

## **Geophysical monitoring in a hydrocarbon reservoir**

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Extraction of hydrocarbons from reservoirs demands ever-increasing technological effort, and there is need for geophysical monitoring to better understand phenomena occurring within the reservoir. Significant deformation processes happen when man-made stimulation is performed, in combination with effects deriving from the existing natural conditions such as stress regime in situ or pre-existing fracturing. Keeping track of such changes in the reservoir is important, on one hand for improving recovery of hydrocarbons, and on the other hand to assure a safe and proper mode of operation. Monitoring becomes particularly important when hydraulic-fracturing (HF) is used, especially in the form of the much-discussed "fracking".

HF is a sophisticated technique that is widely applied in low-porosity geological formations to enhance the production of natural hydrocarbons. In principle, similar HF techniques have been applied in Europe for a long time in conventional reservoirs, and they will probably be intensified in the near future; this suggests an increasing demand in technological development, also for updating and adapting the existing monitoring techniques in applied geophysics.

We review currently available geophysical techniques for reservoir monitoring, which appear in the different fields of analysis in reservoirs. First, the properties of the hydrocarbon reservoir are identified; here we consider geophysical monitoring exclusively. The second step is to define the quantities that can be monitored, associated to the properties. We then describe the geophysical monitoring techniques including the oldest ones, namely those in practical usage from 40-50 years ago, and the most recent developments in technology, within distinct groups, according to the application field of analysis in reservoir.

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