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Geophysical implications of submarine gas seeps on the Hikurangi Margin, NZ

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The Hikurangi Margin, east of the North Island of New Zealand, is an area of active methane venting. A large number of gas seeps has been observed as bubbles and flares in Parasound data and seafloor observations along the entire convergent margin, some of them remain active since many years. Seismic data reveal a widespread BSR indicating the presence of gas hydrate at depth. The project “New Vents” was carried out on German research vessel Sonne, cruise SO191 between January and March 2007 to study key parameter controlling the release and transformation from these gas seeps and gas hydrate deposits, which play a significant role in the global methane exchange, relevant to climate change and global warming.

Here we focus on a marine controlled source electromagnetic (CSEM) experiment in the Wairarapa region at the Southern corner of the North Island. CSEM data are sensitive to the presence of gas and gas hydrate at depth which are both very bad electrical conductors compared to the conductive pore fluid, i.e. seawater. In the Wairarapa region, CSEM data have been collected along two profiles intersecting three known gas seep fields called Takahe, North, and South Tower. The inverted apparent resistivity profiles show very resistive anomalies which can be clearly correlated with North- and South Tower, but have no signature at Takahe. The sizes of the anomalies argue for the presence of considerable gas hydrate deposits at depth, probably accompanied with free gas, rather than free gas alone.

Heat flow measurements in the same area reveal a low average thermal gradient around 30 mK/m, which is in agreement with the estimated depth of the BSR around 600mbsf.

However, the only enhanced heat flow at Wairarapa has been observed at the Takahe seep site. Here, seismic streamer data show a vertical structure of distorted reflection which could be caused by fluid transport, i.e. gas or water. The lack of an observed resistivity anomaly at this site could be a temporal effect or the observed blanking and thermal structure could be due to uprising warm fluids, rather than to gas and associated gas hydrates at depth. Further blank zones have been observed in seismic data and demonstrate the different spatial resolution and complementary nature of CSEM, seismic and other methods.