

GM11

Comparison of Two Different Approaches to Build a 1D Geomechanical Model - A Case Study

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SUMMARY

The geomechanics community in the industry has generally adopted two different approaches to build geomechanical models: (1) determining subsurface horizontal stresses from acoustic dipole logs acquired at sonic frequencies and requires detectable amount of shear wave anisotropy; this approach produces rapidly varying stress profiles reflecting changes between and also within different lithological units. (2) Observation of stress-induced borehole failures (borehole breakouts or tensile fractures) and constrains horizontal stresses at discrete depth points; stress profiles are then extrapolated over the depth intervals of interest generally resulting in smooth horizontal stress profiles without appreciable variations across lithological boundaries. Each approach has its benefits and limitations and depending on the application and also the (service) provider utilized for geomechanics one model is preferred over the other. To better understand and compare results for the two approaches outlined above, OMV Austria Exploration and Production GmbH (OMV) commissioned two service providers with the scope to build a geomechanical model for one of its fields located in the Vienna Basin with the request to utilize "state of the art" modeling technology. This model was then to be calibrated and verified with drilling experiences and wellbore failures/enlargements (detected from provided caliper and image logs).



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The data set available came from two offset wells and was complete in the sense that it contained all required wireline log and downhole data in order to pursue both approaches with more or less equal amounts of remaining uncertainties and to objectively compare results.

The results from this project are shown in Figure 1 and can be summarized as follows:

- Agreement in pore pressure and overburden stress.
- Differences mainly in the approach for
 - constraining principal horizontal stresses in particular SHmax
 - however differences in stress magnitudes were relatively small
- Appreciable differences in the approach to derive rock strength as well as in resulting rock strength values with critical implications to model calibration and verification.
- Stress profiles derived from acoustic anisotropy (approach 1) reveal a much larger variability as a function of lithology
 - rapidly varying stress profiles is a direct response of acoustic variability and anisotropy, which is not only a function of stress but also other factors
 - these are adequate for frac design and other applications that require a more detailed, formation specific stress profile.
- ► A smooth stress profiles (irrespective of lithological changes) resulted from utilizing interpreted wellbore failures (approach 2) and integrated with other wellbore and formation parameters
 - these are adequate for wellbore stability applications but probably not for those that require a more detailed understanding of stress.





Figure 1. Resulting 1D geomechanical models following the two approaches outlined above; left: approach (1); right: approach (2).