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Three-Dimensional Analysis of Stress Pattern within Salt-Base Formation and Integrated Method for Design of Mud-Weight Window

Xinpu Shen

Summary

In practice, the mud-weight window (MWW) of a given wellbore can be designed with either two-dimensional (2D) analytical software or three-dimensional (3D) numerical finite element (FE) software. The advantage of 2D analytical tools is that they are highly efficient. Their major disadvantage is that several assumptions are adopted with the input data. These assumptions may not be accurate enough for subsalt wells. The advantage of the 3D numerical method is that it can accurately calculate the initial geo-stress field with a 3D FE model. Its major disadvantage is that it is not as efficient as the 2D method.

An integrated method was developed for the MWW of subsalt wells. The advantages of 2D and 3D methods are deliberately combined, and disadvantages are avoided. This target is achieved by calculating the initial effective stress ratios with a 3D finite element model. It can be further used as input data when using the 2D analytical method. The initial effective stress ratio numerically calculated with 3D FE model has brought 3D character into the 2D solution of the MWW, and thus making it 3D.

A 3D model was built with a given salt body, which simulated a typical situation existing in engineering practice. The solution of the MWW corresponding to the wellbore trajectory given in the field was calculated. Comparisons were made between the new solution of the MWW and the solution obtained with a 2D and a 3D tool, respectively. The results indicate that the solution obtained with the synthetic method proposed here has 3D characteristics, but with higher accuracy and lower computational costs.