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Making geological data accessible to non-geoscientists: a 3D model case history from Glasgow, U.K.

Tim Kearsey (1), Joanne E. Merritt (1), Mike McCormac (1), Alison A. Monaghan (1), Ricky L. Terrington (2), David J.D. Lawrence (1), and Seumas D. G. Campbell (1)

(1) British Geological Survey, Edinburgh, United Kingdom (timk1@bgs.ac.uk), (2) British Geological Survey, Keyworth, United Kingdom

The British Geological Survey's 3D geological framework modelling of the entire Glasgow conurbation and surrounding River Clyde catchment, has been undertaken as part of the Clyde-Urban Super-Project (CUSP) and in partnership with Glasgow City Council and other local and regulatory authorities. The 3D modelling covers an area of complex glacial superficial deposits, overlain by heterogeneous anthropogenic deposits that reflect Glasgow's industrial heritage, over coal-bearing Palaeozoic bedrock succession deformed by multiple faulting episodes. As such, the geology poses significant interpretive challenges for planners, regulators and engineers.

The depth dimension of conventional geological maps is very hard for non-geologists to appreciate. As a result, decision makers rarely take full account of geoscience issues in planning and development; nor do they fully exploit potential subsurface assets. With the advances of 3D hardware and software, it is now possible to combine disparate geoscience data types for a wide range applications and scenarios and to display these data effectively, and in ways that non-geologists can easily understand and use to inform their decisions.

Using several 3D modelling packages, but primarily GSI3D and GOCAD® workflows in tandem, we have created 3D models designed to 'nest' within each other. Lower resolution regional models (c.1:50,000-scale equivalent) therefore provide the context for higher resolution (1:10,000-scale equivalent), and ultimately site-specific, models.
The geological framework models have been attributed with a wide range of parameters such as permeability, aquifer productivity and various engineering properties. They have also been exported to flow modelling packages to model time-series processes such as recharge and flow of groundwater and will be used to model migration of contaminant plumes and carbon dioxide. Man-made objects, such as tunnels and mine workings have been embedded as 3D objects and placed into the 3D geological framework so their relationships to faults and other geological structures can be examined.

The models are already assisting in the design and layout of new subsurface infrastructure such as buried utilities, tunnels, and underground storage, as part of Glasgow's regeneration and redevelopment. They will also help to accurately quantify resources and enable their sustainable exploitation (e.g. aggregates, coal). In particular, the models provide an excellent basis for assessing the sustainable extraction of heat, using ground source heat pumps, from mine waters in Glasgow's extensive network of abandoned mines.

3D modelling is therefore placing geoscience data and knowledge at the heart of the decision making process. With these data in forms that are interoperable with existing 3D models of surface infrastructure, the vision of an integrated 3 dimensional surfaces and subsurface approach to future city-scale planning is becoming achievable.