Final project report

Project ID: 2002/3.13
Title: MAGICO (MApping of a COmplete GlacIal depositional system)

Principal investigator: Michele Rebesco
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Duration: 2 years
Assigned funding: € 46.000,00

Activities and results

The project started with an acquisition cruise of the R/V OGS-Explora (Ushuaia 19.01.04 -18.02.04 Ushuaia). The cruise had two primary scientific targets: The South Scotia Ridge (Responsible: Nevio Zitellini) and the Drift 7 on the Antarctic Peninsula Pacific Margin (Responsible: Michele Rebesco), and approximately 10 days of investigations were dedicated to each of these. The second target (the objective of the MAGICO project) has previously been studied by OGS and others using multi-channel seismics, shallow cores, and ODP-drillings (Sites 1095 and 1096).
During the cruise nearly 37,000 km^2 of swath bathymetry and about 5,000 km of sub-bottom (CHIRP) profiles were collected across Sediment Drift 7. The data are part of the large data set (including several thousands km of multichannel seismic data) acquired by R/V OGS-Explora between 1995 and 2004 within the projects *MAGICO* and SEDANO (Sedimentary Drifts of the Antarctic Offshore) funded by PNRA.

The analysis of the data conducted in Italy revealed that growth of the drift reflects variations in both Antarctic ice sheet and Southern Ocean alongslope bottom-water (contouritic) currents. The ice sheet transported the sediments to the continental margin, and of flow of contouritic currents controlled their deposition. The understanding of contourite systems and of their sedimentary processes is relevant for paleoclimatic studies and for oil-exploration. Moreover, the discovery of a large field of mud volcanoes with significant active fluid escapes represents the new frontier for research in this margin since the presence of cold-water bioherms coupled to bottom current and fluid escapes may not be ruled out.

Of the scientific products, 16 are cited in SCOPUS. Hirsch index (H = 5).

Products

A – papers in scientific magazines

1. Hernandez-Molina, J., Larter, R., Rebesco, M., Maldonado, A. 2004, Miocene changes in bottom current regime recorded in continental rise sediments on the Pacific margin of the Antarctic Peninsula. Geophysical Research Letters, 31 (22), 1-5
2. Grützner, J., Hillenbrand, C.-D., Rebesco, M., 2005. Terrigenous flux and biogenic silica deposition at the Antarctic continental rise during the late Miocene to early Pliocene: implications for ice sheet stability and sea ice coverage. Global and Planetary Change. V. 45 (1-3), 131-149.
3. Diviacco, P. Rebesco M., Camerlenghi A., 2006, Late Pliocene mega debris flow deposit and related fluid escapes identified on the Antarctic continental margin by seismic reflection data analysis, Marine Geophysical Researches, vol. 27 (2), 109-128.
4. Scheuer C., Gohl K., Larter R., Rebesco M. and Udintsev G., 2006, Variability in Cenozoic sedimentation along the continental rise of the Bellingshausen Sea, West Antarctica, Marine Geology, 227, 279–298
5. Domack, E., Amblas, D., Gilbert, R., Brachfeld, S., Camerlenghi, A., Rebesco, M., Canals, M., and Urgeles, R., 2006, Subglacial Morphology and Glacial Evolution of the Palmer Deep Outlet System, Antarctic Peninsula, Geomorphology. 75, (1-2), 125-142.

6. Rebesco M., Camerlenghi, A., Geletti, R., Canals, M., 2006. Margin architecture reveals the transition to the modern Antarctic Ice Sheet (AIS) at about 3 Ma, Geology, Vol. 34, No. 4, pp. 301–304.
7. Hernandez-Molina, J., Larter, R., Rebesco, M., Maldonado, A., 2006, Miocene reversal of bottom water flow along the Pacific Margin of the Antarctic Peninsula: stratigraphic evidence from a contourite sedimentary tail, Marine Geology, 228, 93–116
8. Amblas, D., Urgeles, R., Canals, M., Calafat, A.M. Rebesco, M., Camerlenghi , A., Estrada, F., De Batist, M., And Hugues-Clarke, J.E. 2006. Relationship between continental rise development and palaeo-ice sheet dynamics, Northern Antarctic Peninsula Pacific margin. Quaternary Science Reviews, 25, 933–944.
9. Macri, P., Sagnotti, L., Lucchi, R., Rebesco, M., 2006, A stacked record of relative geomagnetic paleointensity for the past 270 kyr from the western continental rise of the Antarctic Peninsula, Earth and Planetary Science Letters, 252, (1-2), 162-179
10. Rebesco M., A. Camerlenghi, 2008, Late Pliocene margin development and mega debris flow deposits on the Antarctic continental margins: Evidence of the onset of the modern Antarctic Ice Sheet?, Palaeogeography, Palaeoclimatology, Palaeoecology, 260, 149-167 .
11. Donda F., P.E. O'Brien, L. De Santis, M. Rebesco, G. Brancolini, 2008, Mass wasting processes in the Western Wilkes Land margin: possible implications for East Antarctic glacial history, Palaeogeography, Palaeoclimatology, Palaeoecology, 260, 77-91.
12. Neagu C. R., U. Tinivella, V. Volpi, M. Rebesco, A. Camerlenghi , in press, Estimation of biogenic silica content in marine sediments using seismic and log data. Sediment drift 7 – Antarctica. International Journal of Earth Sciences, DOI 10.1007/s00531-008-0315-2
13. Volpi V., Rebesco M. and Diviacco, P. in press, New insights in the evolution of Antarctic glaciation from depth conversion of well-log calibrated seismic section of Prydz Bay. International Journal of Earth Sciences, DOI 10.1007/s00531-008-0356-6
14. Hillenbrand C.-D., A. Camerlenghi, E.A. Cowan, F.J. Hernández-Molina, R.G. Lucchi, M. Rebesco & G. Uenzelmann-Neben, 2008, The present and past bottom-current flow regime around the sediment drifts on the continental rise west of the Antarctic Peninsula, Marine Geology 255, 50-63

B – book chapters

1. Rebesco M., 2005, Contourites. In: Richard C. Selley, R.C., Cocks L.R.M., Plimer I.R. (eds), Encyclopedia of Geology, Elsevier, Oxford, Vol. 4, 513-527.
2. Viana, A.R. and Rebesco, M. (eds), 2007. Economic and Palaeoceanographic Significance of Contourite Deposits. Geological Society, London, Special Publications, 276, 350 pp.
3. Lucchi, R.G. and Rebesco, M., 2007. Glacial contourites on the Antarctic Peninsula margin: Insight for palaeoenvironmental and palaeoclimatic conditions. In: Viana, A.R. and Rebesco, M. (eds) Economic and Palaeoceanographic Significance of Contourite Deposits. Geological Society, London, Special Publications, 276, 111-127.
4. Rebesco M, Camerlenghi A, Volpi V., Neagu, C, Accettella D., Lindberg B., Cova A., Zgur F., and the MAGICO party, 2007, Interaction of processes and importance of contourites: insights from the detailed morphology of sediment drift 7, Antarctica, In: Viana, A.R. and Rebesco, M. (eds) Economic and Palaeoceanographic Significance of Contourite Deposits. Geological Society, London, Special Publications, 276, 95–110.
5. Rebesco M., Camerlenghi A., (Eds.) 2008. Contourites, Developments in Sedimentology, 60, Elsevier, 615 pp.
6. Rebesco M., A. Camerlenghi, A.J. Van Loon, in press, Contourite research: a field in full development. In: Rebesco M., Camerlenghi A., (Eds.) 2008. Contourites, Developments in Sedimentology, 60, Elsevier.
7. van Weering T., M.S. Stoker, M. Rebesco, in press, High-latitude contourites. In: Rebesco M., Camerlenghi A., (Eds.) 2008. Contourites, Developments in Sedimentology, 60, Elsevier.
8. Volpi V., Amblas D., Camerlenghi A., Canals M., Rebesco M. and Urgeles R., in press, Late Neogene to Recent seafloor instability on the deep Pacific margin of the Antarctic Peninsula". In: C. Shipp, P. Weimer, H. Posamentier (Eds.), "Mass-transport Deposits in Deepwater Settings, SEPM Special Publication 93.

C - proceedings of international conferences

1. Rebesco M. et al. (2004), Western margin of the Antarctic Peninsula: an opportunity for seafloor bathymetric mapping and the new frontier of fluid escapes and mud volcanoes. Abstract volume of the workshop Frontiers and opportunities in Antarctic Geosciences. Pontignano, Agosto 2004
2. Diviacco P., Rebesco M., and Camerlenghi A., 2005, Late Pliocene mega debris flow deposit and related fluid escapes identified on the Antarctic Peninsula continental margin by seismic reflection data analysis, International Conference on Glacial Sedimentary Processes and Products, University of Wales, Aberystwyth, 22-27 August 2005, Programme & Abstracts, 22.
3. Diviacco P., Rebesco M., and Camerlenghi A., 2005, Late Pliocene mega debris flow deposit and related fluid escapes identified on the Antarctic Peninsula continental margin by seismic reflection data analysis, NGF Abstracts and Proceedings of the Geological Society of Norway (2nd. International Conference on Submarine Mass Movements and Their Consequences) N.2, p. 31-32

4. Lucchi R.G. and Rebesco M., 2005, Atypical glacial contourites on Antarctic continental margins: insight for palaeoenvironmental and palaeoclimatic conditions, International Conference on Glacial Sedimentary Processes and Products, University of Wales, Aberystwyth, 22-27 August 2005, Programme & Abstracts, 86.
5. Neagu, C.R., Tinivella U., Volpi, V., 2005, Estimating the biogenic silica concentration and its effects on slope stability in marine sediments using seismic and log data from the sediment drift 7 (Antarctica). Congrès Français de Sédimentologie - Livre des rèsumès, 2005, Publ. ASF, Paris, n°51, 224 p.
6. Neagu C. R., M. Rebesco , V. Volpi, U. Tinivella, A. Camerlenghi, 2005. Estimating the biogenic silica concentration and its effects on slope stability in marine sediments using seismic and log data from the Sediment Drift 7, Antarctica, NGF Abstracts and Proceedings, No 2, 2005 67 p.
7. Rebesco, M., Neagu, C.R., Volpi, V. and Accettella, D., 2005, Imaging the deep seafloor morphology of an Antarctic system: Sediment drift 7 and the bounding deep-sea channels. 10ème Congrès Français de Sédimentologie - Livre des rèsumès, 2005, Publ. ASF, Paris, n°51, 252 p.
8. Volpi, V., Rebesco, M., Amblas, D., Accettella, D., Calafat, A., Camerlenghi, A., Canals, M., Diviacco, P., Farran, M., Geletti, R., Lucchi, R.G., Neagu, C., Tinivella, U., and Urgeles, R., 2005, Recent to Late Neogene seafloor instabilities on the deep Pacific margin of the Antarctic Peninsula, NGF Abstracts and Proceedings of the Geological Society of Norway (2nd. International Conference on Submarine Mass Movements and Their Consequences) N.2, p. 94-95
9. Donda, P.E. O'Brien, L. De Santis, M. Rebesco, and G. Brancolini, 2007, Mega Debris Flow Deposits on the Western Wilkes Land Margin, East Antarctica, IN: Cooper A., Raymond C., and the ISAES Editorial Team (Eds.), Antarctica: A Keystone in a Changing World—Online Proceedings for the Tenth International Symposium on Antarctic Earth Sciences, U.S. Geological Survey Open-File Report 2007-1047 Short Research Paper 040, DOI: 10.3133/of2007-1047.srp040
10. Macrì, P.; Sagnotti, L.; Lucchi, R.G.; Rebesco, M., A relative geomagnetic paleointensity stack for the past 270 kyr from the western continental rise of the Antarctic Peninsula, Geophysical Research Abstracts, Vol. 9, 02710, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-02710
11. Rebesco M. and A. Camerlenghi, 2007, Does the late Pliocene Change in the Architecture of the Antarctic Margin Correspond to the Transition to the Modern Antarctic Ice Sheet?, IN: Cooper A., Raymond C., and the ISAES Editorial Team (Eds.), Antarctica: A Keystone in a Changing World—Online Proceedings for the Tenth International Symposium on Antarctic Earth Sciences, U.S. Geological Survey Open-File Report 2007-1047 Short Research Paper 021, DOI: 10.3133/of2007-1047.srp021
12. Rebesco, M; Camerlenghi, A, Late Pliocene margin development and mega debris flow deposits on the Antarctic continental margins: evidence of the onset of the modern Antarctic Ice Sheet? Geophysical Research Abstracts, Vol. 9, 02710, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-03529
13. Volpi, V.; Rebesco, M.; Diviacco, P., New Insights in the evolution of Anatrctic Glaciation from Depth Conversion of Well-Log calibrated Seismic Section, Geophysical Research Abstracts, Vol. 9, 02710, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-07364

D – proceedings of national meetings and conferences

1. Rebesco M., Neagu C.R., Volpi V. and Accettella D., 2005, Imaging the deep seafloor morphology of an Antarctic system: Sediment drift 7 and the bounding deep-sea channels. Epitome vol. 1, Federazione Italiana Scienze della Terra, GeoItalia2005, p. 21
2. Rebesco, M., Camerlenghi, A., Diviacco, P., Geletti R., Canals, M., 2005, Late Pliocene margin development and mega debris flow deposits on the Antarctic Peninsula continental margin: evidence of the onset of the modern Antarctic Ice Sheet?, Epitome vol. 1, Federazione Italiana Scienze della Terra, GeoItalia2005, p. 19-20

E – thematic maps

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F – patents, prototypes and data bases

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G – exhibits, organization of conferences, editing and similar

1. Rebesco M., Broadcast interview at Telequattro (February 2004)
2. Rebesco M., N/R OGS-EXPLORA and the MAGICO survey, geophysical seminar at OGS, March 2004
3. Rebesco M., Paleoclimatic research in Antarctic Peninsula, seminar for the Master in Science Communication, June 2004
4. Neagu C., The sediment drifts on the continental rise west of Antarctic Peninsula, Master's Thesis presented at the University of Bucharest, Giungno 2004.
5. Rebesco M., Broadcast interview at (July 2004)

6. Rebesco M., Le Contouriti:in Antartide, ma anche nel Mediterraneo e nelle Alpi, Geoitalia 23 (July 2004) pag. 40-42
7. Rebesco M., Multibeam map of Sediment Drift 7 (Antarctic Penisola), Poster in PNRA booth at 32 IGC, Firenze, August 2004
8. Neagu C., Interplaying Instability Processes within Sediment Drift 7 (Antarctica), EURODOM Mid Term Meeting, Erlangen, Spetember 2004
9. Rebesco M., Interview for the Video CD "Giacciai Buldozer" produced by Reparto di Cinematografia Scientifica, CNR-IRPI (December 2004)

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

Raluca Cristina Neagu (pre-doc) has been trained on PNRA data at OGS for 36 months (15/03/2004 – 15/08/2006) within the EURODOM EU project. During these years she performed seismic processing of the data acquired by PNRA in Antarctic Peninsula in the area of sediment drift 7 (continental rise west of Antarctic Peninsula) using FOCUS 4.2 (Paradigm) software and she was also trained in using the free software Seismic Unix.
In order to evaluate the effect of biogenic silica on the submarine slope instability she estimated the concentration of the biogenic silica in the sediments of drift 7 correlating multichannel seismic and log data from the ODP Sites 1095 and 1096 which were drilled during Leg 178.
Using the EMERGE software (Hampson-Russel) she obtained 2-D sections showing the distribution of the physical properties along the seismic profiles which were used to estimate the anomalies of density/porosity produced by the presence of biogenic silica. These anomalies were converted into biogenic silica concentration along the seismic profiles for estimating the gas-hydrates and free gas concentration.

Research units

1. Co-ordinator: Rebesco Michele
Research task: Data analisys and interpretation
People involved:
Name/position/Isntitute
Camerlenghi Angelo/Scientist/OGS
Volpi Valentina/Scientist/OGS
Caburlotto Andrea/Scientist/OGS
Donda Federica/Scientist/OGS
Lucchi Renata/Scientist/OGS
De Cillia Carla/Tecnologist/OGS
Time dedicated during the two-year project (man-months): 18

2. Co-ordinator: Wardell Nigel
Research task: data processing
People involved:
Name/position/Isntitute
Wardell Nigel/Tecnologist/OGS
Pelos Claudio/Technician/OGS
Time dedicated during the two-year project (man-months): 3

Date: