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An optimized workflow for building 3D models from balanced sections and potential field geophysics: a study case in NE Spain.

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Obtaining an accurate 3D image of the geometry and physical properties of geological structures in depth is a challenge regardless the scale and the aim of the investigation. In this framework, assessing the origin of the uncertainties and reducing them is a key issue when building a 3D reconstruction of a target area. Usually, this process involves an interdisciplinary approach and also the use of different software whose inputs and outputs have to be interoperable. We have designed a new workflow for 2.5D and 3D geological and potential field modelling, especially useful in areas where no seismic data is available. The final aim is to obtain a 3D geological model, at a regional or local scale, with the smaller uncertainty as possible. Once the study area and the working scale are is decided, the first obvious step is to compile all preexisting data and to determine its uncertainties. If necessary, a survey will be carried out to acquire additional data (e.g., gravity, magnetic or petrophysical data) to have an appropriated coverage of information and rock samples. A thorough study of the petrophysical properties is made to determine the density, magnetic susceptibility and remanence that will be assigned to each lithology, together with its corresponding uncertainty. Finally, the modelling process is started, and it includes a feedback between geology and potential fields in order to progressively refine the model until it fits all the existing data.

The procedure starts with the construction of balanced geological cross sections from field work, available geological maps as well as data from stratigraphic columns, boreholes, etc. These geological cross sections are exported and imported in GMSYS software to carry out the 2.5D potential field modelling. The model improves and its uncertainty is reduced through the feedback between the geologists and the geophysicists. Once the potential field anomalies are well adjusted, the cross sections are exported into 3DMove (Midland Valley) to construct a preliminary balanced 3D model. Inversion of the potential field data in GeoModeller is the final step to obtain a 3D model consistent with the input data and with the minimum possible uncertainty.

Our case study is a 3D model from the Linking Zone between the Iberian Range and the Catalonian Costal ones (NE Spain, an extension of 11,325 km2). No seismic data was available, so we carried out several surveys to acquire new gravity data and rock samples to complete the data from IGME petrophysical databases. A total of 1470 samples have been used to define the physical properties for the modelled lithologies. The gravity data consists of 2902 stations. The initial model is based on the surface geology, eleven boreholes and 8 balanced geological cross sections built in the frame of this research. The final model resulted from gravimetric inversion has allowed us to define the geometry of the top of the basement as well as to identify two structures (anticlines) as potential CO_2 reservoirs.