

Final project report

<i>Project ID:</i>	2002/4.14
<i>Title:</i>	Definition of the genetic conditions of the pentasil zeolites found at Mt Adamson (Northern Victoria Land): a key for the synthesis of new materials for heterogeneous catalysis.
<i>Principal investigator:</i>	M. Giovanna Vezzalini
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<i>Duration:</i>	2 yearS (2002-2003)
<i>Assigned funding:</i>	€ 31.000 (funzionamento)+ 31.000 (materiale inventariabile)

Activities and results

Zeolites are natural materials that have increased enormously in industrial and economic importance in recent decades. Despite considerable research in industry into the potential uses of synthetic zeolites, natural phases retain their primary position even in this sector. From a methodological point of view the complexity of natural systems and advanced technological systems can be advantageously compared, working simultaneously on synthetic products and natural materials. In this sense the zeolites discovered recently in Antarctica can, not only significantly improve the knowledge of the corresponding synthetic phases, but also indicate the possibility of new methods for the synthesis of zeolitic materials. In particular the lower Si/Al ratio compared with analogous synthetic products, their formation in absence of an organic template, and the presence of calcium as a predominant extraframework cation, suggest the possibility of different conditions of synthesis from those currently applied in industry, and potential alternative applications for these materials.

The research work was aimed to the study of chemical, physical, structural, and applicative characterization of hydrothermal zeolites discovered at Mt. Adamson.

In particular we obtained the structural resolution of the monoclinic and tetragonal polytypes of tschernichite, the natural counterpart of synthetic zeolite beta (Alberti et al., 2002). The dehydration process of boggsite was studied through a single-crystal in-situ experiment (Zanardi et al., 2004). The structure of the synthetic zeolite ERS-10 (Zanardi et al., 2002) was solved starting from the structural data obtained on the natural Antarctic zeolite gottardiite. The interest of the industry for the zeolite occurrence in Antarctica is demonstrated by the collaboration with researchers of ENITECNOLOGIE.

The dehydration mechanism of tschernichite and boggsite (Cruciani et al., 2004) was also studied through in-situ X-ray powder diffraction experiments using synchrotron radiation.

Finally a review on the structural modifications and phase transitions induced by heating, and consequent dehydration, in microporous materials was published, where the thermal properties of the zeolites found at Monte Adamson (Victoria Land, Antarctica) are largely discussed (Alberti e Martucci, 2005).

Products

A – papers in scientific magazines

1. ALBERTI A.; CRUCIANI G.; GALLI E.; MERLINO S.; MILLINI R.; QUARTIERI S.; VEZZALINI G.; ZANARDI S. (2002) Crystal structure of tetragonal and monoclinic polytypes of tschernichite, the natural counterpart of synthetic zeolite beta. JOURNAL OF PHYSICAL CHEMISTRY. B, CONDENSED MATTER, MATERIALS, SURFACES, INTERFACES & BIOPHYSICAL. **106**, 10277-10284. **IF(2005)= 4.033**
2. ZANARDI S; CRUCIANI G.; ALBERTI A; GALLI E. (2004) Dehydration and rehydration process in boggsite: An in situ X-ray single-crystal study. AMERICAN MINERALOGIST. **89**, 1033-1042. **IF(2005)= 2.011**

Programma Nazionale di Ricerche in Antartide (PNRA)

- ZANARDI S; CRUCIANI G.; CARLUCCIO L.C.; BELLUSSI G.; PEREGO G.; MILLINI R. (2002) Framework topology of ERS-10 zeolite. *ANGEWANDTE CHEMIE – Int. Ed.* **41**, 4109-4112. **IF(2005)= 9.596**
- CRUCIANI G., DALCONI, C., FERRO, O., QUARTIERI, S., VEZZALINI, G. Thermal Behaviour of Natural Zeolites from Mt. Adamson (Antarctica). *ESRF Report 2874_A* (2004).

B – book chapters

- ALBERTI A.; MARTUCCI A. (2005) Phase transformations and structural modifications induced by heating in microporous materials. *STUDIES IN SURFACE SCIENCE AND CATALYSIS.* **155**, 19-43. **IF(2005)= 0.307**

C - proceedings of international conferences

- ALBERTI A., MARTUCCI A. (2004) Phase transformations and structural modifications induced by heating in microporous materials. III Workshop on Oxide-based materials, Como, September, 13-16 2004.
- ZANARDI, S., CRUCIALI, G., ALBERTI, A., GALLI, E., VEZZALINI, G. "Dehydration and rehydration process of zeolites boggsite and tschernichite from Antartica: a comparison". 32th International Geological Congress, Florence, Italy, August 20-28, 2004.

D – proceedings of national meetings and conferences

- ZANARDI S; CRUCIANI G.; ALBERTI A; GALLI E. (2003) Dehydration and rehydration process in boggsite: An in situ X-ray single-crystal study. VI Congresso Nazionale AIZ Scienza e Tecnologia delle Zeoliti. Vietri sul Mare (Salerno) 20-23 Settembre 2003.
- ZANARDI S., CRUCIANI G., ALBERTI A., GALLI E. (2003) The thermal behaviour of zeolite boggsite: an in-situ single-crystal X-ray analysis. Joint Congress AIC-SILS Trieste 21-25 Luglio 2003.
- ZANARDI S., G. CRUCIANI, L. C. CARLUCCIO, G BELLUSSI, C. PEREGO AND R. MILLINI (2003) Synthesis and framework topology of ERS-10: a new disordered zeolite VI congresso nazionale AIZ Scienza e Tecnologia delle Zeoliti Vietri sul Mare (Salerno) 20-23 Settembre 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.)

- 1 annualità di un assegno di ricerca (Cristina Betti) periodo 1/1/2004-31/12/2004; Titolo: Caratterizzazione strutturale di silicati porosi e di nanomateriali in esso confinati.
- 1 annualità di un assegno di ricerca (Rossella Arletti) periodo 1/6/2007-1/6/2008 (pro parte); Titolo: Interazioni host-guest e transizioni di fase indotte dalla pressione in materiali nano porosi di interesse tecnologico

Research units

1 - Responsabile / Principal investigator: **M. Giovanna Vezzalini**

Istituto di appartenenza: Dipartimento di Scienze della Terra, **Universita' di Modena e Reggio Emilia**

Ermanno Galli-Professore Ordinario

Antonio Rossi-Professore Associato

Orazio Ferro-Assegnista

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*2 - Responsabile / Principal investigator: **Alberto Alberti***

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Michele Sacerdoti-Professore Ordinario
Giuseppe Cruciani-Professore Associato
Annalisa Martucci- Ricercatore Universitario
Stefano Zanardi-Dottorando
M.Cristina Betti-Dottorando

*3 - Responsabile / Principal investigator: **Simona Quartieri***

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Maurizio Triscari-Professore Associato
Giuseppe Sabatino-Assegnista

Date: 14/10/2008
