Geophysical Research Abstracts, Vol. 7, 05673, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05673

Gas Hydrates and Fluid Flow in the Continental Fore-arc through the Seismic Eye - A Case Study

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The Central American Subduction Zone has of late been a target of investigations of SFB574, in order to study the fate of fluids and volatiles in subduction zones. The general tectonic setting is determined by subduction erosion, resulting in extensional faulting pattern and down-slope mass movement on the continental fore-arc. Upward fluid and material transport has been detected at several locations from, among others, shallow sediment and pore water samples, ocean floor video observations, and deep-tow side scan sonar profiles.

High-resolution streamer seismic data, acquired in a dense grid above Mound Culebra mud dome on the continental middle slope, display a widespread occurrence of a negative-polarity bottom simulating reflector (BSR). This is interpreted as the lower boundary of gas hydrate stability zone (GHSZ), and implies the general presence of gas hydrates in the shallow sediment. A mapping of the BSR has shown both its continuity and its depth below sea floor to vary on horizontal scales of a few hundred meters across the survey area.

A reconstruction of the temperature field from BSR depth reveals lateral changes in the local temperature regime. A correlation with tectonic elements (the mud diapir, a slump headwall) may be attributed to structural constraints of the temperature variations through laterally inhomogenous upward heat- and possibly material transport, which conveys sufficient heat to the GHSZ to shift the lower boundary of stability field upwards. Results show the occurrence of both focussed and disperse flow, with a possible contribution from a major portion of the sub sea-floor. We suggest that the irregular BSR topography may be used to locate sites of upward material transport,

which may manifest as potential locations of fluid expulsion on the sea floor. Thermodynamic considerations also help us constrain the time scale and dynamics of fluid regime at the Costa Rican erosive continental margin.