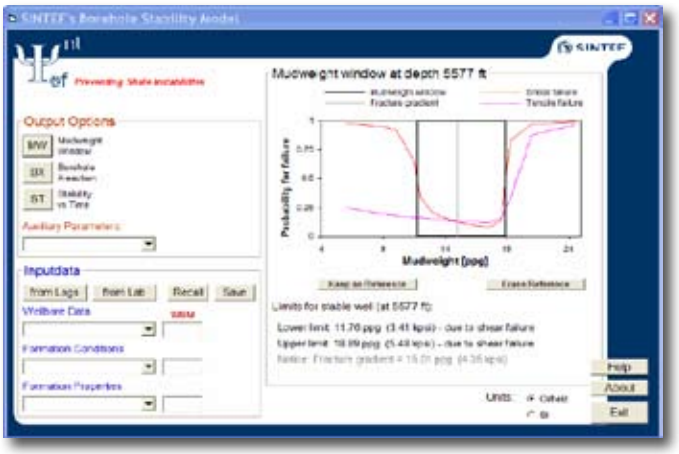
Wellbore Stability – the PSI software

The wellbore stability model implemented in the PSI software combines input parameters describing formation conditions, formation properties and wellbore data to predict the stability of the well over time.



PSI estimates the probability for mechanical failure inside the borehole wall; since the model is largely analytical, solutions are obtained very quickly. The software allows for analysis of stresses and pore pressure around the considered well and analysis of stability versus time since drilling.

PSI software window showing at left the input drop-down menus and at right, the mud weight window output.

Features incorporated into PSI

The PSI model takes into account a rich amount of rock and fluid properties affecting wellbore stability over time. Some general features it can handle are anisotropic formation stresses, arbitrary well orientation and various types of drilling mud (OBM/WBM/SOBM). More specifically, the model takes into account:

- mud chemistry – osmosis and ionic exchange with clay platelets in rock
- well inclination & azimuth
- strength anisotropy
- plasticity
- temperature

The input parameters needed to run a wellbore stability prediction are:

Formation conditions
– in situ stresses, pore pressure, temperature.

Wellbore data
– well inclination & azimuth, borehole diameter, physical & chemical properties of the drilling mud, mud temperature.

Formation properties
– mineralogy, porosity, strength parameters, elastic parameters, plastic parameters, thermo-elastic parameters, poro-elastic parameters, chemo-elastic parameters, diffusion constants.

Wellbore stability depends to various degrees on all these above parameters, but some input parameters are more important than others. To run PSI, the user should use all possible sources for input parameters, such as:

- direct measurements when available
- indirect measurements combined with suitable models/correlations
- common accepted general knowledge together with suitable models/correlations
- extract more information from small sample tests (as available from SINTEF) where material cores are scarce

As a rule, the data should be as consistent as possible, and one should use the same basic models / physical understanding when extracting the different parameters. Some available SINTEF tools and softwares can be used, such as PRESSIM for initial pore pressure calculation, FEM for depleted shale pore pressure, and SINTEF models and correlations generating the needed input from other available parameters.

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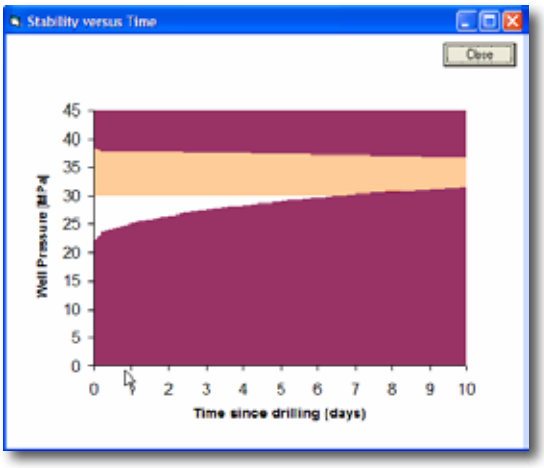
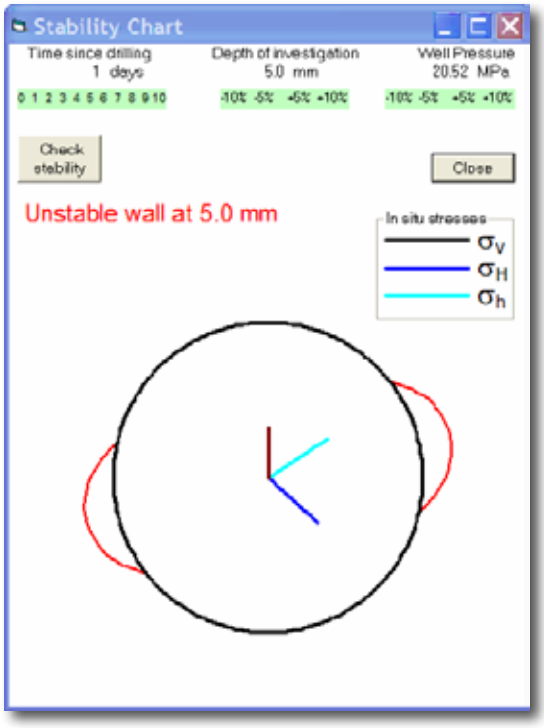
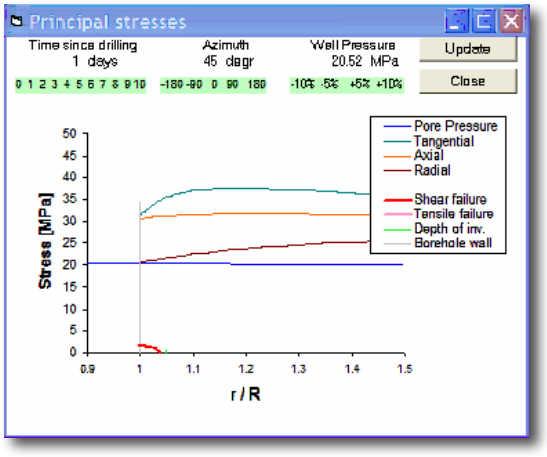
October 2007



PSI output:
mud weight window evolution with time.



PSI output:
stability chart showing borehole cross section with in situ stress directions and extent of breakouts on perimeter of well where wall is unstable.



PSI output:
stress map inside formation showing appearance of shear failure at borehole wall.

SINTEF

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