

Seismic reservoir imaging during the petroleum development/ production stage

Akihisa Takahashi[1]

[1] JAPEX

Reflection seismic methods have been widely used for the exploration of oil and gas from 1950s. Target structures have been changed from simple anticlines to more complex stratigraphic traps. Three-dimensional seismic surveys have been conducted to delineate subsurface structure precisely together with pre-stack depth migration technique. Sequence stratigraphic analyses were also applied to predict non-structural reservoirs from the point of sedimentology. To predict reservoir fluids, AVO analyses were used. Wide range of techniques has been applied in the stage of exploration.

Recently, reflection seismology is applied to evaluate discovered fields and monitor producing fields through reservoir characterization and reservoir monitoring techniques. In this paper, the author will describe current status of reflection seismology from exploration to development/ producing stage, and discuss the future of this technology.

Once the first exploratory well is successful, additional delineation wells are drilled to evaluate the extent of oil and gas reservoirs. In these wells, reservoir parameters such as thickness, porosity, and oil saturation are measured with high accuracy by electrical logs. In the off-well locations, seismic data will be used to delineate these parameters based on the relationship at the well locations. Multi-attribute analysis is one of the most effective methods to estimate a physical property from seismic data when a physical property is considered to be related with several seismic attributes. Selection of target log (physical property) and seismic attributes to be used is essential for the analysis. Results of the analysis will be verified by the validation test and checked with conceptual geological models. The difference of resolution between logs and seismic data should be examined to retrieve proper information from seismic data. By using these results, it becomes possible to construct detailed development plans including well placements.

Geological models (permeability models) which become inputs for the reservoir simulation have been constructed using these reservoir characterization results. Uncertainty of the predicted production profiles, which will be caused by the limitation of seismic resolution, will be evaluated by using wide variety of realization.

Time-lapse seismic methods are used to delineate fluid substitution in the producing fields. They work well especially in the gas or steam injection fields. It should be noted that seismic responses are influenced not only by fluid substitution but also by effective pressure changes. Petrophysical analysis is essential for evaluating the seismic responses quantitatively.