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Heat flow and a rough estimation of gas hydrate in sediments at the Patagonian active continental margin offshore Chile

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Active plate margins are loci where oceanic crust, porous sediment and fluids are subducted beneath an overriding less oceanic or continental plate. Part of the sediment is frontally accreted to the overriding plate, creating an accretionary prism. The sediment contains small amounts of organic carbon, which is mainly converted methane by biogenic or thermogenic processes. The methane migrates upward and is deposited as gas hydrate in the near-surface sediments of the accretionary prism and forearc basin. The base of gas hydrate stability is seen in seismic profiles as a prominent bottom-simulating reflector (BSR) (e.g. [1,2]). Its depth is a constraint for pressure and temperature in the subsurface.

Here we report the spatial distribution of gas hydrates in the accretionary wedge and forearc sediments offshore Patagonian Chile between approximately 50° and 57° southern latitude. Knowledge of the geodynamic of this part of the Antarctic-South American plate boundary is restricted, mainly owing to the small number of reflection seismic profiles and the absence of scientific drillholes. BSR, however, were identified by some authors [3-7].

We have used the temperature-pressure stability relation of gas hydrates to estimate geothermal gradients and then computed the heat flow and its spatial variations over the area, following the approach of Villar-Muñoz et al. [8]. To define the seismic character of the hydrate layer, we worked performed velocity analysis by using the pre–stack depth migration of the multichannel reflection seismic line RC2902-790, located near the southern end of the South American Plate. Regionally BSR were identified around the 3000 m water depth, and between 339 and 632 meters below sea floor. This leads to heat flow around 30-60 mWm^{-2}, values typical for subduction zones of oceanic crust older than ten million years. To provide rough estimates the amount of gas hydrate present, the velocity model was converted into a gas–phase concentration model. The average thickness of gas hydrate layer is 287 m, and average concentrations are about 3.4 % of total, with maxima up to 10%. While not providing a quantitative estimate, the data show that gas hydrate distribution is regionally extensive, and reservoir thicknesses may be substantial.

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