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Analysing cold vents - an example from Wairarapa offshore New Zealand

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The influence of methane on the global bio-geo-system is one of the most important issues of present-day research. Cold seeps, where methane leaves the seafloor and enters the water column, provide valuable evidence of subsurface methane paths. The cruise SO 191-1 (Jan. 2007) on RV Sonne was dedicated to the investigation of local and regional transport processes of methane and gas hydrate deposits east of New Zealand.

The eastern coast of New Zealand is dominated by intensive compressional tectonics caused by the subduction of the Pacific Plate under the Australian Plate. In the area of Wairarapa, offshore the southern tip of the north island, a number of extremely active seeps have been discovered. High resolution seismic sections show a variety of seep appearances. We see seismic chimneys either characterized by high amplitude reflections or by acoustic turbidity and faults acting as fluid paths. The bathymetric expression of the seeps also varies, we see seeps beneath a flat seafloor as well as pockmarks and small mounds.

The images of the 3.5kHz Parasound system and of the deep-towed subbottom profiler system reveal the near-surface structure of the vent sites. While high amplitude spots within the uppermost 50mbsf are observed at the majority of the seeps, indicating carbonate concretions, a few seep sites are characterized by the complete absence of reflections, indicating a high gas content.

A detailed study with five neighboring ocean bottom hydrophone recordings was conducted using two different imaging methods: Kirchhoff depth migration and a mirror imaging technique, which uses the sea surface as a mirror for obh-multiples and thereby improves the coverage in the subsurface. These images provide a valuable complement to the multichannel seismic section.

Five ocean bottom methane sensors had been deployed, which continuously measured the methane concentration and water temperature over a period of several days. The results are most intriguing: One instrument near a seep measured a peak concentration of several μMol/l, while the neighbouring sensor about 300m further recorded values more than an order of magnitude less. This demonstrates the spatial confinement of methane expulsion at seeps. The temporal methane concentration varies over several orders of magnitude without any correlation between the five instrument locations or the tidal signal, in contrast to the temperature variation.