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Detailed seismic analysis of the Terraces sector in the southern Argentine Basin: implications for bottom water flow changes during the Neogene

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Sedimentary processes in the Argentine Basin and particularly on the Argentine margin are largely controlled by the interaction of the seafloor with the abyssal circulation which is characterised by the interaction of northward flowing Antarctic water masses (Antarctic Intermediate Water, AAIW; Circumpolar Deep Water, CDW; Antarctic Bottom Water, AABW) and southward flowing North Atlantic Deep Water (NADW).
The interaction of these water masses with the seafloor is obvious from the fact that the present depths of each of the water masses coincide with the position of a specific sedimentary terrace on continental slope. This set of continental slope terraces located between 44°S and 48°S reveals both erosional (e.g. channels) and depositional (e.g. sediment drifts) features of contourites.
Here, we present the internal seismic structure of the terraces (especially the Valentin Feilberg Terrace), identify phases of terraces evolution in a seismostratigraphic context and discuss their record of the variability of the Neogene Southern Ocean palaeoceanography in response to the influence of global climate and tectonic events. Maps of reflectors depth and seismic unit thickness are compiled and the shape and location of unit depocentres relative to the continental slope are interpreted as indications for the major transport and depositional processes.
Based on regional correlation we established a seismostratigraphic model for the sedimentary development of the Valentine Feilberg Terrace. The terrace grew from 17 Ma onward mainly under the influence of geostrophic bottom currents (AABW and CDW) originating from the south. A prominent intermediate unit that exhibits an aggradational stacking pattern is inferred to have been deposited during the Miocene Climatic Optimum (MCO, ∼17-14 Ma). Above this unit the sediment record of the Valentine Feilberg Terrace can be divided into 5 subunits that show a variety of different drifts, moats and channels and contain a high resolution palaeoceanographic record of late Miocene to recent time. Depocentres are oriented parallel to the continental slope and thus represent mainly along-slope sediment transport.
A major current reorganization can be inferred for the time ∼14-12 Ma when the Valentine Feilberg Terrace started growing due to the deposition of sheeted and mounded drifts which at their distal ends partly covered a giant drift in the deep sea. After ∼12 Ma bottom water flow remained vigorous at both margins of the terrace as indicated by a contouritic channel at the western side and by a current shaped inclined eastern flank. In contrast, the development of sheeted and mounded drifts, as well as the occurrence of erosional troughs suggests a bottom flow - likely at the CDW/AABW interface- that was quite variable in position and strength over the central terrace plateau.
Another marked change in terrace architecture occurred at ∼6 Ma when a mounded drift and other features (moats, sediment waves) indicating stronger bottom flow started developing on the Valentin Veilberg Terrace plateau. This may have been caused by a general change in deep water mass organization following the closure of the Panamanian gateway and a subsequent stronger southward flow of NADW.