

## Final project report

<i>Project ID</i>	2002/3.05
<i>Title</i>	<b>Studio Ground Penetrating Radar (GPR) dell'assetto strutturale dell'area della Northern Victoria Land e di Dome C (Antartide).</b>
<i>Principal investigator</i>	Michele Pipan
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<i>Duration</i>	2 years
<i>Assigned funding</i>	70.000,00

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## Activities and results

The research activity focused on the following topics:

- Methodological developments to image and characterize the basement of the ice sheet from airborne ground-penetrating radar datasets;
- Analysis, modeling, inversion and interpretation of the available radar data from the Northern Victoria Land and Vostok-Dome C areas;
- Correlation with the available geophysical data from the Western Ross Sea

The reprocessed and interpreted seismic data from the western margin of the Ross Sea, obtained in the framework of the Italian expeditions to the area, show evidences of sea-floor deformation due to recent tectonic activity. The deformation of the sea-floor is related to the recent reactivation of crustal faults affecting the Cenozoic sequence to the acoustic basement. The time-analysis of the deformation, based on the new processing and interpretation, suggests that part of these faults were active since the first rifting phases in the area (probably Late Jurassic) and are due to continued strike-slip movements in the region which account for the formation of the whole Ross Embayment. The Discovery Graben exhibits structural features characteristic of fault-bend basins. Paleo-strain analysis based on local transpressions and transtensions related to releasing and restraining bends along the principal faults suggests a regional NW-SE strike-slip movement. Such deformation axis is aligned with the projection of regional transform faults which dislocate the SEIR (South East Indian Ridge) and cross the Southern Ocean. Radar data recently obtained by the Italian expeditions to the Northern Victoria Land reveal topographic features at the base of the ice-sheet probably correlated with the recent strike-slip deformation observed offshore. The study provides new knowledge about time-space evolution of the deformation and establishes a correlation between the orientation of the main fault systems in the Ross Sea and the projection of the regional transform faults displacing the South East India Ridge.

From the methodological point of view, Wavelet Transform based processing provides robust and computationally efficient techniques for high and low frequency noise attenuation. Comparative analysis of the results obtained by Fourier Transform processing methods and Wavelet Transform ones shows that the latter are less sensitive to noise and more selective in the discrimination of signal from noise. Signal components are thus better preserved by wavelet techniques. Primary benefits of the application of the method to the Antarctic Radar dataset examined in the present study are enhanced ice layers and ice-bedrock contact imaging in the low signal to noise ratio sectors of the area of study.

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## Products

### A – papers in scientific magazines

1. Guangyou F. and Pipan M., 2003, Synthetic and Field Examples of GPR profile improvement using two Phase Detection Techniques, *Geophysics*, 68, 554-558

### B – book chapters

1. Pipan M., Forte E., Dal Moro G., Sukan M. and Finetti I., 2004, Multi-fold, multi-component and multi-azimuth GPR for subsurface imaging and material characterization, in *Ground Penetrating Radar – Second Edition*, Daniels D. Ed., IEE books UK

### C - proceedings of international conferences

1. Geletti R., Pipan M., Battigelli A. and Del Ben A., 2000; New seismic evidences in the Victoria Land basin, Antarctica; 62<sup>nd</sup> Conference, European Association of Geoscientists & Engineers, Extended Abstracts, P-192
2. Pipan M., De Vecchi M., Forte E., Tabacco I., 2002. Wavelet Based Processing of Airborne Radar Data from East Antarctica. *Extended Abstracts*, 64<sup>th</sup> EAGE Conference, Florence (Italy)
3. Pipan M., Forte E., Del Ben A., Taboga A., Gasperini L., De Vecchi M., Finetti I., Tabacco I., 2002, Seismic and radar study of recent deformation in the Ross Sea-East Antarctica area, *Geophysical Research Abstract*, vol.4, SE4.09

### D – proceedings of national meetings and conferences

1. Pipan, M., Forte, E., Del Ben, A., Finetti, I., Gasperini, L., and Tabacco, I., **Wavelet based processing of airborne radar data from East Antarctica**, Proceedings Workshop 'Scienze della Terra in Antartide', Certosa di Pontignano (Siena), 30 Settembre – 2 Ottobre 2002

### E – thematic maps

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### F – patents, prototypes and data bases

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

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

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## Research units

University of Trieste  
CNR-ISMAR Bologna

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