Programma Nazionale di Ricerche in Antartide (PNRA)

Final project report

Project ID: 2002/4.11
Title: Morphology and Geology of Antarctic Margins – Wilkes Land and Antarctic Peninsula
Principle investigator: Laura De Santis
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Duration: 2 years
Assigned funding: € 51,646,00

Activities and results

MOGAM project collected swath bathymetric and subbottom acoustic data from the George Vth Land, 145° - 143°E and 64°45' - 65°50'S, in 2006 with R/V OGS Explora, in an area of about 10,000 km², in 600-3500 meters of water depth. Data were collected using Reson SeaBat 8150 multibeam system, with 234 beams and frequency of 12 kHz and subbottom chirp II acoustic data were collected with sweep of 2-7 kHz. Regional studies on multichannel seismic profiles (e.g. Eittreim et al., 1987; Escutia et al., 2005; Donda et al., 2007; Close et al., 2007) and detailed studies (De Santis et al., 2003; Donda et al., 2003), show a buried rugged morphology and seismic facies (e.g. channel-levee) under the continental slope and rise, suggesting a more dynamic setting in the past when the glacial environment was dominated by meltwater processes and deposition by temperate or polythermal glacial systems.

The MOGAM project was set up to investigate the relationship between the modern and recent sea bed depositional processes, in particular in relationship to the inferred downslope cascade pathways of the High Salinity Shelf Water produced along the coast today (Gordon and Tchernia, 1972; Rintoul, 1998; Bindoff et al., 2000, 2001). The production of deep water from the George Vth shelf has a key role in the formation of Antarctic Bottom Water, one of the water masses that regulate the global thermohaline circulation.

Joint Australian and PNRA WEGA project (1999-2002 Brancolini e Harris, 2000) data from the continental shelf, slope and upper rise of the George Vth Land document bottom current activity since the Last Glacial Maximum and during past cycles. Detailed geology and geophysical study in the Mertz-Ninnis Trough have revealed clear signature of present bottom current activity (Harris et al., 2001) and significant changes in the bottom current production throughout the Holocene warmest time interval (3000-5000 years, Harris and Beaman, 2003; Presti et al., 2003, 2005). Signals of bottom current downslope flow and of its variations in past glacial and interglacial cycles, have been also detected in slope sediments, back to Isotopic stage S116 (Busetti et al., 2003; Macri et al., 2005; Damiani et al., 2006; Caburlotto et al., 2006).

MOGAM survey shows that the continental slope and rise seaward of the Mertz-Ninnis Glacial valley sill is actually incised by a complex network of converging submarine canyons (the Jussieu Canyon system), some of which directly connected to the shelf depression. This sea bed character differ from that observed in other Antarctic margins (e.g. the Antarctic Peninsula) that generally show gullies across the shelf edge, smooth slope morphology and channel systems incising the upper rise.

The peculiar morphology of the George Vth margin sea floor likely reflects the intense dynamics of dense water spilling off the shelf and flowing down the continental slope, probably channelled within the canyons. The strata truncation along the flanks of the canyons, the exhumation of buried, relict features along the present slope and thick turbiditic deposit (up to 1 m) recovered from the Jussieu Canyon levees in the rise would suggest that erosive processes still strongly affect the George V Land margin. In analogy with other areas of dense water production, we believe that shelf water cascading currents driven by salinity contrast and also entraining fine organic and terrigenous particles, might have the capacity for reshaping submarine canyon floors and carrying sediment to the deep sea environment.
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Products

A – papers in scientific magazines

B – book chapters

C - proceedings of international conferences


D – proceedings of national meetings and conferences


E – thematic maps

F - patents, prototypes and data bases

G - exhibits, organization of conferences, editing and similar

H - formation (PhD thesis, research fellowships, etc.)

Research units

1) Research task: Sedimentological analyses
Renata Lucchi assegno ricerca OGS
Andrea Caburlotto dottoranda OGS-Università di Siena
Massimo Presti dottorando Univ. Trieste
Patrizia Macri’ dottoranda ING Roma-Università di Bologna

2) Research task: Mineralogical analyses
Isabella Memmi Professoressa Università di Siena
Giovanna Giorgetti ricercatore Università di Siena
Damiano Damiani dottorando Università di Siena

3) Research task: Analysis of morphological and geophysical data
Laura De Santis Ricercatore OGS
Giuliano Brancolini Primo Ricercatore OGS
Federica Donda Dottoranda OGS-Università di Siena
Carla De Cilia tecnologa OGS
Figure 1. Bathymetric map of the George Vth Land margin (Caburlotto et al., 2006, modified). The upper right inset shows a detail of the upper slope as imaged by swath bathymetric data collected by the PNRA/MOGAM cruise in 2006 by OGS Explora. The red, blue and pink thin lines show the location of existing multichannel seismic data and the yellow and blue dots show sediment core location. The red stars are the proposed IODP proposal 482 Rev. sites (Escutia et al., 1997).
References


Escutia C., A.K. Cooper, S.L. Eittreim, D.A. Warnke, and J. Jaramillo (2001), Cenozoic East Antarctic Ice Sheet History From Wilkes Land Margin Sediments-IODP Proposal 482


Harris, P. and Beamam, R. "Processes controlling the formation of the Mertz Drift, George Vth continental shelf, East Antarctica: evidence from 3.5 KHz sub-bottom profiling and sediment cores". In: Deep-Sea Research Special volume: Recent Investigations of the Mertz Polynya and George Vth Land Continental Margin, East Antarctica; 50, Nos.8-9, pp. 1463-1480


