

Final project report

<i>Project ID</i>	2005/3.01
<i>Title</i>	Understanding Larsen Ice Shelf: Seismic Evidence (ULISSE)
<i>Principal investigator</i>	Fabrizio Zgur
<i>Institution</i>	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
<i>Email</i>	fzgur@ogs.trieste.it
<i>Duration</i>	2 years
<i>Assigned funding</i>	40.000,00 Euro

Activities and results

The main objective of this research – included within the framework of the NSF project "Paleohistory of the Larsen Ice Shelf: Evidence from the Marine Record" - was the seismic investigation of the Larsen region (Antarctic Peninsula, Western Weddel Sea), in an area previously covered by the recently collapsed Larsen B Ice Shelf.

Specific task of the PNRA ULISSE crew involved in the NBP0603 Antarctic cruise (Punta Arenas, Chile, 11.04.06 – 06.05.06) on board the USAP icebreaker R/V NB Palmer, was to collect a series of high resolution single channel seismic profiles by means of the OGS portable equipment (ministreamer GEN III and Delph recording system); the aim was to integrate these data to all the geophysical and geological information gathered during the cruise (morphobathymetry data from the hull mounted multibeam echosounder, very high resolution acoustic data from the sub bottom profiler, sediment corings) in order to characterize the glacial (or glacio-marine) sedimentary sequence of the area for the understanding of the ice shelf behaviour.

As a whole, about 140 km of seismic profiles were acquired, notwithstanding the adverse environmental conditions characterized by the presence of floating ice that severely hampered the operations. On board quality control and field processing was performed by means of the Gedco Vista seismic software.

After the cruise, the seismic data were processed by adopting both standard and non-conventional sequence (i.e. migration to collapse diffraction hyperbolas to improve the lateral resolution) and successively integrated to the morphobathymetry and acoustic data. During the interpretation, particular attention was dedicated to the new-born Crane Fjord (Exasperation Inlet, former Larsen B Ice Shelf) originated by the 15 km retreat of the Crane Glacier after the ice shelf collapse in the summer of 2003 and first accessed during the 2006 cruise.

Morphobathymetry data show that the fjord is far deeper (hundreds of meters) than previously estimated on the basis of geophysical airborne data. Combined with the seismic and sub bottom profiles, they image three very deep, narrow and well layered basins, separated by more elevated thresholds and terminated by a wide grounding line.

The information that were extracted from the dataset, namely 1) the flat morphology of the basins, 2) the high deposition rate (up to 2 m/year) derived from the cores, and 3) the unexpected 40 m thick sedimentary sequence well imaged by the seismic in the outer basin, suggest that the sedimentation may have started within a sub-glacial lake environment beneath the outer part of the Crane Glacier; it could then have been amplified by the recent, catastrophic ice shelf collapse. This sedimentary record, yet only partially sampled, is of exceptional importance for paleoclimatic studies. It contains vital information about ice shelf dynamics, sub-glacial lake process and ice basal conditions.

Products

A – papers in scientific magazines

1. Zgur F., Rebesco M., Domack E., DeMoor A., Leventer A., Brachfeld S., Willmott, V., Halverson G., in prep. Evolution of Grounding Line Systems Prior to and Following Collapse of the Larsen-B Ice Shelf. *Science (to be submitted)*.

Programma Nazionale di Ricerche in Antartide (PNRA)

B – book chapters

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C - proceedings of international conferences

1. Rebesco, M., Domack, E.W., Zgur, F., Leventer, A. (2008). The exceptionally thick, expanded sedimentary fill of the Crane Glacier Trough: a new-born fjord following the collapse of Larsen B Ice Shelf, Antarctica. 33rd International Geological Congress. August 6-14th 2008, Oslo.
2. Zgur F., M. Rebesco, E.W. Domack, A. Leventer, S. Brachfeld, and V. Willmott, (2007). Geophysical Survey of the Thick, Expanded Sedimentary Fill of the New-Born Crane Fjord (Former Larsen B Ice Shelf, Antarctica), ISAES Santa Barbara 2007, U.S. Geological Survey and The National Academies; USGS OF-2007-1047, Extended Abstract 141, <http://pubs.usgs.gov/of/2007/1047/ea/of2007-1047ea141.pdf>
3. Domack E.W., A. Leventer, V. Willmott, S. Brachfeld, S. Ishman, B. Huber, M. Rebesco, F. Zgur, L. Padman, and R. Gilbert (2007). New Marine Sediment Core Data Support Holocene Stability of the Larsen B Ice Shelf, ISAES Santa Barbara 2007, U.S. Geological Survey and The National Academies; USGS OF-2007-1047, Extended Abstract 019, <http://pubs.usgs.gov/of/2007/1047/ea/of2007-1047ea019.pdf>
4. Zgur, F.; Rebesco, M.; Domack, E. W.; Willmott, V. (2007). High resolution stratigraphic sequences within the inner Larsen B embayment: seismic imaging within the Crane Glacier (Spillane) Fjord and Hektor Basin, former Larsen B area, Antarctica. EGU General Assembly 2007, Geophysical Research Abstracts, Vol. 9, 02710, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-03490
5. Domack, E.; Leventer, A.; Ishman, S.; Brachfeld, S.; Huber, B.; Willmott, V.; Rebesco, M.; Zgur, F.; Halverson, G.; Rathburn, A. (2007). Beneath the Larsen B Ice Shelf system: a marine perspective on a rapidly changing cryosphere (solicited),. EGU General Assembly 2007, Geophysical Research Abstracts, Vol. 9, 02710, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-04509
6. V. Willmott, A. Parent, E.W. Domack, M. Rebesco, F. Zgur (2006). Chirp acoustic facies from the former Larsen B Area, north-western Weddell Sea. Geological Society of America –GSA- Philadelphia Annual Meeting (22-25 October 2006), Vol.38, No.7, p.229.

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

1. On May 5th 2006 an article concerning the NB0603 cruise was published on the Trieste local newspaper "Il Piccolo".

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

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Research units

Fabrizio Zgur	Technologist – Principal investigator	(OGS)
Michele Rebesco	Researcher – Data Interpretation	(OGS)
Nigel Wardell	Technologist – Data Processing	(OGS)
Andrea Cova	Technologist – Data Acquisition	(OGS)
Paolo Visnovic	Marine Technician – Data Acquisition	(OGS)
Valentina Volpi	Researcher – Data Interpretation	(OGS)

Date: 27.11.2009

Notes