



## **Estimation of gas hydrate and free gas concentration at the Nankai active margin from full waveform inversion of 3D seismic reflection data**

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A 3D seismic study in the Nankai basin has shown the presence of a seismic reflector with an inverse polarity to the seafloor on several profiles. This reflector is interpreted as the BSR (Bottom Simulating reflector) and corresponds to the base of gas hydrate stability zone or to the top of free gas zone. We carried out 1D full waveform inversion to quantify the subsurface velocity structure at the BSR. At most of locations chosen in the 3D domain for the full waveform inversion, we observed a low velocity zone (*LVZ*) below the BSR, which could be interpreted to be due to the partial saturation of free gas in sediments pore space. The thickness of the *LVZ* is about 20 to 50 m. Just above the BSR, we also observed a high velocity zone (*HVZ*) that could be due to the presence of gas hydrate in sediments. These velocity functions are used to interpret the distribution of the hydrate stability zone in the survey area and estimate the gas hydrate and free gas concentration.

We find that the gas hydrate concentration estimated using weighted equation gives values under 25 % per volume of sediment and the concentration of free gas is between 1 to 8 %. The strong amplitudes of BSR in 3D domain could be therefore linked to the *LVZ* (presence of free gas in the sediments).

Considering a mean concentration of 4 % and a mean *LVZ* thickness of 35 m, the total volume of free gas in the area of 42.5 km<sup>2</sup> of the forearc basin is about  $6 \times 10^7$  m<sup>3</sup>. The total volume of gas hydrate estimated for a mean concentration of 10 % is about  $85 \times 10^7$  m<sup>3</sup> (or about  $140 \times 10^9$  m<sup>3</sup> of methane trapped in hydrate at the pressure and temperature conditions), using the mean depth of 200 m between seafloor and BSR.