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Estimating the composition of hydrates from a 3D seismic dataset near Penghu Canyon on Chinese passive margin offshore Taiwan

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A bottom-simulating reflector (BSR), representing the base of the gas hydrate stability zone, can be used to estimate geothermal gradients under seafloor. However, to derive temperature estimates at the BSR, the correct hydrate composition is needed to calculate the phase boundary. Here we applied the method by Minshull and Keddie to constrain the hydrate composition and the pore fluid salinity. We used a 3D seismic dataset offshore SW Taiwan to test the method. Different from previous studies, we have considered the effects of 3D topographic effects using finite element modelling and also depth-dependent thermal conductivity. Using a pore water salinity of 2% at the BSR depth as found from the nearby core samples, we successfully used 99% methane and 1% ethane gas hydrate phase boundary to derive a sub-bottom depth vs. temperature plot which is consistent with the seafloor temperature from in-situ measurements. The results are also consistent with geochemical analyses of the pore fluids. The derived regional geothermal gradient is 40.1oC/km, which is similar to 40oC/km used in the 3D finite element modelling used in this study. This study is among the first documented successful use of Minshull and Keddie's method to constrain seafloor gas hydrate composition.