FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Geobio-engineering and technology development for sustainable energy and carbon cycles associated with CO_2 sequestration in marine subsurface environment (Bio-CCS)	
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1. Background of research

To date, as one of the practical and effective options to reduce the significant level of industrial CO_2 emission into the atmosphere, a variety of CO_2 capture and sequestration (CCS) options have been considered in many countries, including the geological storage in marine subsurface sediment. On the other hand, in shallow to deep marine subsurface, including the western coast of Pacific Ocean off Japan, a remarkable number of microbial cells have been observed. The long-term metabolic processes are considered to play important ecological roles in biogeochemical carbon cycles, such as the formation of methane hydrates and other hydrocarbon reservoirs. However, our knowledge of liquid and/or supercritical CO_2 behaviors as well as of redox-chemical, sedimentological and biological reactions in deep-sea sediments remain largely unknown.

2. Research objectives

In this study, we primary aim to develop a sustainable energy and carbon cycling system associated with CCS in marine sedimentary environments. We call the system as the “Bio-CCS”, for which development we examine a variety of sediment core samples, involving some immature coal-bed and sand layers deeply buried in the oceanic off Japan, to monitor biogeochemical and geophysical characteristics via the possible interactions between CO_2, minerals and microbial activities.

3. Research characteristics (incl. originality and creativity)

Almost nothing is known about the “post” CCS in deep marine subsurface from biogeochemical, microbiological and ecological aspects. The biological conversion of CO_2 to natural gas (i.e., methane) and organic matter is a key process *in situ*, which requires nutrient and energy production from the non-recoverable resources buried in the ocean, like immature coal-beds, via the redox and chemical reactions associated with the offshore CCS.

4. Anticipated effects and future applications of research

This study contributes to the development of “geobioreactor” system, representing global impacts on societal scientific issues. In addition, scientific ocean drilling using the deep-earth drilling vessel “*Chikyu*” will also vastly expand our knowledge of deep subseafloor hydrocarbon system, providing unique opportunity to find out potential geobiological functioning as the ecosystem service for its application to human activities in future.