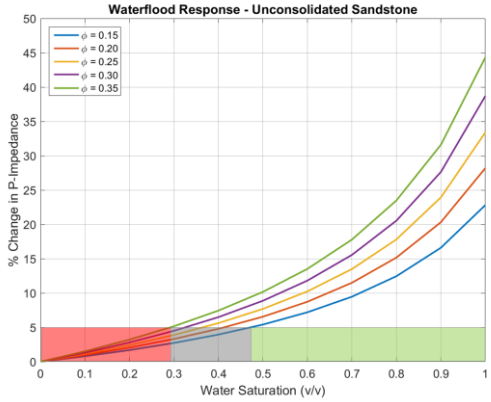
Time-Lapse Analysis

Sound qi
ADVANCED EARTH IMAGING

Whether monitoring CO_2 storage, pressure depletion, or fluid injection such as steam or water, time-lapse seismic can provide quantitative spatial information about the state of the reservoir.

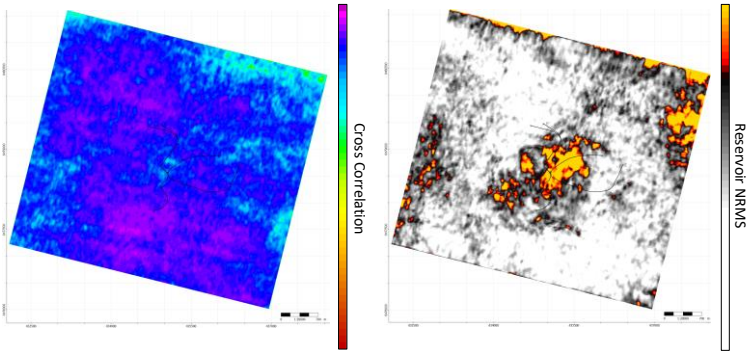
Feasibility

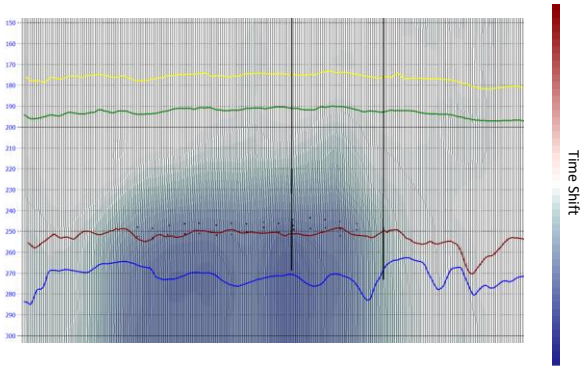
Knowing when to best start a time-lapse monitoring project can be difficult. Feasibility analysis takes into account the expected range of changes in the reservoir and uses rock-physics modelling to assess when those changes result in significant changes in seismic properties. This step answers the questions "Will there be a significant change?" and "How much time is optimal before acquiring a monitor survey?", while at the same time providing a tool to interpret the results when the work is done.



Data Preparation

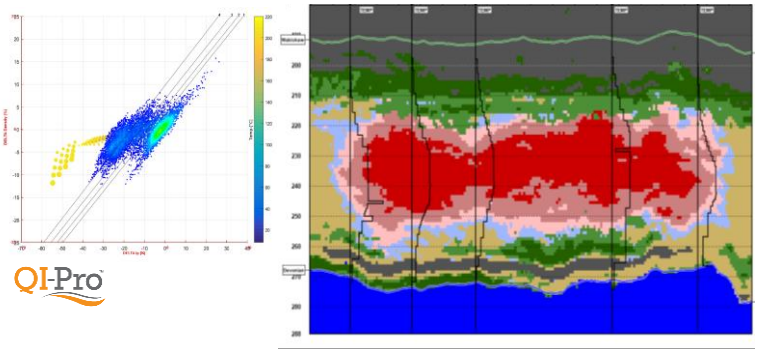
Outside of reservoir changes, the seismic data is expected to be repeatable. A careful assessment of the amplitude, phase, and noise level of the baseline and monitor surveys is necessary to determine the preconditioning necessary for quantitative analysis. Determining the time shifts on the monitor survey due to changes in velocity allows the surveys to be registered and compared more directly. Many of the outputs from this stage are themselves useful information for the inversion process.





Inversion Parameterization

For many aspects of the inversion, it is important to keep the parameterization consistent between different seismic vintages. At the same time, it is necessary to respect the differences in the data. For changes over thick intervals, it can be necessary to alter the initial models of the inversion by incorporating velocity-change information and rock-physics relationships. Relating inverted properties back to well data and reservoir simulations is a key validation step.



Interpretation

Time-lapse analysis is more than maps of amplitude changes and time shifts. Classification using QI-Pro shows how these responses relate to changes in actual reservoir conditions. Using combinations of single-vintage attributes and time-lapse changes, within a rock-physics framework, changes in fluid saturation, pressure, or temperature are categorized while also accounting for the variability of response for different geological facies. The resulting volume contains all of the information critical for effective decisions.

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