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Modelling of In-situ Stress Regime in Cap Rocks in Parts of the North German Basin

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In order to assess the prevailing stress scenarios and to evaluate any future developments due to anthropogenic contributions, in-situ stress modelling of parts of the North-German Basin is being conducted within the project framework of CLEAN*. Analysis of borehole records, obtained from GDF SUEZ E&P, laboratory experiments, and simultaneously 3D-ArcGIS and finite-element (FE) models have been executed. Among other input data GIS model also incorporates borehole breakouts that show stress anisotropy of different Suprasalinar formations in contrary to the isotropic breakout intensity distribution in the Zechstein formation. The model also reveals deformations in the subsurface at some investigated boreholes. Together considering the 'decoupling' effect of the Zechstein Salt, these local deformations obviously play roles dominating the possible orientations of the major and minor horizontal stress components (SHmax and Shmin). Finite-element (F-E) simulation of anisotropic stress conditions for various sedimentary rocks like limestone, anhydrite, claystone etc., showed how micrometer-scale deformations of borehole liners at the deep underground can be used to ascertain the stress fields in its surroundings. Laboratory experiments with newly developed strain gauges based on 'Hard-Inclusion' theory are being carried out to determine magnitude and orientation of different simulated stress regimes. Based on the lab simulations a stress monitoring tool is to be developed for use in liners of selected boreholes. The research results, in one hand, will work as a useful tool in 'decision-making' regarding future utilization of the underground storage facilities for anthropogenic refuse, and on the other hand will enhance data on existing stress database for the Suprasalinar formations where limited available stress records need to be enriched for future monitoring of in-situ tectonic stress conditions.

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