Programma Nazionale di Ricerche in Antartide (PNRA)

Final project report

Project ID	2004/4.09
Title	Integrated stratigraphy and cyclostratigraphy of glacimarine sequences from CRP-3 core
Principal investigator	Simone Galeotti
Institution	Dipartimento di Geologia e Tecnologie Chimiche e Ambientali (GeoTeCA)
Email	simone.galeotti@uniurb.it
Duration	2 years
Assigned funding	36.000 Euros

Activities and results

Upper interval (0-185 mbsf):

On this interval, which includes four glacimarine sedimentary cycles of lower Oligocene (C12r magnetochron) age containing microfossils, an integrated stratigraphic analysis has been carried out including, micropaleontology (foraminifera, calcareous nannofossils, dinoflagellate cysts, diatoms), geochemistry (stable isotopes, rare elements), mineralogy (clay minerals) and grain-size analysis. An image analysis of digital images has been run to obtain a high resolution record of changing proportions of different sedimentary end-members. Obtained results allow to infer paleoenvironmental changes across the surveyed sedimentary cycles. Most relevant results are derived from the more complete two cycles in the uppermost part of the drillhole. In particular benthic foraminiferal assembalges shows neat changes from cosmopolitan to endemic assemblages across these cycles reflecting changes in water mass temperature and sea-level. Astrochronology allowed a calibration of environmental fluctuations recorded on the antarctic margin to the paleoclimatic and paleoceanographic record from deep-sea sequences.

Lower interval (300-800 mbsf):

Image analysis has been extended to the interval 300-800 mbsf. The analysis of luminance data and of the record of clast abundance, reveals an orbital control over the deposition of the CRP-3 sedimentary succession. Frequency filtering of individual components in the orbital bands allowed us to obtain the first cyclostratigraphy-based calibration of the Antarctic marginal record to well-resolved oceanic sequences across the major step of glaciation occurring during the Eocene-Oligocene transition. In line with numerical simulations, volume changes in the Eastern Antarctic ice sheet (EAIS) – as revealed by varying proportions of clasts – are controlled by higher frequency (precession) orbital forcing during the first phases of ice-cap development. Based on the astrochronological age obtained and the calibration to the reference isotopic curve of Site 1218 (Equatorial Pacific), this phase corresponds to the first step of the Oligocene Isotope 1 (Oi1) shift, between 33.9-33.7 Ma. Accordingly, the first step of Oi1 mainly reflect global coling rather than the development of a large EAIS. After this ~200-kyr-long interval, changes in volume of a larger EAIS started to be controlled by obliquity.
As a main outcome of the research, the obtained astrochronology, allows to show that EAIS was relatively small-sized and unstable during the first ~200 kyr of the E-O transition and that fully glaciated conditions occurred at~32.8 Ma, more than a million years after the initiation of the climatic transition recorded by geochemical proxies. This result has implication for the assessment of CO_2 level ranges necessary to trigger non-linear jumps, and hysteresis in Antarctic ice volume changes.

Products

A – papers in scientific magazines

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B – book chapters

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C - proceedings of international conferences

1. AGU Fall Meeting 2005 Galeotti S., DeConto R., Lanci L., Pollard D., 2005. Orbitally Paced Sedimentary Cycles from the Lower Oligocene Antarctic Margin as a Record of Ice Sheet Variability: a Comparison of Field Data and Simulated Ice Sheet Behavior. AGU 2005 Fall Meeting.
2. EGU General Assembly 2006 Galeotti S., DeConto R., Lanci L., Pollard D., Sandroni S., Talarico F., 2006. Sedimentary cycles from the lower Oligocene Antarctic margin as a record of orbitally controlled ice sheet variability: a comparison of field data and numerical simulation. Geophysical Research Abstracts, Vol. 8, 10500, 2006
3. The Geological Society of America, Penrose Conference. Galeotti S., DeConto R., Lanci L., Pollard D., Sandroni S., Talarico F., 2007. Orbitally paced sedimentary cycles from the Eocene- Oligocene Antarctic Margin as a record of Ice-Sheet Variability: a comparison of field data and simulated ice sheet behavior., Hothouse, Icehouse, and Impacts: The Late Eocene Earth. Ancona, Italy, October 3-6, 2007.
4. EGU General Assembly 2009 (***invited***)Galeotti S., DeConto R., Lanci L., Sandroni S., Talarico F., 2009. Orbitally paced sedimentary record across the Eocene/Oligocene boundary glaciation in the Western Antarctic Margin. Geophysical Research Abstracts, Vol. 11, EGU2009-10694-1, 2009

D – proceedings of national meetings and conferences

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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

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

1. Baffa Elisabetta (A.A. 2004/2005) – Studio dell'Oligocene inferiore del Pozzo CRP-3 (McMurdo Sound, Mare di Ross). Considerazioni paleoambientali e paleoclimatiche. Tesi di Laurea. Università di Urbino.
2. Post-graduate scholarships (6 months): Il ruolo del continente Antartide nell'evoluzione del clima al passaggio Eocene/Oligocene. Università di Urbino
3. Post-doc (2 years): "Il Ruolo del continente Antartide nel cambiamento climatico associato alla transizione Eocene-Oligocene". Università di Urbino

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Research units

One research unit including the following researchers:

Fulvia Aghib: CNR-IDPA Milano
Adriana Bellanca: Professore Università di Palermo
Giovanni Rusciadelli: Università di Chieti
Rodolfo Neri: Università di Palermo
Sonia Sandroni: Università di Siena
Mario Sprovieri - CNR-IAMC di Napoli
Luca Lanci - Università di Urbino
Giuliana Villa - Università di Parma
Franco Talarico - Università di Siena
Silvia Giuliani - CNR-ISMAR - Bologna
Massimo Setti - Università di Pavia

Luigi Marinoni - Università di Pavia

Date: May 7, 2009

Notes

The second year of the program has been funded on personal money of the PI