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Construction of a 3D structural model based on balanced cross sections and borehole data to create a fundament for further geolocial and hydrological simulations

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Cross section balancing is a generally accepted method for studying fault zone geometries. We show a method for the construction of structural 3D models of complex fault zones using a combination of gOcad modelling and balanced cross sections. In this work a 3D model of the Schlotheim graben in the Thuringian basin was created from serial, parallel cross sections and existing borehole data. The Thuringian Basin is originally a part of the North German Basin, which was separated from it by the Harz uplift in the Late Cretaceous. It comprises several parallel NW-trending inversion structures. The Schlotheim graben is one example of these inverted graben zones, whose structure poses special challenges to 3D modelling. The fault zone extends 30 km in NW-SE direction and 1 km in NE-SW direction.

This project was split into two parts: data management and model building. To manage the fundamental data a central database was created in ESRI's ArcGIS. The development of a scripting interface handles the data exchange between the different steps of modelling. The first step is the pre-processing of the base data in ArcGIS, followed by cross section balancing with Midland Valley's Move software and finally the construction of the 3D model in Paradigm's gOcad.

With the specific aim of constructing a 3D model based on cross sections, the functionality of the gOcad software had to be extended. These extensions include pre-processing functions to create a simplified and usable data base for gOcad as well as construction functions to create surfaces based on linearly distributed data and processing functions to create the 3D model from different surfaces.

In order to use the model for further geological and hydrological simulations, special requirements apply to the surface properties. The first characteristic of the surfaces should be a quality mesh, which contains triangles with maximized internal angles. To achieve that, an external meshing tool was included in gOcad. The second characteristic is that intersecting lines between two surfaces must be included in both surfaces and share nodes with them. To finish the modelling process 3D balancing was performed to further improve the model quality.