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Application of three dimensional geological models to hydrogeology

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Recently, three dimensional (3D) numerical simulation of subsurface structure has become a common engineering geological tool to investigate a variety of geological settings. Besides, hydrogeology always tightly combines with geological structures. For these reasons, coupling 3D geological models with hydrogeology will not only improve understanding of subsurface conditions, but also provide a common stratigraphic framework for hydrogeological applications.

The reliability of 3D geological models largely depends on the quality and quantity of data. Normally, before 3D geological models are constructed in the software package, the initial data (borehole descriptions, geological maps, geological cross sections, outcrop data, geo-electrical survey, digital elevation model, etc.) are acquired from archive as much as possible and standardized in a single table. To ensure the precision of models, new drilling data should be gathered from local authorities such as Geological Survey in time. Some experimental data are necessary to be kept at the initial moment to create a subset for verification of the models.

In particular, the resulting models will be used for hydrogeological applications. So, more parameters should be collected to construct the 3D property models. Properties contain porosities of soil, bearing capacity, compressibility and particular geological phenomenon such as the regional aquifers, aquitard and faults. During the processing of model construction, the minimum element of the models is grid, which can be converted to some finite elements software.

Further studies of these models to hydrogeological application involve:

- integrating faulted horizons of the 3D geological model into the groundwater modeling software package and simulating the groundwater flow within the main relevant aquifers using a finite elements approach;
- simulating distribution and calculating volume of groundwater in particular area;
- providing 3D parameters for vulnerability maps of groundwater, and comparing the results with the vulnerability maps constructed by 2D parameters;
- establishing the information system as a complement for long-term land use planning of cities; and
- helping to control widespread land subsidence risks in cities where the water table is lower by overexploitation of groundwater.