3D machine-readable depictions in which thickness, properties, heterogeneity, and uncertainty are specified.

The purpose of the current volume is to document and synthesize examples of this transition by GSOs to 3D geology. The volume is an update of an earlier version (Berg et al., 2011) that emerged from a series of workshops initiated in 2001. As with the earlier version, the volume includes three parts. Part One provides background, Part Two provides jurisdictional summaries, and Part Three provides synthesis. Part Two in the current volume includes 22 chapters, from provincial, state, and national GSOs in Europe (13), North America (7), and Australasia (2). The volume represents a broad sampling of GSOs involved in 3D work; however, there are many additional GSOs who are active in 3D that are not included. Contributors were asked to follow a template to structure their chapters, thus allowing the reader to more clearly compare 3D program objectives, approaches and strategies amongst various GSOs.

An update to the 2011 volume seemed warranted due to the growth in GSO 3D activity, emerging methods, new regional and global initiatives, and increasing interest by client groups. Additionally, pressures on resources, subsurface space, and the environment add urgency to ongoing documentation of geology, such that more realistic and machine-readable reconstructions are needed. There also are parallel developments in the sophistication, scale, and diversity of modelling initiatives taking place.

GSOs are now supporting not only framework lithostratigraphic modelling, but also associated property models such as texture, physical properties, and other derivative applications such as for groundwater and heat flow. From the prototype national models that were presented in 2011, work documented in the current...
volume highlights the advancement in jurisdictional modelling resolution and approaches.

GSOs thus are demonstrating that they have embraced the transition to 21st Century community information protocols such as big data, machine processing, and digital twins. This volume indicates that through a balance of explicit and implicit modelling, and development of interoperability for data integration and exchange, GSOs will be well positioned to continue advancement of 3D geology.

The contributions demonstrate the value of 3D geology, and highlight the heightened need for improved transboundary reconciliation of the mapping, with concurrent application support. National and international collaborations such as OneGeology and EuroGeoSurveys also highlight the need for such collaboration.

In a world with increasing environmental stresses and pressure on natural resources, enhanced geoscience products therefore are much needed as a fundamental underpinning of the infrastructure of modern societies. It is clear, however, that a commitment to a 3D geology GSO paradigm requires thinking that is long-term, institutional, and jurisdiction-wide in scope, such that needed data compilation and acquisition, followed by required iterative mapping, can be achieved in a complete and consistent manner over several years to decades.

This provides the rationale for the current volume, so that we can learn from each other, allowing us to make progress in fulfilment of our obligations to society with a maximum of efficiency and effectiveness.

Reference