# Final project report


| | |
|---|---|
| *Project ID:* | 2004/3.03 |
| *Title:* | ASSO (East Antarctic Sedimentary ProceSses through the CenOzoic) |
| *Principal investigator:* | Federica Donda |
| *Institution:* | Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) |
| *Email:* | fdonda@ogs.trieste.it |
| *Duration:* | 3 years |
| *Assigned funding:* | € 40.000,00 |


## Activities and results

Seismostratigraphic analyses conducted on multichannel seismic profiles collected in the Wilkes Land margin suggest that the Cenozoic evolution of the Wilkes Land depositional environment took place in four main phases. The early development stages of this East Antarctic margin sector were mainly related to the tectonic event that led to the final separation between the East Antarctic and Australian continents in the Early Oligocene. The reflector configurations in the early post-rift sequences suggest that hemipelagic and, possibly, distal turbidite deposition took place on the continental rise, whereas on the continental shelf aggradational conditions were generally present. During this time interval (Phase 1, ?Late Cretaceous–?Early Oligocene) the Wilkes Land margin would have had almost ice–free conditions, except for the occurrence of limited ice caps in its western sector. The emplacement of sediment ridges and the occurrence of debris-flow deposits at the base of the continental slope off the George V Land mark the transition to Phase 2 (?Oligocene-?Early Miocene). This phase records a progressive increase in sediment input from the continent, where a glacio-fluvial system was developing as a consequence of the early stages of the East Antarctic Ice Sheet emplacement, which involved the nucleation of small, highly dynamic ice masses, possibly since the Early Oligocene. During the ?Early–?Late Miocene (Phase 3), the major channels were emplaced as permanent features, constituting an articulated channel network along with their tributaries on the continental rise. Well-developed channel-levee systems, overflow sediment waves and giant debris-flow deposits testify to the predominance of gravity-driven processes. The highly dynamic depositional environment during Phase 3 reflects the occurrence of a temperate, dynamic ice sheet. The glacial melt-water eroded and delivered large amounts of sediments on the continental shelf edge, leading to slope instability and triggering gravity flows down the slope. This is testified by the occurrence of giant debris flows in the continental rise area, which emplacement would be related to the high dynamism of the ice sheet. Isostatic rebound, following major ice sheet retreat, could be possibly at the origin of large earthquakes, leading to the failure of sediments already prone to slide. The abundant fine component in the sediment load became then available for advection from the turbidity flows by contour currents, contributing to sediment drift formation on the lower rise off Eastern Wilkes Land.
During Phase 4, the development of thick, prograding shelf edge wedges on the continental shelf and slope suggests that ice margins reached the shelf edge and deposited subglacial, unsorted debris there. A reduction of the thickness of the continental rise seismic sequences led to the hypothesis that sediment transport to the rise area was reduced during this time interval. This would reflect that the ice sheet was progressively less dynamic than during Phase 3, and a transition to colder, more polar regimes occurred. Nevertheless, evidence of continuing down-slope current activity has been detected off George V Land. Down-slope fluxes are probably related to bottom-water formation related to the Mertz polynya and its overflow over the shelf edge.

# Products

**A – papers in scientific magazines**

1. Escutia C., De Santis L., Donda F., Dunbar R.B., Cooper A.K., Brancolini G., Eittreim S.L., 2005-Cenozoic Ice Sheet History from East Antarctic Wilkes Land continental margin sediments - Global and Planetary Change, 45, pp. 51-81.
2. Donda F., Brancolini G., O'Brien P.E., De Santis L., Escutia C., 2007– Sedimentary processes in the Wilkes Land margin: a record of the Cenozoic East Antarctic Ice Sheet evolution – Journal of the Geological Society of London, 164, 243-256
3. Escutia C., Donda F., Lobo F.J., Tanahashi M., 2007. Extensive debris flow deposits on the eastern Wilkes Land margin: a key to changing glacial regimes. Online Proceedings of the 10th ISAES, edited by A. K., Cooper and C. R. Raymond et al., USGS Open-File Report 2007-1-4, doi:10.3133/ OF2007.
4. Donda F., O'Brien P. E., De Santis L., Brancolini G.and Rebesco M., 2007. Mega debris flows deposits in the Western Wilkes Land margin (East Antarctica). Online Proceedings of the 10th ISAES, edited by A. K., Cooper and C. R. Raymond et al., USGS Open-File Report 2007-1-4, doi:10.3133/OF2007
5. Donda F., O'Brien P.E., De Santis L., Rebesco M., Brancolini G., 2008a- Mass wasting processes in the Western Wilkes Land margin: implications for the East Antarctic glacial history - Paleogeography, Paleoclimatology, Palaecology, 260, 77-91

**B – book chapters**

--

**C - proceedings of international conferences**

1. Donda F., Brancolini G., De Santis L., Escutia C.– Different stages of the East Antarctic Ice Sheet evolution in the Wilkes Land margin through the Cenozoic – 32nd International Geological Congress, Firenze, 20-28 Agosto 2004.
2. Escutia C., De Santis L., Donda F., Dunbar R., Cooper A., Brancolini G., Eittreim S., - Cenozoic ice sheet history from the East Antarctic Wilkes Land margin - 32nd International Geological Congress, Firenze, 20-28 Agosto 2004.
3. Donda F., Brancolini G., De Santis L., O'Brien P.E., Stagg H.M.J., Rebesco M.– The East Antarctic Ice Sheet evolution through the Cenozoic: a record from the continental rise – Workshop "Frontiers and Opportunities in Antarctic Geosciences", Pontignano (SI), 28-31 Agosto 2004.•
4. Donda F., O'Brien P.E., Escutia C., De Santis L., Brancolini G., 2005 – Debris flows in the Wilkes Land continental margin (East Antarctica): a record of a temperate East Antarctic Ice Sheet – 2nd International Conference "Submarine mass movements and their consequences", Oslo, 5-7 settembre 2005.
5. Donda F., Brancolini G., O'Brien P.E., De Santis L., Escutia C., 2005 – The East Antarctic continental margin evolution through the Cenozoic: a possible 4 phases model – East Antarctic workshop, Cenozoic onshore and offshore stratigraphic record from the East Antarctic margin: recent results and future directions, Spoleto, 19-21 settembre 2005
6. Escutia C., Donda F. Tanahashi M., 2005 – Early glacial massive submarine debris flows on the East Antarctic Wilkes Land margin: diagnostic for a temperate-dynamic ice sheet? - East Antarctic workshop, Cenozoic onshore and offshore stratigraphic record from the East Antarctic margin: recent results and future directions, Spoleto, 19-21 settembre 2005
7. Donda F., Rebesco M., O'Brien. P.E., Escutia C., Brancolini G., De Santis L., Diviacco P., Camerlenghi A., 2006 (solicited) – Debris flows in Antarctica: Where? When? Why? – European Geosciences Union General Assembly, Vienna, 2-7 Aprile 2006.
8. De Santis, 2007. The Italian Marine Geophysics Programme. Antartica: 50 years on the ice-just the tip of the iceberg, Wellington (New Zealand), 2-6 luglio 2007.
9. Presti M., Barbara L., Denis D., Crosta X.,De Voos E., Lipizer M., De Vittor C., Acquavita A., Kissel C., De Santis L. Late Quaternary sediment record of six glacial/interglacial cycles off the Wilkes Land - Adelie Land Coast (East Antarctica): Preliminary geochemical results. U.S. Geological Survey and The National Academies; USGS OF-2007-1047, Extended Abstract 126
10. Donda F., O'Brien P.E., De Santis L., Brancolini G., Rebesco M., 2007. Mass wasting processes in the Western Wilkes Land margin: implications for the East Antarctic glacial history. Submarine Mass Movements and Their Consequences 3rd International Symposium, Santorini, 1-3 ottobre 2007

**D – proceedings of national meetings and conferences**

1. Donda F. – The PNRA/ASSO (East Antarctic Sedimentary ProceSses through the CenOzoic) project – State-of-art and recent results from geophysical and geological studies in the Wilkes Land, Trieste, 19-22 Aprile 2004.

2. Donda F., Brancolini G., O'Brien P.E., De Santis L., Escutia C., 2005 – Sedimentary processes in the Wilkes Land margin: a record of the Cenozoic East Antarctic Ice Sheet evolution – Geoitalia 2005, Quinto forum italiano di Scienze della Terra, Spoleto, 21-23 settembre 2005.

**E – thematic maps**

--

**F – patents, prototypes and data bases**

--

**G – exhibits, organization of conferences, editing and similar**

--

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

1. Temporary research position assigned to dr. Massimo Presti from January 1 to August 31, 2008. Research task: correlation between the seismic lines and the sedimentological data, addressed in particular to the sediment core called "CADO 6". This core has been acquired by the project P.I. during the IMAGES cruise in the Wilkes Land margin, that took place in January-February 2003. The CADO 6 core has been acquired in a sector of the continental rise, where sedimentological data play a crucial role for the seismic interpretation.

---

## Research units

Unit 1-Principal investigator: Federica Donda

Research task: Morphologic features and depositional settings analysis on the continental shelf, slope and rise of the Antarctic margin sector between 110° and 150° E, using multichannel seismic data collected in the frame of AASOPP, WEGA projects and those available on SLDS. This analysis allowed to reconstruct the time and spatial evolution of the sedimentary processes and of the East Antarctic Ice Sheet in this sector through the Cenozoic.

Unit 2-Principal investigator: Laura De Santis

Research task: Sismostratigraphic comparison between the post-rift sequences in the sector of the Australian margin conjugate to the Antarctic sector between 110° and 150° E. The main aim of this study was to compare the seismic units in the two margins in order to eventually identify, in different climatic conditions, morphologic signatures of main environmental variations, probably related to large scale climatiec change and/or to the circum-polar circulation establishment. For this purpose the correlation between the seismostratigraphic units and the geologic and chronostratigraphic informations provided by the DSDP Leg 28 were conducted.

---

**Date: 18 December 2008**

---

*Notes*