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Seismic depth imaging of fluid flow plumbing system and bottom simulating reflectors in the Circum-Antarctic seas

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In the Antarctic region, several Bottom Simulating Reflectors (BSRs) have been observed in different offshore crustal domains. Some types of BSRs are related to the presence of gas hydrate (methane) below the sea floor. The relationship between ocean warming and escape of methane from the seabed is a crucial problem and therefore it is important to identify fluid flow plumbing system linked to reservoirs of gas hydrates. This phenomenon is undoubtedly related to climate change, but also depend on geological factors such as tectonics. For these reasons, it is important to have a good seismic image in depth to characterize the deep geological features. In this work, we show new seismic images of several BSRs in Circum-Antarctic seas using the multichannel seismic lines acquired by the OGS since 1988 with the R/V OGS-Explora in the framework of the Italian Programma Nazionale di Ricerche in Antartide (PNRA). We used different techniques of true amplitude seismic processing in order to characterize the BSRs: spectrum velocity analysis, seismic instantaneous attributes and Amplitude Versus Offset. These different approaches have been integrated by the Pre-Stack Depth Migration (PSDM) of the seismic profiles to define the real geometry in depth of seismic horizons. In particular, the velocity fields for the PSDM have been obtained using different, integrated approach: 2D grid tomography, horizon-based tomography and residual velocity analysis performed on Common Image Gathers. The seismic depth images obtained and the geological information of the explored sedimentary layers allow us to identify some new BSRs as well as those already known in literature. In particular (i) fossil-diagenetic BSRs have been observed in the Scotia Sea, while (ii) methane hydrate BSRs have been observed in the Ross Sea (Geletti & Busetti, 2011), on the South Shetland Margin (Lodolo et al., 1993; Tinivella et al., 1998), on the some areas of the Scotia Sea. The fault systems generally represent a preferred pathway for fluids migration and often this process produces mud volcanoes and pockmarks on the sea floor such as in the Ross Sea (Geletti & Busetti, 2011) and Scotia Sea. This analysis aims to improve the general understanding of BSRs formation in the Antarctic region and suggests that integrated use of all the seismic data can give important information on the fluid flow upward migration linked to the gas hydrate reservoirs and fault systems.

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