

## Final project report

*Project ID:* 2002/7.3  
*Title:* *Dynamical aspects of the Earth's magnetosphere*

*Principal investigator:* Umberto Villante  
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*Duration:* two years, 2002-2003  
*Assigned funding:* € 55673 (funzionamento: € 34896 + investimento: € 20777)

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### Activities and results

The present project is the continuation of the research activity conducted by our group at Terra Nova Bay (TNB) since 1992. The activity consists in recording the variations of the geomagnetic field in the ULF band (1 mHz - 1 Hz), in their analysis and interpretation.

These measurements are of special value because this high latitude region is magnetically connected to the outer magnetospheric regions where several mechanisms of energy transfer from the solar wind to the magnetosphere are active.

A renewed instrumentation was installed during the 2002/2003 campaign. It consists of a high sensitivity triaxial induction magnetometer and of an acquisition system which allows a continuous recording (at 4 Hz sampling rate and timing via GPS) also during the austral winter. For longer period phenomena, we also used measurements from a fluxgate magnetometer in the framework of a scientific cooperation with the Istituto Nazionale di Geofisica e Vulcanologia.

During november 2003 we also conducted a measurement campaign at Concordia station for testing the possibility of a permanent installation.

The characteristics of ULF pulsations were studied using the data recorded at TNB, Concordia, as well as at other antarctic stations (cooperation with the Bell Laboratories, NJ) at L'Aquila station, and from interplanetary spacecraft. The main results obtained are the following:

- The solar wind velocity appears to have a stronger control on the Pc3-4-5 oscillations in the polar cap than at lower latitudes, indicating a stronger influence of the Kelvin-Helmholtz instability (Lepidi et al., 2003; Santarelli et al., 2003).
- An analysis about the possible antropogenic contamination of geomagnetic signals in the ULF band both at low and high latitude shows that no significant effects are present in TNB measurements (Villante et al., 2004).
- Using the data recorded at Concordia during the short campaign of November 2003, an analysis of Pc3 pulsations simultaneously recorded also at TNB was carried out. The frequency of these pulsations is consistent with an upstream wave generation on the flanks of the bow shock and possible ground transmission via the magnetotail lobes (De Lauretis et al., 2005).
- A statistical analysis of low-frequency pulsations (0.8-7 mHz) recorded at South Pole (SP) and TNB shows that the diurnal modulation of the pulsation power at SP has two maxima: one before midnight (associated to substorm phenomena) and the other in the morning. During quiet magnetospheric conditions, when the boundary between open and closed field lines is located poleward with respect to SP, the spectral and polarization characteristics of the pulsations in the 1-3 mHz band suggest that resonant oscillations of the outermost closed field lines commonly occur at SP in the local morning. At TNB, in the polar cap, the pulsation power is much lower and its diurnal variation is characterized by a single maximum at noon when the station approaches the cusp (Francia et al., 2005).

## Programma Nazionale di Ricerche in Antartide (PNRA)

### Products

#### A – papers in scientific magazines

1. Lepidi S., L. Cafarella, P. Francia, A. Meloni, P. Palangio, and J.J. Schott, Low frequency geomagnetic field variations at DomeC (Antarctica), *Ann. Geophys.*, 21, 1, 2003.
2. Villante U., M. Vellante, A. Piancatelli, A. Di Cienzo, T.L. Zhang, W. Magnes, V. Wetztergom, and A. Meloni, Some aspects of man-made contamination on ULF measurements, *Ann. Geophys.*, 22, 1335, 2004.
3. De Lauretis M., P. Francia, M. Vellante, A. Piancatelli, U. Villante, and D. Di Memmo, ULF geomagnetic pulsations in the southern polar cap: Simultaneous measurements near the cusp and the geomagnetic pole, *J. Geophys. Res.*, 110, A11204, doi:10.1029/2005JA011058, 2005.
4. Francia P., L.J. Lanzerotti, U. Villante, S. Lepidi, and D. Di Memmo, A statistical analysis of low frequency magnetic pulsations at cusp and cap latitudes in Antarctica, *J. Geophys. Res.*, 110(A2), A02205, doi:10.1029/2004JA010680, 2005.

#### B – book chapters

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#### C - proceedings of international conferences

1. Villante U., M. De Lauretis, P. Francia, M. Vellante, and A. Piancatelli, Solar wind-magnetosphere interaction as observed in the geomagnetic field variations in the polar regions, *Proceedings of the Solar Variability and Earth Climate Conference (27 June - 1th July, 2005, Monte Porzio Catone, Rome)*, *Mem. SAI.*, 76, 888-889, 2005.

#### D – proceedings of national meetings and conferences

1. Santarelli L., S. Lepidi, P. Palangio, and L. Cafarella, Pc3-Pc4 pulsations at Terra Nova Bay (Antarctica): seasonal dependence of the power and its relationship with solar wind parameters, *Proceedings of the 3rd National Meeting on the Italian Solar Research (30 September - 4 October, 2002, Vulcano)*, *Mem. S.A.It.*, 74, 766-769, 2003.

#### 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.)

Nell'ambito di questo progetto sono stati assegnati i seguenti contratti a giovani laureati:

- "Analisi dati sulle misure acquisite in Antartide"; contraente: Davide Di Memmo.
- "Sviluppo di software per selezione di eventi di pulsazioni geomagnetiche registrati presso le stazioni di BTN e Concordia"; contraente: Mauro Regi.

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### Research units

Composizione dell'Unità operativa (CAN-VIL):

Umberto Villante	(Università dell'Aquila)
Lili Cafarella	(Istituto Nazionale di Geofisica e Vulcanologia)
Marcello De Lauretis	(Università dell'Aquila)
Paolo Di Giuseppe	(Università dell'Aquila)
Patrizia Francia	(Università dell'Aquila)
Stefania Lepidi	(Istituto Nazionale di Geofisica e Vulcanologia)
Andrea Piancatelli	(Università dell'Aquila)
Lucia Santarelli	(Istituto Nazionale di Geofisica e Vulcanologia)
Massimo Vellante	(Università dell'Aquila)

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**Date:**

17 Ottobre 2008

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