Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03217, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03217
EGU General Assembly 2008

Integrated side-scan, sub-bottom profiler and seismic signatures of methane seepage from Omakere Ridge on New Zealand's Hikurangi margin.

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Omakere Ridge is one of a series of prominent northeast-southwest orientated anticlinal ridges associated with major thrust faults on New Zealand's Hikurangi margin. The Hikurangi margin is an extensive gas hydrate province and recent marine surveys have confirmed that the mid-slope Omakere Ridge is a zone of methane-rich seabed seepage. Acoustic flares initially observed in the area by fishermen, were imaged in the water column at Omakere Ridge during a 2006 RV Tangaroa survey (TAN06-07). Anomalous methane concentrations (up to 165 nM) were detected by a methane sensor (METS) attached to a conductivity-temperature-depth-optical backscatter device (CTD) on TAN06-07 and a 2007 RV Sonne survey (SO-191). Six seep sites have been identified at the southern end of Omakere Ridge, where it bifurcates into two parallel ridgelines. All sites are located towards the crests of the two ridgelines in approximately 1150 m water depth. The seabed seeps were identified acoustically with an EdgeTech Deep-Tow side-scan operating at 75 kHz, and are shown as high backscatter intensity areas on processed side-scan data, which are interpreted to be methane derived authigenic carbonate hardgrounds. Acoustic shadows behind hardgrounds in the side-scan far range suggest the seabed features have moderate relief. Sub-bottom profiles acquired with an EdgeTech Deep-Tow chirper system, operating at 2-10 kHz,

identified numerous signatures of shallow gas in the near subsurface. These signatures include zones of acoustic turbidity and gas blanking, interpreted to mark shallow gas fronts. The evidence for shallow gas in the subsurface from the sub-bottom profiler displays a marked spatial correlation with seabed expressions of seepage. The seepage sites also correspond to potential gas indicators in multi-channel seismic data, such as interpreted amplitude anomalies. Enigmatic subsurface features in the sub-bottom profiler data, such as potential amplitude anomalies and gas blanking, which are below the depression that bifurcates the ridge and are not associated with surface expressions of seepage, may represent lithological and topographic features or may be a component of the gas migration pathway which feeds the seeps on the ridge crest. Underwater video and still camera images show seabed seepage sites of high backscatter intensity represent widespread authigenic carbonate concretions and chemoherms associated with biological assemblages including siboglinid tube worms, vesicomyid clams, bathymodiolin mussels, and bacterial mats. A high backscatter intensity site of similar acoustic character to, and directly adjacent to, seep sites on the southern part of the ridge does not contain seep fauna and is interpreted to be a cold-water reef. While this feature may represent a relict seep, this finding highlights the fact that present day seepage cannot be identified with acoustic techniques alone.