

**RAMAN INVESTIGATION ON PIGEONITE IN UREILITE.** D. Bersani<sup>1</sup>, L. Mantovani<sup>2</sup>, M. Tribaudino<sup>2</sup> and P. P. Lottici<sup>1</sup>, <sup>1</sup> Dipartimento di Fisica, Viale Usberti 7/A, 43100 Parma, Italy, e-mail: [danilo.bersani@unipr.it](mailto:danilo.bersani@unipr.it), <sup>2</sup> Dipartimento di Scienze della Terra, Viale Usberti 157/A, 43100 Parma, Italy

**Introduction:** The family of ureilites is one of the most studied among achondrites. Ureilites are mainly composed by a mineral assemblage of pyroxene and olivine [1], [2]. Both ortho and clinopyroxenes are present, and clinopyroxenes are mostly pigeonite. Pigeonites have a potential in unraveling the thermal history of the parent body: their composition, TEM microtextures and single crystal site partitioning are therefore widely studied [3], [4], [5]. On the other hand, the potential of spectroscopic methods was little exploited. Raman spectroscopy provides a non-destructive method of investigation, which can be used for on site studies, as well as for laboratory investigations [6]. The Raman technique was used in ureilites to test the presence of diamond [7]: important information are expected also from the study of silicates.

The relation between composition and Raman spectra in pyroxenes was studied in [8] and [9], but very few data were collected in the pigeonite field; recently it was also shown that, as an effect of the  $P2_1/c$  to  $C2/c$  phase transition, the relation between Raman peak positions and composition does not follow the same trend in pigeonite as in other clinopyroxenes [10]. Therefore for pigeonite a specific calibration is required. Moreover, the analysis of the peak-width can provide further information on the sample microtextures, preliminary to TEM analysis.

First results on the Raman spectra of pigeonite in three ureilites are here reported and compared with those obtained on natural and synthetic samples with different iron content.

**Results:** Raman spectra of pigeonite in three ureilites (Y791538, ALHA77257 and RKPA80239, Wo respectively 9.4, 6.4 and 6.4,  $mg = 91.2$ ,  $86.3$  and  $84.3$  [4]), in an iron free synthetic pigeonite sample ( $Di_{15}En_{85}$ , Wo7.5 and  $mg = 100$  [11]) and in the volcanic iron richer sample BTS308 (Wo10 and  $mg = 52$  [12]) were collected (Fig. 1). Peak fitting was done via Lorentzian profile functions, and related with composition. The spectra of pigeonites from ureilites are quite similar to the iron free synthetic one, and can be distinguished from Fe richer BTS308 by the two peaks of similar intensity at  $670\text{ cm}^{-1}$ , nearly unresolved for Fe richer pigeonite. The wavenumber of the main peaks changes linearly with  $mg$  (Fig. 2), whereas, due to the small difference in Ca content, no correlation is found with Wo.

Peak-width increases according to  $Di_{15} < ALHA77257 \approx RKPA80239 < Y791538 < BTS308$ . The

result can be related to previous TEM observations: in samples BTS308 and Y791538, few nanometer sized antiphase domains were observed together with mottled textures, indicating compositional heterogeneity. In ALHA77257 and RKPA80239, even if antiphase domains are larger, stacking disorder is present. The synthetic sample  $Di_{15}En_{85}$  is homogeneous.

**Conclusions:** Preliminary results have shown the potential of Raman spectroscopy as a non destructive compositional probe of microstructures in pigeonite. Further studies in ureilic pigeonite are in progress to better define the relationships between composition and peak position and between linewidth and microstructures.

**References:** [1] Berkley J.L. *et al.* (1980) *GCA*, 44, 1579. [2] Goodrich C.A. *et al.* (1987) *GCA*, 51, 2255. [3] Goodrich C.A. *et al.* (2001) *GCA*, 65, 621. [4] Tribaudino M. (2006) *Meteoritics & Planet. Sci.*, 41, 979. [5] Michouki *et al.* (2010) *Meteoritics & Planet. Sci.*, 45, A145. [6] Wang A. *et al.* (2004) *JRS*, 35, 504. [7] Ferroir T. *et al.*, (2010) *EPSL*, 290, 150. [8] Huang E. *et al.* (2010) *Am. Min.*, 85, 473. [9] Wang A. *et al.* (2001) *Am. Min.*, 86, 790. [10] Mantovani L. *et al.* (2010) *89th SIMP meeting*, 262. [11] Pasqual D. *et al.* (2000) *Am. Min.*, 85, 953. [12] Tribaudino M. *et al.* (2002) *Am. Min.*, 87, 648.

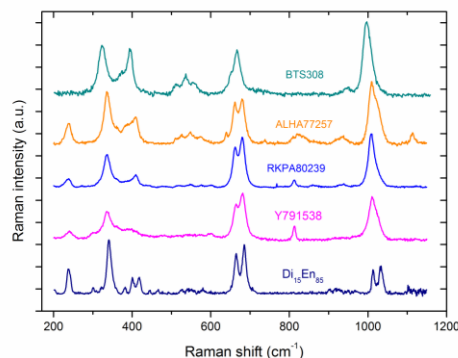


Fig. 1 Raman spectra of the pigeonite samples

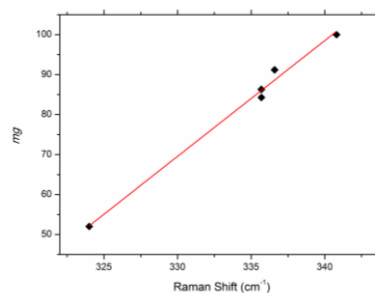


Fig. 2. Raman shift vs  $mg$  for the peak at  $330\text{ cm}^{-1}$ .