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Gas hydrate and free gas concentrations from seismic data and theoretical approaches: example of real data

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In the last years, many methods to estimate hydrate and free gas concentrations by using indirect method (such as seismic) and theoretical approaches are reported in literature. We developed a procedure in order to determine the potentiality of an area based on the analysis of the compressional and shear wave velocities and the Biot theory. Our method includes: (1) calculation of the velocity field through iteratively pre-stack depth migration; (2) geological evaluation of velocity anomalies; and, (3) estimate gas hydrate and free gas concentrations by means of background velocity (i.e. velocity in failing of gas hydrates and free gas in the pore space) and theoretical model. Then, knowing seafloor and BSR depths, and seafloor temperature, the geothermal gradient was calculated. Our method was applied successfully in many geological settings and verified by using well data. The gas hydrate and free gas estimate values obtained by our method are in agreement with the values reported by other authors, confirming that our procedure can be considered a useful tool to determine and characterize the gas-phase variability at regional scale. Recently, we applied our procedure to assess the energy resource potentiality at a regional scale in Chile Offshore (reported here as example of application on real data), confirming that the method can be exported to study in details other interesting areas, such as the European margin.
Along the Chilean margin, gas hydrates occurrences are reported by detecting BSR reflector; in fact, the BSR has been identified along the accretionary prism. ODP Leg 141, drilling near the Chile triple junction, found average concentrations of 18% and 1% of volume of gas hydrate and free gas concentrations respectively. Actually, in literature only few studies related to the hydrate quantification along the Chilean margin are available. However, a regional estimate is needed in order to map the gas–phase distribution along this margin. The results that are presented here contribute to the global knowledge of the relationship between hydrate/free gas presence and tectonic features, such as faults and folds, and furnishes a piece of the regional hydrate potentiality Chile offshore. In fact, the high local concentrations of hydrate and free gas could be considered as a potential future energy resource or a geological risk due to possible gas hydrate dissociations related to natural effects, such as climate change and earthquake. In fact, it is worth recalling that gas hydrate research development can play an important role along the Chilean margin due to the high seismicity that characterizes this region. Moreover, our results confirm the inverse relationship between gas hydrate concentration and faults and fractures presence that have already been reported by several authors.