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# New insights into Quaternary glacial dynamic changes on the George V Land continental margin (East Antarctica)

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**Abstract**

The continental margin of the George V Land represents the seaward termination of one of the largest sub-glacial basins (the Wilkes Basin) of the East Antarctic Ice Sheet (EAIS) and hence is a potentially useful site for the investigation of the Cenozoic glacial history of Antarctica. Because the seafloor morphology relates strictly to recent glacial marine sedimentary processes, we have compiled all available echo-soundings data collected until the year 2001 and integrated the data set with satellite altimetry data. As a result, we have produced a new bathymetric map of the margin, covering an area of more than 80,000 km$^2$ with a spatial resolution of about 1 km. The bathymetric data have been integrated with sub-bottom profiler data with the purpose of defining sedimentary processes and their variations during the Quaternary.

The continental shelf of the Wilkes Land margin is characterised by alternating banks and glacial troughs connected to sub-marine canyons that cut into the continental slope. Our study focussed on the continental rise, where asymmetrical ridges alternate with large deep-sea channels. The ridges have a long gentle eastern side and short steep western side, with axis elongated approximately in north–south direction, perpendicular to the margin. The channels represent the main sediment drainage pattern feeding the ridge depositional system found along the continental rise. The sediment is supplied to the continental shelf edge by ice sheets, and sediment gravity flows are considered the main process for sediment supply to the rise.

The modern sedimentary environment of the deep margin is affected by turbiditic down-slope sediment transfer with a minor contribution from along-slope contour currents. The WEGA channel is currently affected by transport and settling of sediment through High-Salinity Shelf Water (HSSW), originating on the continental shelf. We infer that thermohaline circulation has contributed to sediment transport and deposition since the mid-Pleistocene.


## 1. Introduction

Wilkes Land is located on the eastern Antarctic continental margin and it represents the seaward termination of the largest sub-glacial basin (Wilkes Basin) of the East Antarctic Ice Sheet (EAIS). Across the Wilkes sub-glacial Basin, the ice sheet is based below the present-day sea level (Drewry, 1983) and is thought to be more sensitive than other parts of the EAIS to eustatic sea-level fluctuations (Denton et al., 1991).

The Adèlie and George V Coasts (Fig. 1) drain the EAIS with a divergent ice flow, except where ice is funnelled into the Mertz and Ninnis glacial ice tongues. At present, the coast is formed by ice cliffs and ice tongues, like the Mertz and Ninnis glaciers, protruding into the ocean. Being the seaward termination of ice streams, these ice tongues play an important role in the glacial drainage and in the sediment transport toward offshore areas (Drewry and Cooper, 1981). Their flow velocities range from 0.5 to 3.7 km yr$^{-1}$ (Lindstrom and Tyler, 1984; MacDonald et al., 1989; Frezzotti et al., 1998), whereas between them the ice flow is considerably slower, with velocity varying between 2 m yr$^{-1}$ and tens of metres per year (Anderson, 1999).

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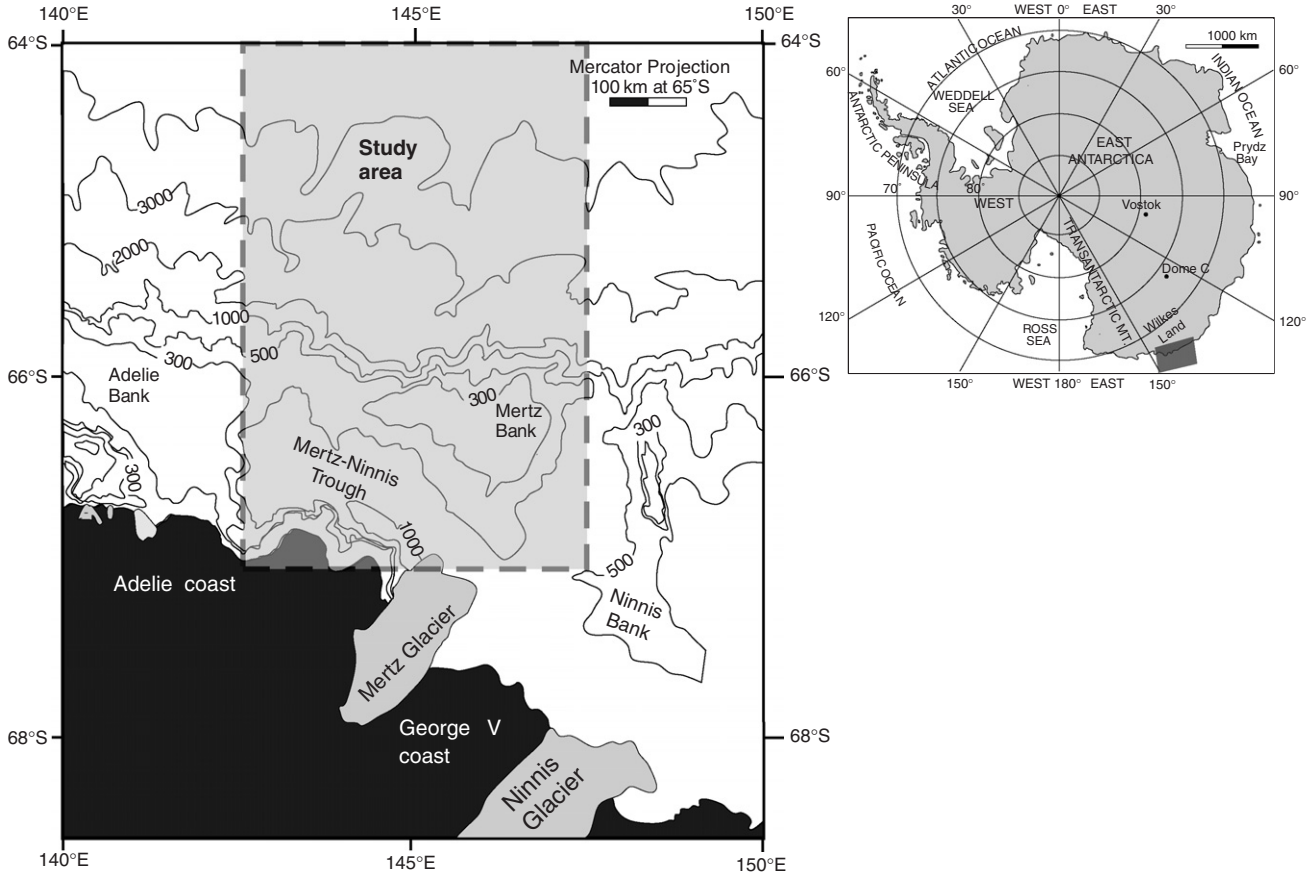


Fig. 1. Location map of the George V Land continental margin, East Antarctica and bathymetric outline of the study area.

Like in other polar and sub-polar marine regions, the sedimentary environment of Wilkes Land continental margin has undergone significant change during Cenozoic. During the Holocene, the extension of the ice sheet was confined toward the coastal area, except the Mertz and Ninnis floating ice tongues. Glacial advances during glacial stages created a series of inner deep troughs and outer depositional banks on the continental shelf (Vanney and Johnson, 1979; Domack, 1982). Channel excavation and over-bank deposition throughout the Cenozoic occurred also further offshore, as reported on the Wilkes Land continental rise from seismic stratigraphic analysis by Eittreim and Smith (1987), Hampton et al. (1987), Tanahashi et al. (1987) and Wannesson (1991). More recently, seismic investigations revealed the existence of deep-sea channels, interpreted as the product of erosion by down-slope gravity flows, alternated to sedimentary ridges (Donda et al., 2003). Based on seismic facies analysis, Escutia et al., 1997, 2000), DeSantis et al. (2003) and Donda et al. (2003) suggested that an interplay of turbidity and bottom currents contributed to the recent shaping of the continental rise: fine grained over-bank sediments, entrained in bottom contour current, contributed to the growth of interchannel sedimentary ridges. Such interpretation is in many respects similar to the one provided for the other mounded deposits around the Antarctic margin, such as the western Antarctica Peninsula (McGinnis and Hayes, 1995; Rebesco et al., 1996, 1997; McGinnis et al., 1997; Barker et al., 2002), the Prydz Bay channel (Kuvaas and Leitchenkov, 1992; Grützner et al., 2003; O'Brien et al., 2004) and the Weddell Sea (Michels et al., 2001, 2002).

One character of the George V Land continental margin is that the continental shelf of Wilkes Land, particularly the Mertz–Ninnis trough (Fig. 1) close to the Mertz glacier, has been identified as one source of Antarctic Bottom Water (AABW) (Gordon and Tchernia, 1972; Rintoul, 1998). Plumes of cold, relatively fresh, dense water flow down the continental slope and rise (Rintoul, 1998), and are probably confined within canyons (Bindoff et al., 2000).

In order to investigate these processes further, and how they have changed throughout time, Wilkes Land continental margin was visited in February-March 2000 in the frame of the joint Italian and Australian WEGA (WilkEs bAsin GlAcial history) project onboard the R/V *Tangaroa*. More than 1800 km of multichannel and high-resolution (3.5 kHz) seismic profiles, "gravity" and "piston" cores, were collected during the cruise on the continental shelf, slope and rise (in the area between 142°, 147°E and 67°, 63°S).

The purpose of this paper is to illustrate and discuss the recent to Quaternary sedimentary environment by analysis