ÉCOLE DOCTORALE SCIENCES DE LA TERRE

IPGP INSTITUT DE PHYSIQUE DU GLOBE DE PARIS

université PARIS DIDEROT PARIS 7

Dynamics and heat fluxes of hydrothermal fields

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Hydrothermal activity along mid-ocean ridges is responsible for the loss of ~25% of the Earth's heat to the ocean, and sustain venting of fluids at temperatures of >300°C, while sustaining chimiosynthetic ecosystems. Owing to their tectonic setting along active ridges, there is important temporal variability with strong interactions between magmatic processes at the axis (lava eruptions, dike injections, magma chambers), and deformation of the brittle crusts that hosts the plumbing of the hydrothermal circulation.

To investigate in detail hydrothermal activity and its temporal variability, the PhD candidate will study the Lucky Strike hydrothermal field along the mid-atlantic ridge, one of the largest sites known to date that extends over more than a square kilometer. This area has been the object of several cruises during the past 3 years, providing high-resolution geophysical data (sonar, microbathymetry, seafloor photography), and time series data (temperature of fluid outflows, microsesmicity, tides, etc.). This site will also host a deep-sea seafloor observatory from Fall 2010. Hence, Lucky Strike is the ideal laboratory for an integrated approach to study hydrothermal activity, with one of the most comprehensive datasets available, and time series data spanning over several years. The PhD candidate will develop the thesis work to address the following questions:

HEAT FLUX

What is the heat flux associated with the hydrothermal field, and the partition between focalized, high-temperature vents and lower temperature diffuse flow? Is there a temporal variability at the scale of several years, corresponding to existing observations?

DISTRIBUTION OF HYDROTHERMAL ACTIVITY

What is the structure of the hydrothermal outflow, and what are the geological and tectonic controls?

TEMPORAL VARIABILITY AND LINK WITH ACTIVE PROCESSES AT THE RIDGE AXIS

What are the links between fluid flow temperature variability, seismicity (deformation), and pressure (tides)? What is the temporal variability in hydrothermal activity at time scales ranging from days, through years, to thousands of years?

The PhD candidate will dedicate the bulk of the research to

a) Analyze seafloor imagery to study the distribution of hydrothermal outflow zones, and their temporal variability from repeated surveys.

b) Analize instrumental records or temperature, pressure and seismicity time-series to investigate the temporal variability and heat fluxes of hydrothermalism

c) Develop a quantitative approach to study heat and mass fluxes, transferable to other hydrothermal fields

d) Develop theoretical, numerical, or laboratory models of hydrothermal outflow (i.e., plume dynamics, crustal fluid flow, etc.)

We expect that the PhD candidate will acquire expertise in deep-sea instrumentation, and that he will participate in planned cruises in Sep'2010 (installation of seafloor observatory) and summer 2011 (recovery), as well as in other cruises through international collaborations.