Seismic pore pressure prediction in the Norwegian Sea, Halten Terrace

Pre-drill pore pressure prediction is essential for safe and efficient drilling and is a key element in the risk reducing toolbox when designing a well. Our work with seismic interval velocities shows that the velocity field can provide an important basis for pressure prediction and enable construction of regional 3D pressure cubes supporting traditional 1D offset analysis.

**The Halten Terrace**
The study area is highlighted in green covering the Halten Terrace in the Norwegian Sea; an area with a complex pattern of pore pressure anomalies which traditionally has been difficult to map.

**Velocity-to-pore-pressure transform**
We apply the method of Bowers (1995) to transform velocity, \( v_p \) to effective stress, \( \sigma_e \):

\[
v_p = v_{ml} + A \sigma_e^B
\]

Here \( v_{ml} \) is the velocity at mudline and \( A \) and \( B \) are empirical parameters that is calibrated to our data. In order to calibrate the transformation we compute the misfit (root mean square of the residuals) between the predicted, \( P_{pred} \) and reported pore pressure, \( P_{well} \):

\[
\Delta P_{rms} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} \Delta P_i^2}
\]

where

\[
\Delta P = P_{well} - P_{pred}
\]

The parameter pair \((A, B)\) giving the minimum misfit is selected for the transformation.

**Conclusion**: We find that the predicted pore pressure fits well with reported maximum pore pressure in Tertiary and Cretaceous. We note that reported pore pressure is usually correct only at depths where a reaction from the borehole is registered (kick, connection gas or RFT/MDT pressure points obtained from the iQx™ well database, a software developed in-house). Further lithologic characterisation and high resolution seismic velocity data, especially in Jurassic, may enhance the accuracy of the method.

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