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# OBS data analysis to characterize gas hydrate reservoir in South Shetland margin (Antarctic Peninsula)

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During the past five decades, the Antarctic Peninsula has been warming up faster than any other part of the Southern Hemisphere, and long-term ocean warming could affect the stability of the hydrate reservoir detected in this area. In fact, in the South Shetland margin (Antarctic Peninsula), the presence of a Bottom Simulating Reflector (BSR), indicating a potential gas hydrate reservoir, was discovered during three Italian Antarctic cruises. On the basis of this consideration, it is very important to quantify the gas stored in gas hydrate and free gas layer. The amount of gas hydrates can be estimated based on P-wave velocity: however, the S-wave velocity can provide further constrain in estimating gas hydrate concentration. The combined analysis of P-wave and S-wave velocity can be performed to obtain a more reliable quantification. In this study, multi-channel seismic (MCS) and Ocean Bottom Seismometer (OBS) data acquired in 2004 were analyzed in order to characterize gas hydrate reservoir and free gas layer and estimate their concentrations and distributions in the sediment pore space. To reach this goal we analyzed the data to obtain reliable P-wave and S-wave velocity fields. First of all, we created an initial model on the basis of the MCS analysis and interpretation. Then, the P-wave velocity field was determined by the joint travel time inversion of refractions and reflections, using MCS and OBS data. The S-wave velocity field was obtained by ray-tracing forward modeling of the converted S-waves from horizontal components of OBS data. The final model shows that the BSR lies 530-640 m below the seafloor and gas hydrates layer can be associated to an approximately 220-300 m thick sediment layer showing high P-wave velocity of 2000-2100 m/s. Below the BSR, a low velocity layer of 1400-1600 m/s is observed, which indicates the presence of free gas, and the base of this layer is at approximately 80 m below the BSR. The average S-wave velocity is about 840 m/s in the gas hydrate layer and 870 m/s in the free gas layer. The velocity field was translated in terms of gas hydrate and free gas concentration, using a modified Biot-Geerstma-Smit theory. A quantitative estimation of gas hydrate and free gas trapped in the sediments was performed by interpreting velocity anomalies with respect to reference velocity curves. The results indicate that the gas hydrate concentration near the OBS station is about 10.6% of volume above the BSR, and a free gas amount of 0.4% of volume below the BSR, considering a uniform gas distribution.