Glacial sedimentary processes at a major West Antarctic trough-mouth fan: The Belgica Fan

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Abstract

Glacial processes played a key role in the Neogene-Quaternary development of the West Antarctic continental margin. Most sectors prograded as a consequence of glacial sediment transport and deposition on the slope, but in rare locations trough mouth fans (TMFs) – depocentres of glacigenic debris derived from the continent – with very low angle slopes (<3°) have formed. The Belgica Fan, at the mouth of the Belgica Trough in the Bellingshausen Sea, is the largest TMF in West Antarctica with a volume of >60,000 km^3. Acoustic profiles and sediment cores from the fan's upper surface show that the most recent phases of sediment delivery involved glacigenic debris flows, whilst turbidity currents bypassed the upper slope acting as the main mechanism for sediment delivery to the distal fan. These observations suggest that the fan was built largely by debris delivered via repeated advances of the Belgica Trough ice stream to the shelf edge. However, little is known about the internal structure of the fan, the reasons for and timing of its inception, or the factors that have resulted in the continental margin morphology at the fan location being strikingly different compared with other sectors. Furthermore, the mechanisms and modes of sediment delivery that contributed to the construction of the depocentre through time are poorly understood.

Four new multichannel seismic lines covering approximately 370 line-km were collected over the distal part of Belgica Fan during RRS *James Clark Ross* cruise JR298 (2015), providing a new opportunity to assess TMF formation and development.
The base of the depocentre is marked by a prominent erosional unconformity onto which very low-angle, thin, acoustically-transparent units down-lap, pinching out away from the continental margin. The fan toe partially buries an older strongly-layered drift-like sedimentary body, which retains some sea-floor topographic expression today. A seismic profile across the drift-like body reveals large-scale debris flow units at the seabed either side of the drift crest. Our preliminary interpretation is that glacigenic debris flows make up a large proportion of the distal part of the depocentre. In addition, debris flows from palaeo-ice streams occupying Belgica Trough were effective in routing sediment considerable distances (>100 kilometres) from the shelf edge onto the continental rise. Relict drift bodies have, in turn, been instrumental in controlling sediment transport pathways, highlighting an interplay between along-slope and down-slope transport processes and hinting at the importance of pre-glacial topography in focusing TMF formation. Further work will now address the timing of the onset of glacial deposition at Belgica Fan, and the internal stratigraphy of the depocentre in its proximal parts. We will also compare the

seismic architecture against other well-surveyed continental margin sectors in Antarctica to test the idea that pre-glacial topography was a key factor in generating TMFs.

Keywords: trough-mouth fan, multichannel seismic, palaeo-ice stream, sediment processes