ESRF	**Experiment title:** Volume measurements of dioctahedral mica at simultaneously high pressure and temperature	**Experiment number**: CH987
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Shifts: 6	**Local contact(s)**: Wilson Crichton	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Prof. Pier Francesco ZANAZZI Dipartimento di Scienze della Terra, Università di Perugia
Dr. Paola COMODI Dipartimento di Scienze della Terra, Università di Perugia
Dr. Davide LEVY Dip. di Scienze Mineralogiche e Petrologiche, Università di Torino
Dr. Giacomo Diego Gatta Dipartimento di Scienze della Terra, Università di Perugia

Report:

Muscovite (K-mica, Ms) and paragonite (Na-mica, Pg) are common minerals in metamorphic rocks, and are extremely useful as petrogenetic indicators. Between these two end-members, there is a partial solid solution with a slightly asymmetric unmixing solvus. There have been many attempts by petrologists to use the partitioning of Na and K between coexisting Ms and Pg as a geothermometer. However, this quantitative geothermometer is not completely successful, difficulties arising from using solvi that are not accurate enough to model the thermodynamic properties. Inasmuch as the exact shape of the solvus and its changes with pressure and temperature are not well known, thermometric estimates are often inconsistent. The molar volumes of the terms along Ms-Pg join and how they change with pressure and temperature must be exactly known before a more accurate phase diagram can be drawn. Recent studies by Comodi and Zanazzi (1995; 1997) contributed to the knowledge of the molar volumes of muscovite and paragonite and their variation with *P* through compressibility measurements on single crystals in a diamond anvil cell at room temperature. These data, together with thermal expansion coefficients measured at 1 bar (Symmes, 1986; Guggenheim et al., 1987; Catti et al, 1989) allowed to define an approximate equation of state for K- and Na-dioctahedral micas in the *PT* space. However, this only indicates volumetric behaviour at the boundaries of the *P-T* conditions achieved in rocks in the Earth's crust. To determine what really happens to Pg-Ms micas when they form and react in deep-seated geologic environments, it is essential to measuring compressibilities at high temperatures to determine if there are any "non-linear effects" when both *P* and *T* are high.

The powder diffraction measurements on samples of 2M1 polytypes of Ms and Pg were performed at the beamline ID30 of ESRF (Grenoble), by using the Paris-Edinburgh cell (Besson et al., 1992; Mezouar et al., 1996). 2-D diffractograms were collected by using an angle-dispersion set-up by a MAR3450 Imaging Plate and integrated to ordinary diffractograms using the FIT2D program (Hammersley et al., 1996). Temperature was gauged by a CrAl thermocouple, while NaCl was used as pressure internal calibrant, determining the pressure by means of its EOS (Birch, 1986). Measurements were performed along four isotherms between 298 and 873K, in the pressure range 0-6 GPa, with intervals of about 0.7 GPa. Cell

parameters were determined by means of a full profile fitting, available with the GSAS software package (Larson and Von Dreele, 1986), on three phases (mica, NaCl and BN).

The data analysis is still in progress, so we report in Fig.1 and Fig. 2 some preliminary results for paragonite and muscovite. In the figures the cell volumes on different isotherms and at different pressures are reported.

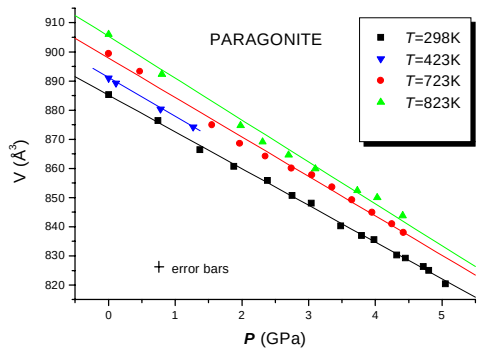

Fig. 1

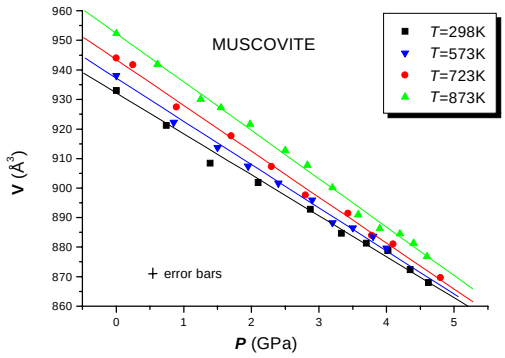

Fig. 2

The bulk moduli of Ms, calculated as the inverse of the linear compressibility coefficient obtained from the least-squares fitting of *V–P* data on each isotherm, were: 68(2), 64(2), 61(2) and 58(2) GPa on the isotherms at 298, 573, 723 and 873 K respectively. The value of $(\partial K_T/\partial T)_P$ was -0.017(1) GPa K^{-1}. The thermal expansion coefficient α varied from 36(3) 10^{-6} K^{-1} at *P* ambient to 20(3) 10^{-6} K^{-1} at *P* = 4 GPa ($(\partial\alpha/\partial P)_T$ = -4.00 10^{-6} $GPa^{-1}K^{-1}$).

The corresponding values for Pg on the isotherms at 298, 423, 723 and 823 K were: bulk moduli 70(1), 67(2), 65(1) and 63(1) GPa, $(\partial K_T/\partial T)_P$ -0.011 (1) GPa K^{-1}. The thermal expansion coefficient α varied from 44(3) 10^{-6} K^{-1} at *P* ambient to 31(3) 10^{-6} K^{-1} at *P* = 4 GPa ($(\partial\alpha/\partial P)_T$ = -3.25 10^{-6} $GPa^{-1}K^{-1}$).

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