SpannEnD – providing stress data and geomechanical modelling tools for the site selection process in Germany

Oliver Heidbach[1], Andreas Henk[2], Birgit Müller[3], Karsten Reiter[2], Tobias Hergert[2], Frank Schilling[3]

[1] Deutsches GeoForschungsZentrum GFZ, Sektion 2.6 Erdbebengefährdung und Spannungsfeld, Telegrafenberg, 14473 Potsdam, Germany, heidbach@gfz-potsdam.de
[2] Institut für Angewandte Geowissenschaften TU Darmstadt, Schnittspahnstraße 9, 64287 Darmstadt, Germany,
[3] Karlsruhe Institut für Technologie, Institut für Angewandte Geowissenschaften, Adenauerring 20b, 76131 Karlsruhe, Germany

SpannEnd stands as an acronym for «Geomechanisch-numerische Modellierungen zur Charakterisierung des tektonischen **Spann**ungszustandes für die **En**tsorgung radioaktiver Abfälle in **D**eutschland». It is an initiative of various German research institutions with the aim to set-up of a comprehensive data base for the crustal state in Germany and the further development of 3D geomechanical-numerical modelling tools for robust stress predictions in areas where no stress data exist. Thus, SpannEnd provides fundamental information and basic techniques generally required for the site selection process of a geological disposal site for radioactive waste.

At present, only the orientation of the tectonic stress field in Germany, i.e., the orientation of the maximum horizontal stress S_{Hmax} has been compiled in a systematic manner and ranked according to an international quality ranking scheme (Reiter et al., 2015). These data are derived, among others, from well bore data (e.g. borehole breakouts, hydraulic fractures), earthquake analysis as well as geological information and overcoring data. However, only 277 of the 757 data records compiled for Germany have an acceptable quality (Reiter et al., 2015). For the stress magnitude data, which is the essential information to assess the criticality of the stress field, such as database does not exist for Germany. Furthermore, given the sparse and incomplete knowledge of the stress field geomechanical-numerical models have to predict the full stress tensor at arbitrary points in the subsurface.

To provide a stress prognosis for a potential disposal site, i.e., prior to drilling or excavation, a toolbox of 3D geomechanical-numerical models has to be developed. We propose that this model should be Germany-wide with dimensions of 1200 x 900 x 80 km³ to capture the geometry and mechanical properties of the main lithological units that control the overall pattern of the crustal stress field. This model has to be calibrated using a stress magnitude stress data base. Such a model allows for a physics-based interpolation between individual stress measurements and stress prognosis at points not covered by stress observations, respectively. Furthermore, the Germany-wide model, that simulates the large-scale variations of the stress field, would also deliver reliable initial- and boundary conditions for regional and local scale 3D geomechanical-numerical models. Both, the set-up of the stress magnitude data base as well as development of the modelling tools has to be started now in order to provide the necessary fundamental information on the local tectonic stress field once the site-selection process will be started in Germany.

Besides the recently published new stress map of Germany (Reiter et al., 2015) we present an example of a new 3D geom.-num. model concept applied in southern Germany that shows a fast and automated calibration process as well as the derivation of boundary conditions from regional models for local site models. The aforementioned initiative SpannEnd proposes to extend this concept for Germany, to set up a fundamental stress magnitude database and to integrate the expert knowledge of the stress field modelling in Germany in order to provide geomechanical measures needed in the course of the selection process.

References

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