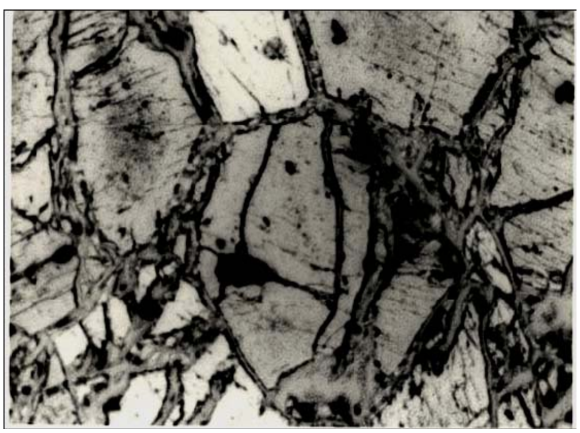
SPECTRSOCOPIC AND HIGH PRESSURE INVESTIGATION ON ANTIGORITE FROM THE ARARKI (L5) CHONDRITE : IMPLICATIONS FOR DETERMINATION OF THE PEAK METAMORPHIC PRESSURE . G. Parthasarathy[1] and Usha Chandra[2], [1]CSIR-National Geophysical Research Institute, Hyderabad- 500007, India (drg.parthasarathy@gmail.com) [2] Department of Physics, University of Rajasthan, Jaipur, 302004. (chandrausha@hotmail.com).

Introduction: Ararki meteorite is known to be the the first meteorite find from India in the sand dunes of Ararki village of Hanumangarh district in the Rajasthan desert of North-West India . The details of the mineralogy and geochemistry have been described elsewhere [1]. In recent years we have been working on the high pressure spectroscopic and mineral physics of meteorites that fell in India, with the motivation of estimating the peak metamorphic conditions and residual stress present in the chondrites [2-3].

Figure-1 shows the thin section photomicrograph of the Ararki meteorite (total with of the photo is 200 micro meter) exhibiting the olivine and serpenttinites channel surrounding the olivine . The dark part in the middle of the olivine grain is a glassy silica representing the shock metamorphism. The EPMA and the spectrocpic studies established that the serpentine mineral is the antigorite. The details of the micro - Raman and Fourier transform infrared (FTIR) spectrometer set up and the uncertainties involved in the wavenumber have beed discussed elsewhere [4-5] .



Results and Discussion : The chemical composition of the antigorite is determined by EPMA and found to be ($(Mg,Fe)_3Si_2O_5(OH)_4$ based on the determined composition Mg=18.2 %,Fe 13.8 %;Si=18.9 %; Ni=0.2%. The hydroxyl or water component is determined independently by Differential thermal analysis and thermogravimetric (DTA/TG) methods.

Powder X-ray diffraction of the sample showed charactertistics strong peaks of peaks of antigorite at 0.728 nm;0.362nm; and 0.252nm.

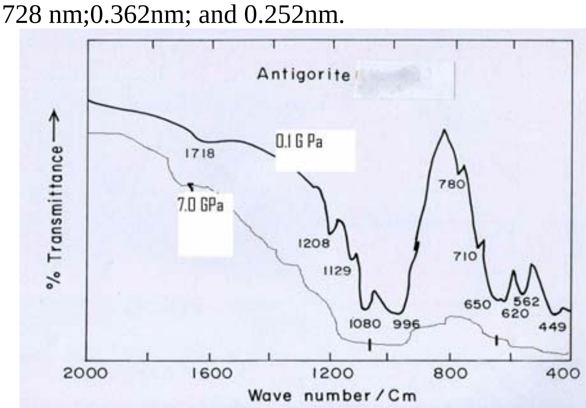


Figure-2 shows FTIR spectra of antigorite at (0.1 MPa) room pressure as well as the pressurized sample (at 7 0 GPa). The room pressure spectra of antigorite is found be in good agreement with the data reported earlier [8]. The stron bands at 1080 and 998 cm^{-1} are assigned to Si-O stretching mode. 440 cm^{-1} band assigned to Si-O-Mg vibration mode. The bands at 620,650 and 710 cm^{-1} are assigned to the OH deformation band and OH-Mg-OH antisymmetric vibration mode (for pure antigorite it occurs at 635 cm^{-1}) [6].The dofrmed vibration mode of SiO_4 and AlO_4 tetrahedra indicates that the present sample is antigorite and not lizardite, which has a similar chemical compostion of antigorite.

The FTIR spectrum of the high pressure antigorite does not show any strong absorption peaks (Fig.2) indicting the amorphous nature of the antigorite sample. The pressure induced amoprphization of serpentine group minerals have been studied by many researchers [7-8 and the references therin]. However this study represents the first investigation on the serpentine extracted from the meteorite samples.

The high pressure diamond anvil cell experiments on the serpentine minerals indicated that the serpentine mineral lizardite transforms to amorphous phase in the pressure range of 6 and 22 GPa. But later studies on pure antigorite by powder XRD and spectroscopic method did not show any amorphous phase up to 25

GPa, at room temperature [7-9]. Pure antigorite dehydrates at 2 and 7 GPa and 600 to 700^0C. But the present study does not show any pressure induced dehydration at room temperature . It is clear from Fig.2 that the pressure induced amorphization of antogorite occurs at much lower pressure 7 GPa. The broadening of the FTIR bands and the similarity with the bands of hydrous silicate galss suggest that the pressure induced order-disorder transition of antigorite. The observed lower value of the transition is almost similar to the earlier studies on Lohawat meteorite [2] and native iron Fe^0 [3], where the non hydrostatic pressure and the internal stress present in the meteorite or impact materials found to be responsible for lowering the transition pressure. The present study provides a new toll for measuring the residual stress present in the planetary materials and also useful in estimating the peak metamorphic pressure experienced by the meteorites.

Further investigations on the in-situ powder XRD is needed to establish the pressure induced amorphization of antigorite unequivocally, are under progress .

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