

Business Drivers and Technology Advances in 4-D Seismic Monitoring

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This paper will discuss the business drivers and technology advances that are rapidly improving the state-of-the-art in 4-D seismology today, drawing from selected reservoir monitoring case study examples around the world. Time-lapse “4-D” seismic technology was pioneered in the late 1980’s and early 1990’s as a series of EOR field pilot studies, and has today become a well-accepted reservoir management tool for monitoring many types of hydrocarbon production. The technology first gained major commercial success in the North Sea during the late 1990’s, and evolving business forces are now expanding the application of 4-D seismic to new geographies, reservoir geologies and production mechanisms, as will be shown in the examples.

4-D seismic advances are also being driven by an increased interaction with the petroleum engineering community to become more quantitative and accurate in our ability to monitor reservoir processes. Qualitative interpretations of colorful time-lapse anomalies are being replaced by quantitative inversions of the 4-D seismic data to produce accurate maps of fluid saturations, pore pressure, temperature etc. in physical engineering units with uncertainty analysis, as the examples will show. These 4-D technology advances are improving engineering work flows for reservoir model updating, history matching, estimating the inter-well distribution of oil and injectants (water, gas, steam, CO₂...), delineating reservoir compartments, flow paths/barriers, and the sealing properties of faults.