MICRO–RAMAN SPECTROSCOPY OF DIAMONDS FROM JaH 054 AND SAHARA 98505 UREILITES, STATISTIC RESEARCH. A. Karczemska [1], T. Jakubowski [2], M. Kozanecki [3], M. Szurgot [4], A. […] Lodz, Poland; [4] Technical University of Lodz, Center of Mathematics and Physics, Politechniki 11, Lodz Poland; [5] Max Planck Institute for Chemistry, Department of Geochemistry, Mainz, Germany, Joh.-J.-Becherweg 27, D-55128;

Introduction: Ureilites are ultramafic, coarse grained primitive achondrites. They are mainly composed of olivine and pigeonite [1]. They are also known to contain carbon, represented by graphite, diamond, amorphous carbon and carbide. Other accessory phases are iron and sulfide. When present, the carbon usually fills the spaces between olivine and pyroxene minerals, but it also sometimes occurs inside them. Diamonds are usually 1 – 10 µm size. The origin of diamonds in this enigmatic group is well discussed by various authors, and has been explained in various ways including the theory of metamorphic transformation of graphite during impact, as well as the theory that they formed through a process of chemical vapor deposition (CVD) in the solar nebula [2-6].

Experiments: We examined polished slices of two ureilites: JaH 054 and Sahara 98505. The choice of these ureilites was based on preliminary investigations which shown that they posses relatively high diamond content [3]. The samples used were re-polished with non-diamond powder.

Record of Raman spectra was done on a confocal Raman micro-spectrometer T-64000 (Jobin-Yvon) equipped with the BX-40 microscope (Olympus). The 514.5 nm Ar line was used for sample excitation. Acquisition time and laser power were adjusted to obtain spectra of sufficient quality. The laser beam diameter was 1.5 µm, and the light intensity across the beam was of Gaussian distribution.

Results: Our analysis is based on 43 different diamond Raman peaks from JaH 054 and on 27 peaks from Sahara 98505. Typical diamond and graphite peaks for both ureilites are shown on Figure 1.

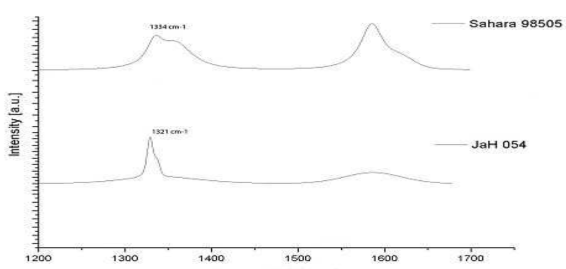

Figure 1. Examples of Raman spectra of Sahara 98505 and JaH 054.

The results indicate that diamonds Raman shifts were between 1322,81 cm^{-1} and 1334,03 cm^{-1} in JaH 054, and from 1329,13 cm^{-1} to 1334,58 cm^{-1} in Sahara 98505 (Fig. 2). A wide spread of FWHM (full width at half maximum) parameters were also seen, from 0,75 cm^{-1} to 13,37 cm^{-1} in JaH 054, and 5,02 cm^{-1} to 37,65 cm^{-1} in Sahara 98505 (Fig. 3).

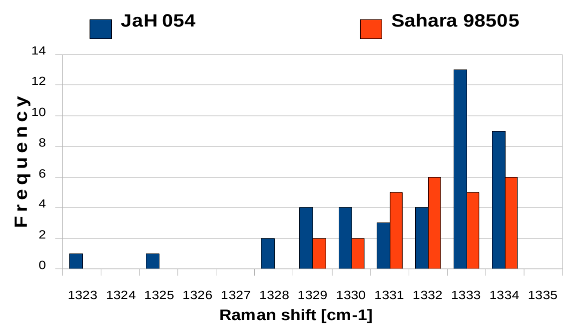

Figure 2. Distribution of the diamond Raman peak position in JaH 054 and in Sahara 98505 ureilites.

JaH 054 shows a relatively narrow FWHM range of diamond peaks in comparison to Sahara 98505 (the mean value of FWHM for JaH 054 is 6,53 cm^{-1} and mean value of FWHM for Sahara 98505 is 18,12 cm^{-1}).

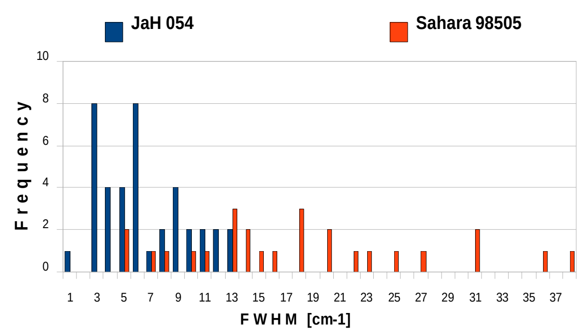

Figure 3. Distribution of the diamond Raman peak FWHM of JaH 054 and Sahara 98505 ureilites.

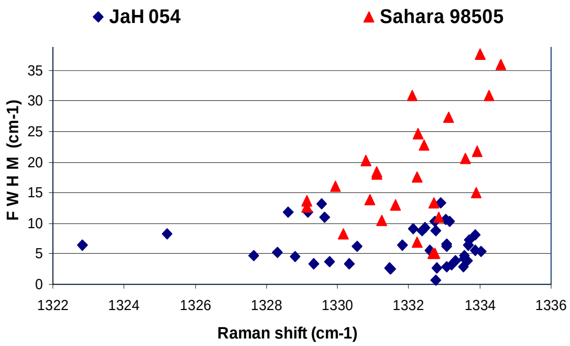

Figure 4. Plot of the diamond Raman peak position versus FWHM of JaH 054 and Sahara 98505 ureilites

The FWHM of the diamond peak against the Raman shift of diamond band shows some degree of correlation (Fig. 4). The mean values of diamond Raman shifts for both samples are similar, 1331,64 cm^{-1} for JaH 054 and 1332,1 cm^{-1} for Sahara 98505.

Conclusions: Our research of two ureilites JaH 054 and Sahara 98505, based on micro-Raman spectroscopy, proves the occurrence of different kinds of diamonds in both samples.

Various Raman shifts show the significant diamonds differences occurring both, inside one and the same sample and among the samples. The Raman peak positions in some cases are shifted towards smaller wavenumbers, this could indicate the presence of lonsdaleite. Interesting is that some peaks are shifted toward higher wavenumbers: 1334 cm^{-1}, even to 1335 cm^{-1} for Sahara 98505.

The diamond peaks most often coexist with graphite phases, but sometimes only diamond peaks are observed. This could be explained by the bigger size of diamonds in comparison to the area being sampled by the laser, or the graphite phase simply does not exist around these diamonds.

In few cases the diamond peak is broad and consits of two merged maxima. The different groups ofdiamonds (potentially different polytypes) sometimes coexist together. FWHM of diamonds synthesized by CVD process range from 3 cm^{-1} to 25 cm^{-1} [2-4]. The FWHM values of JaH 054 diamonds are similar to FWHM of CVD diamonds and differ significantly in comparison to shock-produced diamonds, what agrees well with the results by Miyamoto and coworkers [2-4]. However, FWHM of diamond Raman peaks of Sahara 98505 ranges from 5,02 cm^{-1} to 37,65 cm^{-1} which is much broader range than that exhibited in ureilites studied by Miyamoto group.

We hope that ureilitic diamonds will help in understanding of the origin of extraterrestrial diamonds.

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