

Final project report

<i>Project ID</i>	2004/5.01
<i>Title</i>	Paleoclima e paleoambiente dalla stratigrafia chimica, fisica e isotopica di carote di ghiaccio
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<i>Duration</i>	3 years
<i>Assigned funding</i>	605,000.00 Euro

Activities and results

In the framework of 2004-06 Project, an extensive data set of chemical, physical, isotopic parameters was obtained in order to produce high resolution ice core stratigraphy allowing to study climatic and environmental variability in late Quaternary.

In particular, combining dD and dex data from EPICA Dome C (EDC) ice by the use of an inversion method and a simple isotopic model, it was possible to reconstruct past changes in Dome Concordia surface temperature (T_{site}) and ocean moisture source temperature (T_{source} , mainly the sub-Antarctic Indian Ocean) for the last 800 kyr. On the same ice core, continuous chemical stratigraphies provided information on winter sea-ice extent in the Indian Ocean, Southern Ocean biogenic productivity and Patagonian climatic conditions of the last 8 glacial cycles. Biological emissions south of the polar front seem to have changed little with climate, suggesting their minor role in climate regulation. Large glacial-interglacial contrasts in iron deposition could reflect changes in Patagonia conditions. During glacial terminations, such changes preceded sea-ice reduction, showing that multiple mechanisms could be responsible for different phases of CO₂ increase. Results from the chemical characterization of dust samples (PIXE-PIGE), carried out for the last 200 kyr revealed significant differences in dust chemical composition in LGM, MIS4 and MIS6. Moreover, Sr-Nd isotopic fingerprint of EDC ice core dust for the last 800 kyr, compared to the isotopic signature of source samples, provided a preliminary identification of the dust source areas for East Antarctica. Magnetic properties of aeolian dust were also measured.

High-resolution sulphate stratigraphies allowed extending up to the last 50 kyr BP the synchronization of the EDC and EDML timescales through volcanic signature match. Volcanic eruptions were identified by tephra layers analysis along the EDC ice core and in the deeper sections of Vostok core aiming to identify the volcanic sources, to provide complementary information on paleo-atmospheric trajectories, and to perform stratigraphic correlations between climate records. Two dust layers in the EDC core were attributed to meteoritic events, providing the first well-dated cosmic horizons in deep Antarctic ice cores.

Trace elements were analysed on EDC, EDML and TD05 ice samples. Hg and Hg-species measured along the last 600 kyr gave new information on the processes controlling sources and transport of Hg in Antarctica. The analysis of specific molecular markers of biomass burning provided the first reconstruction of such events in the last 800 kyr.

Time scale synchronization between EDC, EDML and Greenland ice core revealed strong coupling of AIM with the longest D-O events in Greenland, through the AMOC. High-resolution EDML chemical stratigraphies showed a one-to-one coupling between AIM and D-O events with a bipolar seesaw pattern.

In order to better interpret the ice core stratigraphies, present-day aerosol source, transport, atmospheric transformation (including photochemistry) and deposition processes have been studied at Dome C by all-year-round sampling and analysis.

Products

A – papers in scientific magazines

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- 2008
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Studio dei processi attuali di trasporto a lungo raggio dalle regioni dell'emisfero meridionale all'Antartide attraverso la caratterizzazione mineralogica delle polveri dell'aerosol atmosferico a Dome C. XII Convegno Nazionale "Chimica degli Ambienti Polari", Venezia, 22-23 Giugno 2009.
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61. Vallelonga Paul, Kevin J.R. Rosman and Carlo Barbante. 2009. Determinazione degli isotopi di piombo per le valutazioni dei cambiamenti climatici e studio dei flussi naturali e antropogenici nell'atmosfera (Determination of lead isotopes for the evaluation of climatic change and the study of natural and anthropogenic fluxes in the atmosphere). In: "La variabilità del clima nel Quaternario: la ricerca italiana (Variability of the Quaternary

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62. Traversi R., S. Becagli, D. Frosini, G. Galli, F. Rugi, M. Severi, R. Udisti. Contributo degli anioni organici a basso peso molecolare alla composizione del particolato atmosferico in siti a diverso grado di antropizzazione. PM 2010 – 4° Convegno Nazionale sul Particolato Atmosferico. Venezia, 18-20 Maggio 2010, P-7.
63. Udisti R., S. Becagli, D. Frosini, G. Galli, F. Rugi, M. Severi, R. Traversi, F. Lucarelli, S. Nava. Studio della variabilità stagionale delle sorgenti e dei processi di trasporto del particolato atmosferico a Dome C (Antartide) dall'analisi dei campioni raccolti con impattori multi-stadio e campionatori a cut-off pre-definito. PM 2010 – 4° Convegno Nazionale sul Particolato Atmosferico. Venezia, 18-20 Maggio 2010, O-12.

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. Carlo Barbante, European Winter Conference on Plasma Spectrochemistry, Taormina, Italy, 2007, Member of the Scientific Organizing Committee
2. Carlo Barbante, 7th International Sector Field ICP-MS Conference, New Brunswick, NJ, 10-12 Sep 2008, Member of the Scientific Organizing Committee, EPICA 2008 Open Science Conference, 10-13 Nov 2008, Venice, Italy. Chairman
3. Carlo Barbante, 8th International Sector Field ICP-MS Conference, Ghent, Belgium 14-16 Sep 2009, Member of the Scientific Organizing Committee
4. European Science Foundation Research Conference Mechanisms of Quaternary Climate Change: Stability of warm phases the past and in the future. 6-11 Jun 2009. Obergurgl, Austria. Chairman

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

PhD Thesis

1. Enricomaria Selmo. Variazioni dell'eccesso di deuterio nel corso degli ultimi 800.000 anni nella carota di EPICA Dome C (Antartide Orientale): implicazioni paleoclimatiche. Tesi di Dottorato di ricerca in Scienze della Terra, Università di Parma, 2007.
2. Alexandrine Marteel. Past natural changes in trace elements, rare earth elements (REE), Hg and Pb isotopes in the EPICA/DOME C ice core (East Antarctica) from 263,000 to 671,000 yrs BP – Tesi di Dottorato in Scienze Polari, XX ciclo, Università di Siena, 2008.
3. Mirko Severi. Correlazione tra variazioni ambientali e climatiche dalla stratigrafia chimica di carote di ghiaccio in Antartide. Tesi di Dottorato in Scienze Chimiche, Università di Firenze, 2004.
4. Ilaria Fattori. Studio della composizione chimica e della distribuzione dimensionale delle particelle in atmosfera, in relazione alle fonti e ai diversi ecosistemi remoti antropizzati. Tesi di Dottorato in Scienze Chimiche – Università di Firenze, 2005.
5. Andrea Morganti. Rivelazione ed interpretazione di variazioni climatiche ed ambientali ottenute dall'analisi chimica di carote di ghiaccio. Tesi di Dottorato in Scienze Chimiche – Università di Firenze, 2008.
6. Omar Cerri. Caratterizzazione chimica e fisica dell'aerosol in Antartide e sua interazione con i sistemi di circolazione atmosferica. Tesi di Dottorato in Scienze Chimiche – Università di Firenze, 2009.

Research fellowship and contracts

1. Borsa di studio – Università di Parma. Di Matteo Antonietta. Titolo: "studio geochimico-isotopico di carote di ghiaccio di provenienza antartica". Dal 04-05-2007 al 03-04-2008
2. Borsa di studio – Università di Parma, Candidato: Mantovani Luciana. Titolo: "studio geochimico-isotopico di carote di ghiaccio di provenienza antartica". Dal 04-08-2008 al 04-02-2010
3. Borsa di studio – Università di Trieste, Laura Genoni. Titolo: "Stratigrafia isotopica nel sito di perforazione TALDICE (Antartide Orientale)". Dal 1-01-2008 al 30-06-2008
4. Borsa di studio – Università di Trieste, Marzia Michelini. Titolo: "Isotopi stabili e instabili in campioni di ghiaccio di carote antartiche". Dal 1-01-2009 al 31-05-2009.
5. Borsa di studio – Università di Trieste, Marzia Michelini. Titolo: "Isotopi stabili in campioni di neve e ghiaccio dell'Antartide". Dal 1-09-2009 al 31-12-2009.
6. Borsa di studio – Università di Trieste, Mattia Bonazza. Titolo: "Analisi isotopiche di campioni provenienti dall'Antartide". Dal 1-07-2009 al 31-12-2009.
7. Assegno di ricerca – Università di Venezia, Paolo Gabrielli. Titolo: "Ricostruzione paleoclimatica ed ambientale

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- mediante lo studio di carote di ghiaccio polare ed alpino". Dal 15/11/2006 al 14/09/2007
8. Assegno di Ricerca – Università di Venezia, Jacopo Gabrieli. Titolo: "Variazioni climatiche ed ambientali ottenute dallo studio della carota di ghiaccio di Talos Dome (Antarctica)" 2008-2009
 9. Borsa di studio – Università di Firenze, Iliaria Fattori. Titolo: " Caratterizzazione chimica e fisica di aerosol e precipitazioni in aree antropizzate e remote". 01/09/04 – 31/08/05
 10. Borsa Post-Dottorato – Museo Nazionale dell'Antartide, Università di Siena, Emiliano Castellano. Titolo: " Ricostruzione di record paleo-vulcanici da carote di ghiaccio e studio dell'interazione tra vulcanismo e clima". 01/11/04-31/10/05
 11. Borsa Post-Dottorato – Museo Nazionale dell'Antartide, Università di Siena, Mirko Severi. Titolo: "Sviluppo e applicazione di metodi di analisi di carote di ghiaccio ad alta risoluzione per Fast ion Chromatography - FIC". 01/11/04-31/10/05
 12. Incarico di collaborazione occasionale – CoNISMa, Desire Manganelli. Titolo: "Sincronizzazione temporale delle carote di ghiaccio prelevate a Dome C, Dronning Maud Land e Talos Dome, mediante segnali di comuni eventi vulcanici". 13/09/07- 31/12/2007
 13. Borsa di studio – Università di Firenze, Federica Marino. Titolo: "Studio delle sorgenti e dei processi di trasporto dell'aerosol atmosferico in aree polari attraverso la caratterizzazione chimica e geochimica del particolato solubile e insolubile". 01/01/2009-31/12/2009
 14. Borsa di studio – Gaia Galli. Titolo: "Determinazione della composizione ionica di campioni di aerosol , neve e ghiaccio prelevati in Italia e Antartide". 01/09/08 – 31/03/09
 15. Co.Co.Pro – Università di Firenze, Stefania Pistoiesi. Titolo: "Elaborazione di serie di dati ambientali e climatici provenienti dall'analisi chimica di campioni di carote di ghiaccio prelevati in Antartide". 01/09/-30/10/09
 16. Co.Co.Pro – Università di Firenze, Desire Manganelli, Titolo: "Ottimizzazione di dati cromatografici da misure di fast ion Chromatography", 01/01/09 – 30/11/09
 17. Borsa di studio – Università di Firenze, Jessica Fondi. Titolo: "Sviluppo di metodologie in I.C. per analisi di carote di ghiaccio". 01/06/09 – 31/12/09
 18. Borsa di studio – Università di Firenze, Daniele Frosini. Titolo: " Caratterizzazione chimica di aerosol atmosferici per cromatografia ionica ad alte prestazioni". 01/11/09-30/04/10
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Research units

- FRE-UDI - Roberto Udisti Emiliano Castellano Mirko Severi Silvia Benassai Andrea Morganti Emanuele Salvietti Omar Cerri
- FRE-BAR - Carlo Barbante Gabriele Capodaglio Paolo Gabrielli Vania Gaspari Giulio Cozzi, Valter Zampieri
- FRE-STE - Barbara Stenni Laura Genoni Cristinamaria Salvi
- FRE-IAC - Paola Iacumin Enrico Selmo Gianpiero Venturelli
- FRE-MAG - Valter Maggi Giuseppe Orombelli Marco Filipazzi Barbara Delmonte Federica Marino Chiara Uglietti Marco Sala Alberto Deponti Simone Sironi
- FRE-GHE - Grazia Ghermandi Rodolfo Cecchi Sergio Teggi Matteo Remitti Federica Marino
- FRE-NAR - Biancamaria Narcisi Marco Proposito
- FRE-TAB - Ignazio Ezio Tabacco Andrea Passerini Antonio Tartaglia Alessandro Forieri Stefano Urbini
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Date: March 31st 2011

Notes