Geophysical exploration for petroleum in Japan: Past, present, and future

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Geophysical exploration for petroleum in Japan was initiated with the gravity measurement at the Niitsu oil field in 1918. Since then, researchers and engineers of universities, Geological Survey of Japan and mining companies continued to develop and construct the foundation of the geophysical exploration. From 1955 to 1969, under the governmental policy, geophysical surveys, such as seismic survey, gravity survey and magnetic survey, were continuously conducted in the Niigata, Yamagata, Akita and Hokkaido areas by Japex (the national policy concern at that time) and Japan National Oil Corporation (JNOC). These geophysical surveys contributed to discover 26 oil and gas fields during the 15 years. This is mainly because of 1) the technical innovation both in hardware and software for data acquisition and processing, which improved quality and quantity of the data, and 2) accumulation of the amount of surveys, which gave knowledge of the targets. From 1970 to 1979, in addition to the former results, most part of the basin structure around Japan were roughly understood and this led to the discovery of the Aganogawa oil field, which is the first offshore oil field in Japan. On the other hand, only two oil fields were discovered with the contribution of the geophysical surveys. This meant that the oil field explorations with the existing concepts were already matured. After that, new concepts and methodologies were required to find the new prospects because of the exploration in the plain area and hills were almost completed and gathering oil structure of the continental shelf were already explored. Therefore, many geophysical surveys were conducted with various specifications and as the consequence, Iwafune-oki oil field and Katagai gas field were explored.

After the Great Hanshin-Awaji Earthquake in 1995, geophysical exploration, mainly seismic (both refraction and reflection) surveys, were actively conducted to provide basic structural information for the earthquake disaster prevention and scientific investigation. These include surveys for active fault, under ground structure investigation of depositional plain, 'Special Project for Earthquake Disaster Mitigation in Urban Areas', and so on.

Many substantial results were obtained through these projects, and it is important to utilize these results back to the petroleum exploration.

In this paper, we summarize the history of the geophysical exploration for petroleum in Japan and analyze the development of data acquisition specifications after 1980. Then, the contribution of the geophysical survey for the exploration of Iwafune oil field and Katakai gas field and the subsequent exploration for the deep target are reviewed. Finally, we introduce the future (on going) plan of geophysical exploration to utilize the results of disaster prevention project and scientific investigation.