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Middle Miocene sedimentary shift in the Scotia Sea (Southern Ocean): global tectonic and oceanographic implications

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Tectonic processes such as continental rifting and oceanic drifting set the primary scenario for the evolution of any oceanic basin [1]. Tectonics also influences the sediment source and deep-water circulation by modifying the seafloor morphology and gateways location. Meanwhile, persistent bottom water flows modify both the seafloor morphology and the sedimentary stacking pattern [2]. The main aim of this work is to assess the global influence of the mayor tectonic and oceanographic changes that occurred during the middle Miocene in the Drake Passage and the Scotia Sea.

The Southern Ocean is one of the worldwide best located regions to analyse the interaction between tectonics and oceanography. Particularly, the Drake Passage and adjacent Scotia Sea reveal a complex geodynamic evolution resulting from several phases of major tectonic events and associated oceanographic changes [3]. The opening of the Drake Passage since Eocene and the subsequent formation of the Scotia Sea permitted the instauration of the present-day model of Global Thermohaline Circulation. A number of oceanic basins and deep gateways were developed within the southern Scotia Sea by middle Miocene [3], some of them have controlled deep-water circulation patterns as the main conduits for bottom water flows.

Morpho-structural and seismo-stratigraphic analyses have been done in the dense network of multichannel seismic reflection profiles along the southern Scotia Sea. Results reveal a major shift in the regional sedimentary record occurring during middle Miocene. Older deposits are characterized by facies predominantly attributed to down-slope processes, where the sedimentary growth patterns of the basins were strongly influence by tectonic events. From middle Miocene to the Present time, in contrast, the abundance of contourite drifts and wavy facies supports the predominance of along-slope sedimentary processes and onset of invigorated bottom water flows. This regional shift is generally attributed to the opening of gateways along the South Scotia Ridge and the end of drifting in the small oceanic basins of the southern Scotia Sea, which was followed by tectonic subsidence.

The subsidence phase during the middle Miocene has been, however, globally observed and associated with an increase of the orogenic activity in the main continental cordilleras [1], in turn accompanied by a global slow-down of the main spreading centres [4] and a sedimentation rate peak in the three main oceans [5]. The importance of this event even exceeds the Southern Hemisphere since an increase of subsidence is also observed in several Northern Hemisphere basins during the middle Miocene [6]. Therefore, we propose that the middle Miocene change in the sedimentary pattern of the Scotia Sea is not only a result of the regional tectonic and palaeoceanographic changes; it furthermore represents a tectonic change at the global scale.

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