Construction and Usage of geological near-surface models with GSI3D - applied (hydro-)geological information for land sites and urban areas

Neber, Alexander[*] & Howahr, Michael[*]

[*] *lithosphere - applied 3D geological surveying, Cologne, Germany (e-mail: info@lithosphere.de)*

The first detailed regional illustration of the subsurface has been made in 1815 by William Smith in his “Geological Map of England and Southern Scotland“. William Smith used cross-sections to image the recorded three dimensional geological setting, its chronological evolution and the spatial distribution of unit strata.
In general, a precise view of the geological environment can only be obtained by high resolution mapping campaigns in combination with the prevalence of a dense mesh of natural or man-made exposures. Where these are absent individual drilling campaigns or geo-physical investigations are the only way to discover the subsurface setting. These often heterogeneous data collections are not a straightforward information pool for decision makers and other end-users, as they have to be re-interpreted by experts for each single purpose.
With advances in digital visualisation and modelling techniques geologists are nowadays able to express their knowledge of subsurface conditions in easy-to-use and easy-to-understand digital 3D models. One of the tools for the 3D mapping of land sites and urban areas is the *GSI3D* (Geological Surveying and Investigation in 3D) methodology. The dynamic digital 3D models are built by using existing data sets, as geological and soil maps, historic maps, digital terrain models, drill logs, geo-technical, hydro-geological data, and geo-physical measurements. With *GSI3D* the geologist is able to use drilling down hole and outcrop information to build up a net of consistent cross-sections, defining the spatial distribution as well as top and base of each geological unit present. These geological units are defined according to lithological and stratigraphical characteristics and geological structures are constructed referring to genetical and morphological rules and perceptions. An iterative modification and fitting of intersecting cross-sections allows the generation of geological subsurface structures, as channels, basins, swells. These dynamic 3D models can be supplemented by artificial ground distributions and man-made technogenic modifications of the subsurface, as infrastructure lines, tunnels, building foundations.
Further processing of the 3D structure-models allow an attributing of each individual geological unit, sub-unit or lenses in terms of engineering conditions or hydro-geological parameters. Generated models are distributed by an platform independent software-tool, the *subsurface viewer*, enabling the end-user to customize his visualization and analysation of the subsurface, optimised for his individual tasks in the fields of mineral resources exploration, engineering-geology, hydro-geology, or environmental-geology.
Thus, for geoscientists the *GSI3D* methodology is a powerful tool for displaying their knowledge of the subsurface. *GSI3D* is helpful instrument for the clarification of the complex configuration of the natural and man-made environment by producing easy-to-understand, but nonetheless detailed, three dimensional structure-models ready-to-use as planning criteria for a sustainable management of our natural resources.