Final project report

| Project ID | 2002/3.08 |
|---------------------------------------|---|
| Title | WISE - West Ice Sheets Evolution |
| Principal investigator Institution | Gualtiero Böhm OGS – Istituto Nazionale di Oceanografia e di Geofisica Sperimentale |
| Email | gbohm@ogs.trieste.it |
| Duration | 2 years |
| Assigned funding | 52.000 euro |

Activities and results

The aim of this project was to study the dynamic evolution of the Western Antarctic Ice Sheet (WAIS) evolution in the Ross Sea during the lower Pliocene. This study uses new high-resolution seismic and multibeam bathymetry data from the western sector of the Eastern Ross Sea, combined with previous 2D multichannel seismic reflection data, in order to provide new insights into the seismic stratigraphy of western sector of the Eastern Ross Sea, and into the depositional environment related to glacial dynamics, since the RSU2 time.

In the Antarctic cruise 2005-2006, the OGS-Explora vessel collected multi-channel high resolution seismic survey (total of 1230 km), multi-beam bathimetry data and sound velocity profiles (SVP) in a 90x60 km rectangular area of the Eastern Basin of the Ross Sea. A total of 17 2-D lines (10 lines parallel to the NE-SW direction and 7 lines in the orthogonal direction) were acquired.

We reconstructed the morphology of the principal unconformities present in the investigated area by the 3D travel time tomography of the reflected events picked on the 2D seismic lines. The adopted tomographic software CAT3D, based on the SIRT method and the minimum-time ray tracing, estimates the velocity field and the reflector structure in sequence, from the upper to the deeper horizon. As final results, the project will produce a 3D velocity-depth model of the sediment structures below the sea bottom corresponding to the main unconformities from late Miocene to early Pliocene.

The resulting model is used to reconstruct the geomorphological and depositional history of this sector of the outer continental shelf and to infer ice sheet dynamics during Miocene and Plio-Quaternary times. High velocity anomaly observed in units below the Ross Sea Unconformity 2 (RSU2) of Pliocene age (3-3.7 Ma) is interpreted as indicative of, glacial sediments over-compacted by overriding of thick and relatively stable ice sheet. The low velocity of unit above RSU1 (ca. 0.7 Ma), is instead associated to normally-compacted sediments.

Two way time contour depth and isopach maps show migration of the sediment depocenter from RSS-6 to RSS-8, indicating a change in the direction of grounding ice advance over the continental shelf. Morphologic inversion occurred during deposition of RSS-8, that is combined with changes in the acoustic facies and sediment velocity possibly reflecting a large scale change in the WAIS dynamics in late Pliocene-Quaternary times.

A change from wet-based to dry-based basal ice dynamics of WAIS expansion over the continental shelf in the late Pliocene is suggested. The geometric change of the sedimentary units and the morphology of the margin architecture, combined with the change in the P-wave velocity of the seismic units, as recorded in the study area, might indicate not only a local, but also a regional change in the ice regime, possibly reflecting a significant transition in the evolution of WAIS in the late Pliocene.

Products

A – papers in scientific magazines

1. Böhm, G., Okagoğlu, N., Picotti, S., De Santis, L., 2009. *Western Ice Sheet evolution: new insights from a seismic tomographic 3D depth model in the Eastern Ross Sea (Antarctica)*. Marine Geology 266 (2009) 109-128

B – book chapters

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C - proceedings of international conferences

- 1. Ocakoğlu, N. and Böhm, G., 2007. *Multi-channel seismic reflection study in the Eastern Basin (Ross Sea), Antarctica*. EGU General Assembly 2007. 15-20 April, 2007.
- 2. Böhm, G., Ocakoğlu, N. and Picotti, S., 2007. *Seisnic investigation and 3D tomography in the Ross Sea (Antarctica) for Western Ice Sheet evolution studies.* Expanded Abstracts of the 69th EAEG Meeting (London).
- 3. Böhm G., Ocakoğlu N., Picotti S. and De Santis L., 2008. *New insights into Western ice sheet evolution in the outer Ross Sea (Antarctica): a 3D depth velocity model of Pliocene to present glacial sediments.* XXX SCAR/IASC IPY Open science conference, 8-11 July, St. Petesburg Russia.
- 4. Böhm, G., Okagoğlu, N., Picotti, S., De Santis, L., 2009. *West ice sheet evolution studies in the Eastern Ross Sea (Antarctica): a 3D velocity model from seismic tomography*. European Geosciences Union, General Assembly 2009. 19-24 April 2009, Vienna Austria.

D – proceedings of national meetings and conferences

- Böhm G., Okagoğlu, N. ed il gruppo nave OGS-EXPLORA, 2006. Progetto WISE Evoluzione della calotta occidentale nel mare di Ross (Antartide). Prima parte – L'acquisizione sismica e l'elaborazione in tempi. Riassunti estesi del 25° Convegno Nazionale GNGTS, Roma, 475-477.
- Böhm G. e Picotti S., 2007. Progetto WISE Evoluzione della calotta occidentale nel Mare di Ross (Antartide). Seconda parte: l'inversione tomografica ed il modello 3D finale. Riassunti estesi del 26° Convegno Nazionale GNGTS, Roma, 505-508.

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. Picotti S., 2008. *Applications of the seismic method to Antarctic ice-sheet related problems. Cap. 6 - Seismic investigations in the Ross Sea for Antarctic glaciations studies.* pp. 123-132. Phd Thesis Scuola di dottorato di ricerca in scienze polari xix ciclo - Università degli Studi di Siena.

Research units

REDAS (REsearch, Development and Application for Seismic) group – Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS

Acquisition group, OGS-Explora - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS

Date:

Data acquisition: January-February 2006 Project closed: October 2008

Notes

PNRA – Final project report