VII. Environmental Studies

For commercial production of methane gas from methane hydrate-bearing sediments, it is essential to understand potential environmental impacts associated with methane hydrate development, and to establish an appropriate assessment procedure for these environmental impacts.

In Phase 1, necessary information for realistic investigation of environmental issues, such as detailed methane hydrate distribution, and effective methods for gas production and target areas, was uncertain, and various basic environmental studies associated with environmental monitoring, surveys and predictions had been conducted.

During Phase 2 and Phase 3, more realistic environmental studies have been conducted based on the important findings of Phase 1, namely, identification of the distribution of methane hydrate concentrated zones, and the effectiveness of the depressurization method.

The offshore production tests conducted twice in the "Japan's Methane Hydrate R&D Program" were meaningful and important opportunities to acquire real data on environmental impacts and to apply and optimize the methods for prediction, assessment and monitoring of future methane hydrate development. Environmental studies had been conducted referring to the procedure of Environmental Impact Assessment (EIA) generally implemented in conventional offshore oil and gas production projects worldwide. The iterative process of environmental studies is shown in Fig.VII-1.

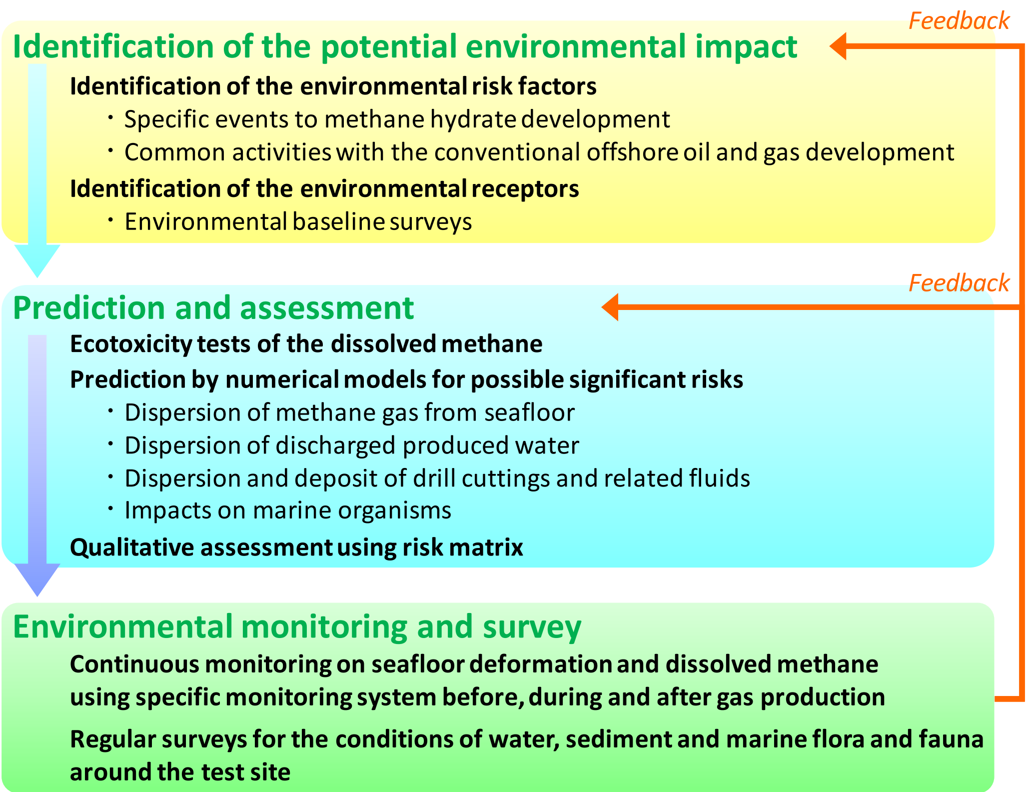

Fig.VII-1 Process of environmental studies

In summary, four events were identified as potential environmental risk factors that might cause significant impacts, namely, methane leakage from the seafloor, seafloor deformation, discharge of produced water, and deposition of drill cuttings and related fluids. The first three events are considered to be methane hydrate-specific events. In addition to the produced water, the difference from that of conventional oil and gas production is that pure water generated from dissociation of methane hydrate is mixed with formation water. With reference to the last one arising from riser-less drilling, even though this event is common among conventional offshore oil and gas developments and generally accepted worldwide through the EIA process, MH21 took sufficient care of this taking into account the uncertainty surrounding the deep sea environment.

Regarding the prediction for methane gas seepage from the seafloor and seafloor deformation, specific numerical models have been developed and applied (Please refer to chapter V for seafloor deformation). On the other hand, proven models applied within oceanographic, coastal and estuarine environments were used for the dispersion of produced water and drill cuttings. Additionally an ecosystem model has been developed to enable consideration of environmental impacts on marine organisms in the lower trophic levels of the food chain. Other environmental risks were comprehensively assessed using a risk matrix. The results of these predictions and assessments were checked based on the data acquired by environmental monitoring and surveys that were implemented to extract technical issues.

Regarding environmental monitoring, a newly improved methane sensor was applied to dissolved methane monitoring, and a highly accurate pressure sensor was used to monitor seafloor deformation. In general, several technical issues were identified, and necessary conditions and limitations for deep sea long-term use were clarified.

The results and developed methods mentioned above were only for small-scale gas production tests in limited areas, and EIA methods should be optimized taking into account environmental characteristics of actual production fields, production methods and development activities for future commercial methane hydrate development.