Programma Nazionale di Ricerche in Antartide (PNRA)

Final project report

Project ID:	**2003/4.2**
Title:	**Metasomatic processes and amphibole petrogenesis in the Antarctic lithosphere**
Principal investigator:	**Massimo Coltorti**
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Duration:	**two years**
Assigned funding:	**€ 10.000**

Activities and results

Petrographic and geochemical (major and trace element) features of clinopyroxene, amphibole and glass of composite xenoliths from Mt. Melbourne and Mt. Overlord (Victoria Land, Antarctica) were investigated. A carefully investigation of the textural occurrence of amphibole together with a detailed microanalytical study has been carried out. Amphibole appears both in vein or disseminated within the matrix. Amphibole disseminated in the peridotite matrix appears to grow around clinopyroxene and spinel, and is often associated with high-TiO_2 silicate glass. Clinopyroxene presents a wide range of composition, from primary unmetasomatized diopside to high-MgO salite, with REE patterns varying from flat (at Yb_N 5Xchondrite) to slightly enriched [$(La/Yb)_N$ 2.7-4.2] at higher HREE contents (Yb_N 9.3-14.3). These compositional variations are texturally related. Clinopyroxene, with constant mg#, appears in fact to be enriched in Al_2O_3, TiO_2 and REE when in contact with amphibole. Amphibole also occurs in veins which, in few cases, grade into glass-rich vein before vanishing into the peridotite. Glasses are not related to amphibole destabilization; on the contrary, they appear to be strictly related to its formation. No chemical differences were noted between glasses related to disseminated or vein amphiboles. Their geochemical features favour a Na-alkaline silicate melt as metasomatizing agent. Mass balance calculations were used to model the reactions producing amphibole from primary clinopyroxene, and to highlight the nature of the metasomatic agent/s. Trace element contents of the inferred melt/s are comparable to those of the most undersaturated magma found in the area, suggesting a strong link between metasomatism and the magmatism of the Ross Sea Rift system. This hypothesis is further strengthened by the analogy between trace element patterns of clinopyroxene associated with amphibole and those of clinopyroxene contaminated by the host basalt. On the basis of the Mg/Fe diffusion model, the difference in mgv between these two clinopyroxenes was used to estimate the timing of the basalt infiltration and amphibole formation. Finally, various models for disseminated and vein amphibole relationships are recalled and their application to Antarctic amphiboles is tested. The petrographic and geochemical features of disseminated amphiboles, in fact, do not support the hypothesis that they may derive from differentiated magma after vein amphiboles have crystallized. Both amphibole types may have formed within a similar time span due to the different magma/wall rock ratios which control the mode of melt migration from porous flow to cracking and fracturing.

Products

A – papers in scientific magazines

1. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2003. Metasomatic processes in Antarctic lithospheric mantle (Mt.Melbourne, Victoria land). Terra Antartica Reports n. 9, 5-8.
2. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2004. Amphibole genesis via metasomatic reaction with clinopyroxene in mantle xenoliths from Victoria Land, Antartica. Lithos Sp.Vol., 75/1-2 pp 115-139.

B – book chapters

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C - proceedings of international conferences

1. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2002. Relationships between Ti-rich alkali silicate metasomatism and amphibole, glass and clinopyroxene genesis in mantle xenoliths from Antarctica, Australia and Austria. Goldschmidt 2002, Davos 18-23 August 2002. Geoch.Cosmoch.Acta 66, 15A, suppl.1, 149.
2. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T. Siena F. 2004. Ti-metasomatism in Antarctic lithospheric mantle. EGU meeting, 25-30 Aprile, Nizza.
3. Coltorti M., Bonadiman C., Faccini B., Gregoire M., O'Reilly S. 2004. Amphiboles in mantle xenoliths from anorogenic and orogenic settings. evidence bearings on different style of metasomatism and implication for Nb and Ti anomalies in calk-alkaline magmas. IGC2004, 20-28 Agosto 2004, Firenze.

D – proceedings of national meetings and conferences

1. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2001. Petrological relationships between clinopyroxene, amphibole, phlogopite and glass in metasomatized mantle xenoliths from Mt.Melbourne (Antarctica), Mt. Leura (Australia) and Kapfenstein (Austria). 3° Convegno FIST (Federazione Italiana Scienze della Terra), Chieti 5-8 Settembre 2001.
2. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2002. Disseminated and vein amphiboles in mantle xenoliths from Antarctica and Australia. 82° Congresso SIMP, Cosenza 18-20 Settembre 2002.
3. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2002. Metasomatic processes in Antarctic lithospheric mantle (Mt. Melbourne, Victoria Land). Workshop "Scienze della Terra in Antartide" Certosa di Pontignano (Siena), 30 Settembre - 2 Ottobre 2002.
4. Coltorti M., Beccaluva L., Bonadiman C., Faccini B., Ntaflos T., Siena F. 2003. Genesi dell'anfibolo negli xenoliti di mantello del M. Melbourne, Antartide. 4° Convegno FIST (Federazione Italiana Scienze della Terra), Bellaria 16-18 Settembre 2003.
5. Faccini B., Beccaluva L., Bonadiman C., Coltorti M., Ntaflos T., Siena F. 2005. Within-plate and suprasuduction metasomatisms in mantle amphiboles from Antarctica and Austria. A comparison with the case of Tallante. Progetto PRIN 2002, Evoluzione petrologica del sistema litosfera-astenosfera nell'area circum-tirrenica, Napoli 22 Aprile 2005.
6. Coltorti M., Bonadiman C., Faccini B., Siena F. 2005. Minerals and glasses as indicators of metasomatic processes in the lithospheric mantle. FIST, Geoitalia2005, Spoleto 20-22 Settembre 2005.

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.)

1. **Tesi di Laurea**: Faccini B. 2001. Relazioni fra metasomatismo e genesi dell'anfibolo in xenoliti idrati del Mt.Melbourne (Antartide), Mt. Leura (Australia), e Kapfenstein (Austria). Tesi di Laurea, Università di Ferrara.
2. **Tesi di Dottorato**: Faccini B. 2004. Relationships between metasomatism and amphibole genesis in mantle xenoliths. Tesi di dottorato, Università di Ferrara.
3. **Assegno di ricerca annuale** cofinanziato dal Dipartimento di Scienze della Terra dell'Università di Ferrara

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Research units

Unità operativa dell'Università di Ferrara

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Data: 14 Ottobre 2008

Note