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## Developing a Better Bio-Geology Overview and Information Needs for Effective Assessment of the Environmental Risks of Deepwater Oil and Gas Development

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### Abstract

A review is presented of the relationship between scientific knowledge of seafloor ecology and the regulations intended to protect that ecosystem. The review concludes that current deep-water environment regulation maybe inappropriately too similar to that developed for ecologically dissimilar habitats in shallow water. Deep patterns of zonation, diversity, and abundance are all different than encountered in shallow water. Settling of shallow regulations drew heavily from considerable prior factual and conceptual information as well as an established pattern of usage. By contrast, the deep-water environment remains very poorly studied. The composition of the biota is poorly known, as are the details of the major biotic patterns. Concepts as to why the deep system is as it is are still being developed and few existing concepts have ever been proven sufficiently to serve as a basis for regulation development. There are, however, strong connections between biological and geological processes. One scientific theme common to the normal mud bottom, seep habitat, and deep coral assemblages is that food (energy) supply from sediment flux or hydrocarbon seepage is extremely important. Impacts to this supply should be a major concern. Once thought to be a monotonous desert where there could be few environmental issues, the deep-seafloor is increasingly being seen as a heterogeneous environment with a growing list of biodiversity hotspots such as cold seeps, deep coral banks, deep sponge assemblages, and chemically extreme habitats. The actual risks posed by seafloor drilling have yet to be well assessed. Both industry and regulatory agencies would be better served by better data. There should be improvement in the quantitative sampling of large animals, standardization of methods, assessment of actual sensitivities, and greater biological exploration.

### Introduction

Major scientific investigation of deep-sea ecology began with the circum-global cruise of the HMS Challenger (1872-1876) a full century before oil platforms reached a bottom depth of 1000 feet in the Gulf of Mexico. In spite of this 100-year lead-time, both deep-sea ecologists and offshore developers must consider the continental slopes and abyssal seafloor poorly understood pioneer areas. Indeed, the pace of scientific investigation of the deep sea ecology off the US, Mexico, Brazil, Europe, Africa, India, Australia, New Zealand, Russia, and Japan is now being driven by exploration for hydrocarbons rather than basic science questions. This leads to a situation in which biological discoveries are being made during the course of industrial development. A very different relationship between environmental understanding and regulations existed in shallow water once continental shelf development began in the 1940's and 50's. From the late 1890's onward ecologists applied a relatively standard set of methods and sampling designs to biologically characterize and map large areas of the European and smaller areas of the North American shelf (Carney 2007). Therefore a strong foundation of concepts, methods, and knowledge was in place in the 1970's when the Bureau of Land Management initiated extensive oceanographic studies to gain a stronger scientific basis for management of development areas in the Gulf of Mexico, Alaska, California, and the US Atlantic coast.

In order to better understand environmental restrictions placed on offshore development on publicly owned deep and ultra-deep seafloor, it is important to realize that both industry activity and regulations began in shallow water. Deep regulations are based in large part upon policies and strategies developed for much shallower habitats. Boesch et al. (1987) presented a