ESRF	Experiment title: **Thermal expansion and dehydration process in phengite micas**	**Experiment number**: 08-02-613
Beamline: BM08	**Date of experiment**: from: 24/07/2005 to: 27/07/2005	**Date of report**:
Shifts: 9	**Local contact(s)**: Carlo Meneghini	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Marco Merlini* Università di Milano

Mauro Gemmi* Università di Milano

Alessandro Pavese Università di Milano

Report:

Micas are rock-forming minerals and they are relevant for geologic and petrologic studies. They are stable over a very wide compositional range and they present very interesting crystallographic features, such as polytypism.

Novel experimental studies are demanded now especially for two reasons:

- acquire much more precise thermo-elastic data fort micas over a wide compositional range, to calculate precise PVT equation of state relations (to use in phase equilibria calculation)
- follow the structural change as function of change in T and /or P condition, to assess the validity of ab-initio calculations

In a project aimed at the crystal chemistry characterization and thermal behavior of natural phengite micas [1] and PVT equation of state calculation [2], we measured by X-ray powder diffraction at the Italian CRG BM08 GILDA beamline the thermal behavior of several samples of phengite micas. The samples are characterized by a variable Fe/Mg, $Al^{[6]}$/Mg and interlayer cation content and different crystallographic features (i.e. monoclinic 2M samples, hexagonal 3T samples…) Each experimental run consisted in a continuous heating ramp from 25 °C to 950 °C with a thermal gradient of 5 °C/min. The thermal evolution was monitored by continuous recording of the diffraction signal with a translating image plate detector.

An accurate experimental set-up calibration (sample to detector distance, detector tilt, non-linear detector translation correction, …) allows accurate thermal expansion measurements. The diffraction data quality allows also a realistic Rietveld refinement of the structure evolution with increasing temperature.

Preliminary data analysis results are reported in figures 1 and 2.

Pure synthetic 2M1 muscovite (figure 1) has a linear expansion along the main crystallographic directions up to 700 °C, when the dehydration process begins. The volumetric linear expansion is 42.5E-6 $°C^{-1}$.

A natural 3T phengite sample (figure 2) show a linear expansion up to 600 °C, when a negative thermal expansion along *a* is visible. However probably over 600 °C there is also a symmetry change. The measured linear volumetric thermal expansion in the temperature interval 25-600 °C is 32E-6 $°C^{-1}$.

An accurate data analysis on the thermal expansion behavior as function of phengite chemical composition and phengite polytypic features is currently under way. It is under way also a study on the structural changes during the dehydration process by Rietveld analysis.

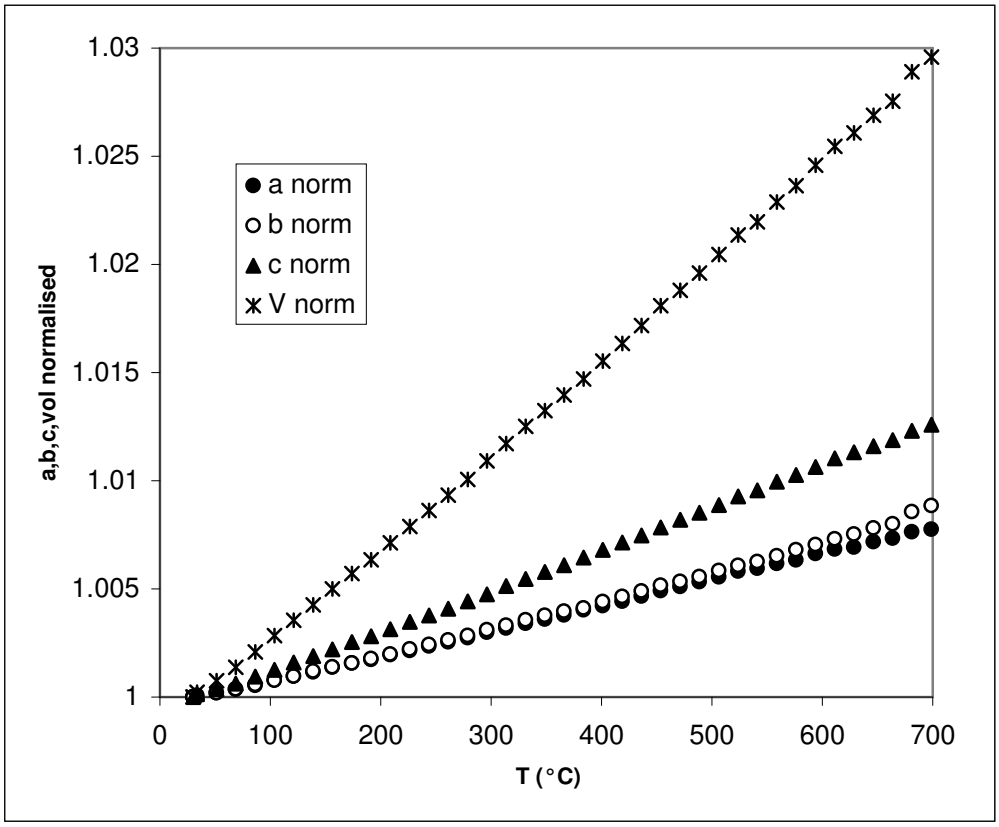

Figure 1 – Thermal expansion for synthetic pure 2M muscovite

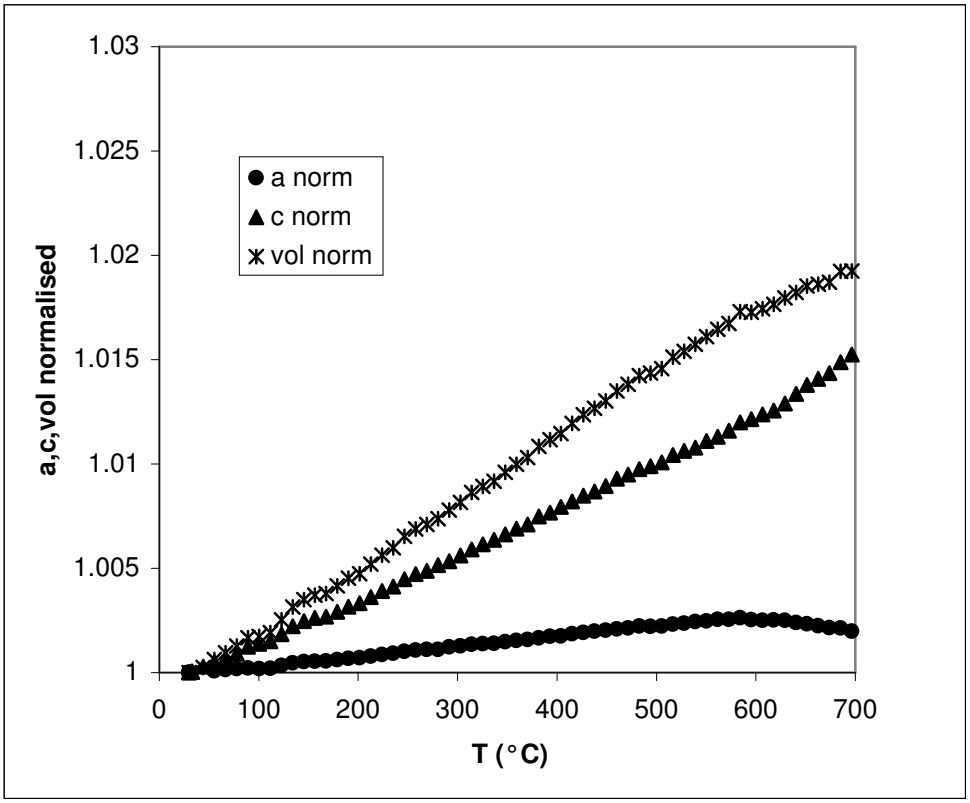

Figure 2 – Thermal expansion for natural 3T phengite

[1] Pavese A., Nadia Curetti, Giovanni Ferraris, Gabriella Ivaldi, Umberto Russo and Richard Ibberson, 2003, Deprotonation and order-disorder reactions as a function of temperature in a phengite 3T (Cima Pal, western Alps) by neutron diffraction and Mössbauer spectroscopy. European Journal of Mineralogy, 15, 357-363.

[2] Pavese A., Ferraris G., Pischedda V., Mezouar M., 1999, Synchrotron powder diffraction study of phengite 3T from the Dora Maira massif: p-V-T equation of state and petrological consequences. Physics and Chemistry of Minerals, 26, 460-467.