

# Rock Physics and Modeling in the Interpretation of Time Lapse Seismic Data

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## **Summary**

Time-lapse seismic monitoring involves the comparison of two or more surveys acquired at different times over an active producing field. Spurious differences between the seismic surveys, caused by seismic acquisition and processing as well as seasonal variations in the near surface, must be minimized to isolate and enhance the differences in seismic signal that are caused by the production process. Once these production-related changes are identified, they must be properly interpreted and calibrated before the seismic information can be used to enhance the recovery process.

One method for interpreting these time-lapse seismic signals involves the use of rock physics and seismic modeling. Rock physics relationships are used to determine the changes in velocity and density caused by production-induced changes in reservoir saturation, pressure and temperature. A suite of new sonic and density logs is then created which include values consistent with a range of critical reservoir parameters. Synthetic seismic traces are then generated for each of the modeled logs, which represent the various production scenarios. These new synthetic traces are compared to the initial synthetics to determine the attributes that are most highly correlated with the reservoir properties of interest. Finally, these same attributes are extracted from the actual seismic data to determine which reservoir parameters best explain the observed seismic response.

This calibration procedure was applied to the data from the Amoco/Aostra Gregoire Lake steam flood pilot. Changes in reservoir temperature estimated from the seismic data compare favorably with temperature logs recorded at the observation wells and the interpreted distribution of heated zones in the reservoir is consistent with the production history of the field.