

Exploration of gas reservoir using 3D seismic at Offshore Iwaki Gas Field

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The gas reservoir might appear as a large amplitude reflection event in the seismic data when the gas is included in the sandstone layer in the sand and shale alternation. This is called a bright spot. However, the gas might not be found even if drilling aiming at such a bright spot. Because a bright spot is brought from various factors other than the gas. Recently, the success probability of exploration well is improved by expecting and confirming the cause that brings such a large amplitude by the AVO (amplitude variation with offset) analysis or the elastic inversion including S wave information to avoid such misidentification.

The purpose of this is to introduce the example of the exploration of the gas reservoir where the AVO analysis was used. The AVO analysis is the technique that examine the amplitude variation in the reflection wave at the reflector (boundary between sand and shale layers) according to the change in an angle of incidence or source-geophone distance (offset). When the elastic wave incident on the gas sand, P wave velocity is slower in the gas sand than the brain sand, but S wave velocity is almost same. This brings the increasing amplitude according to the increasing angle of incidence. We know there are some different AVO responses because of the relation of the hardness (velocity and density) etc. of overlapping sand and shale layers. The amplitude of normal incidence and the gradient with an angle of incidence are achieved from the AVO analysis. We are able to choose the best AVO attribute that shows the gas reservoir from some combination of these AVO attributes. Even if we get the AVO anomaly that shows the gas effect, AVO anomaly might be shown according to other geological factors. Therefore, it is important to expect what AVO anomaly our target shows using AVO modeling.

Offshore Iwaki Petroleum Co., Ltd. achieved the 3D seismic in 1998 at the south of Offshore Iwaki Gas Field to find new reserves. Main reservoir of this gas field is C5 sand in Lower Miocene. It is concluded from the simulation using existent well log data that the bright spot of the C5 sand reservoir is the AVO anomaly from gas. The area of C5 sand's bright spot is almost corresponding with the area of AVO anomaly. Therefore, the distribution of the gas reservoir of C5 sand is able to obtain by tracking the reflection event of C5 sand on the seismic data and mapping the large amplitude at this area.

An attached figure shows the 3D seismic data was cut out along the C5 sand, and some gas reservoir are showed as black events on the top of anticline at each fault blocks.

