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Implementation of an observatory strategy in the Lucky Strike vent Field, MoMAR

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Hydrothermal fields along mid-ocean ridges are zones where processes deep seated in the crust and upper mantle (faulting, melting, hydrothermal circulation) interact with the water column, and sustain peculiar biological communities. Hydrothermal circulation, which is hosted by a porous crust and sustained by the transfer of heat towards the water column, shows important temporal variability, both as part of the "normal" evolution of the system (i.e., porosity variations due to precipitation), or as a result of events such as earthquakes, volcanic events, or tides. The physical and chemical characteristics of vent emissions are the result of complex rock seawater interactions in the subsurface that forms high temperature hydrothermal fluids. These fluids can be subsequently modified by subseafloor and near surface mixing with background seawater leading to a variety of emitted fluids enriched in gases, metals and radionuclides. Deep-sea hydrothermal communities are dwelling in the interfacial zone where the hot and reduced hydrothermal fluid turbulently mixes with the cold and oxygenated seawater. The mixing zone is highly reactive and produces mineral precipitation and large chemical gradients offering a complex and dynamic variety of habitats for organisms. This fluctuating environment provides a periodical access to chemical species present both in the vent fluid and in seawater and required for chemolithoautotrophic bacterial primary production but also to potentially toxic species (e.g. heavy metals, radionuclides). The vent communities thriving on chemosynthesis are thus dependant on vent fluid supply for survival and growth. The dynamics of hydrothermal systems at slow-spreading ridges are poorly understood. To understand the ecosystem dynamics and the links with the active hydrothermal processes require an integrated study of the

whole hydrothermal system, together with the acquisition of time series of chemical, geophysical and biological variables. We propose to initiate the implementation of an integrated deep sea observatory at the Lucky Strike hydrothermal vent field on the mid Atlantic ridge (MoMAR project). The objectives of the project rely on the elaboration of a working strategy concerted and multidiciplinary. This strategy will allow the acquisition and integration of data at different spatial and temporal scales. The geophysical studies at the vent field scale will provide a global context to the ecological and microbiological projects performed at vent scales or smaller. Temperature will be used as a tracer of the temporal variability of the hydrothermal system at all the scales studied during the project (from subsurface processes to the impact on the ecosystem), and linked to other geochemical, geophysical and geological observables. The main questions that we want to address are: - What are the size and nature of hydrothermal systems at slow-spreading ridges? What is the correlation between hydrothermalism, geology, magnetic structure, and fine-scale tectonic structure of the seafloor? - What is the correlation between the seafloor distribution of vents and their characteristics, associated ecosystems, and the effect of external environmental factors? In the long term, through integration of data, we plan to study the system over a period of time of 5-10 years, so as to: - characterize the temporal evolution natural to the hydrothermal system (i.e., variations in water temperature and chemistry, distribution of vents, changes in ecosystems), the feedback among active processes, the evolution of ecosystems, - determine the response of the system to extraordinary events such as a seismic crisis of possible magmatic origin that took place in early 2001, - identify the biotic, abiotic or random factors that control the structure and dynamics of ecosystems at varying time-scales (hours-days for microbiological studies, and months for the whole ecosystem, As plan of the MoMAR inititative, we plan to initiate coordinated field work in 2005 and 2007, with expected yearly fieldwork through 2012 for a first 5-yr phase of integrated studies.