HIGH PRESSURE TEMPERATURE STUDIES OF PHYLLOSILICATES FROM THE DECCAN TRAP, INDIA: IMPLICATIONS TO MARTIAN MINERALOGY AND NEAR SUBSURAFCE PROCESSES.
G.Parthasarathy[1*] and P.K. Sarkar[2] [1] CSIR- National Geophysical Research Institute, Uppal Road, Hyderabad-500007, India (*drg.parthasarathy@gmail.com)[2] Department of Geology, Fergusson Cllege, Pune, 411004, India.

Introduction: Since the discovery of phyllosilicates by the OMEGA, CRISM, and MRO on the Noachian the Martian surface [1], thermodynamic and thermal phase stability studies on the phyllosilicates attracted much more attention [2,3]. The origin of clay formation can be understood by studying the paragenesis and phase stability clay minerals that occur in areas like Deccan Trap and Columbian River Basalts [3]. Earler studies on the ferrous saponite with a chemical composition [$Na_{0.60}$ $K_{0.40}$ $Ca_{0.47}$] {$Mg_{2.05}Fe_{3.95}$} ($Si_{6.45}Al_{1.55}$) $O_{20}(OH)_4$from the Deccan Trap indicated that ferrous saponite is stable up to 1070-1130 K [4]. In this paper high pressure and temperature studies on ferrous saponite, and nontronite are reported for the first time.High pressure and high temperature investigations on phyllosilicates are relevant to the understading the paragenesis of phyllosilicates on Noachian Mars.

Geological Settings : The samples of ferrous saponite and nontronite were collected from the Deccan Trap, which is one of the most well known volcanic provinces on the earth. The Deccan basalts of this region are 65 Ma and are correlated with the K-P boundary event [4,5]. The chemical composition of the ferrous saponite has been discussed elsewhere[4]. The geological settings ofoccurrence , and chemical composition of the well crystallized nontronite in the Deccan Trap area have been discussed by Sarkar et al. [5].

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Experimental Details: The geochemical analyses were carried out by using powder XRF and EPMA anlyses for chemical compostion of the samples. Three different set of samples were studied to check the uniformity and reproduceability of the compositional data. Structural studies were carried out by using powder X-ray diffraction technique and Fourier transform infrared spectroscopic techniques. The details of the instrumentation and uncertainties involved mesuerements were discussed elsewhere [4,6,7]. High-Pressure-temperature studies have been carried out in an opposed Bridgman anvil cell system [8]. The Bridgman opposed anvil cell system consists of tungsten carbide anvils with a guide ring with the tip diameter of the anvils is 6 mm. The sample is embedded in solid pressure transmitting medium, surrounding with pyrophyllite gaskets. We used internal pressure standard of high-purity bismuth, which exhibit three pressure induced solid-solid phase transitions at 2.5, 2.7 and 7.4 GPa respectively. The high-pressure cell was also calibrated by studying the electrical resistivity of manganin (in the pressure range up to 2.5 G Pa), pressure-induced phase transitions in bismuth, thallium and tellurium [8]. The typical uncertainty involved in the pressure measurements is 5 %.

Results and Discussions : Powder XRD and EPMA analyses confirmed that our studies samples are 99.9 % pure nontronite sample. Figure.1 shows the DTA/TG traces of the nontronite samples (Sample A and B) from different locations of the Deccan Trap .

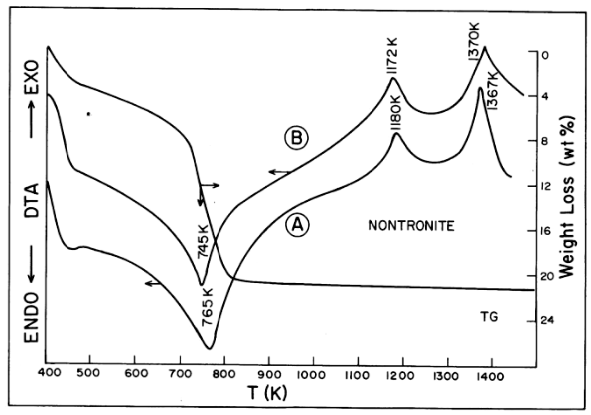

Fig.1 DTA/TG traces of Nontronite

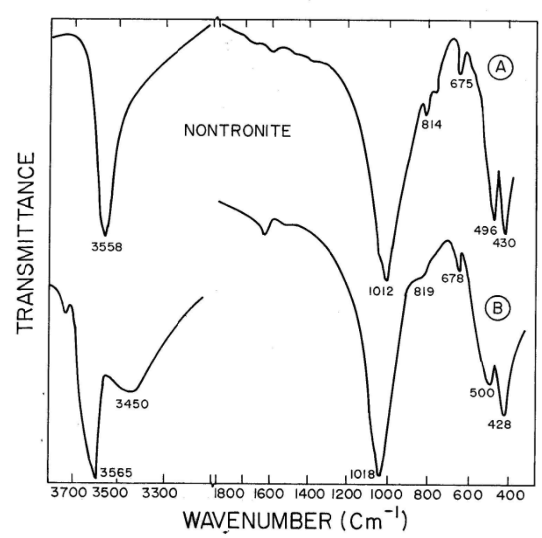

Figure-2 FTIR spectroscopy of Nontronite

Figure.2 shows the FTIR spectra of the nontronite samples at room pressure conditions. Both the FTIR and thermal studies confirmed the presence of hydrous component about 20 wt %. The FTIR spectral data obtained for the Deccan trap are found to be in good agreement with the data obtained for the pure synthetic nontronite [9,10].

High-pressure phase stability of phyllosilicates. Our high pressure experiments on the ferrous saponite and nontronite samples from the Deccan Trap showed that the samples treated at 8 GPa were found be almost amorphous with a broad XRD peak centered at 1.52 nm for nontronite and at 1.54 nm peak for saponite. The hydrous content on the pressurized samples were found to be almost 20 % of the starting materials. Our studies support the earlier suggestions made by Gavin and Chevrier [2] that phyllosilicates were not formed post impact on the Noachian Martian surface.Our high pressure and high temperature studies on the phyllosilicates from the Deccan trap suggest a transformation of phyllosilicates from a crystalline phase to amorphous or glassy nature by meteorite impact. High pressure and temperature studies on the saponite and nontronite suggest a pressure induced partial dehydration of the phyllosilicates during the impact process.

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