INVESTIGATIONS OF CARBON PHASES IN CANYON DIABLO METEORITE.

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Introduction: Canyon Diablo is IAB iron meteorite found around Meteor Crater in Arizona ,USA. Thousands of pieces were collected in the surrounding area close to the crater and on crater rim. In 1891 [1], diamonds were discovered in Canyon Diablo. During the last hundred years, diamonds and the other allotropic forms of carbon have been detected in many other meteorites [2]. In this work, the main focus is on the carbon phases found in the Canyon Diablo meteorite.

Methods: The X-ray diffraction studies were made using Empyrean diffractometer (PANalytical), working in grazing incidence (GIXRD) mode with Co kα (1.78901Å) radiation. The incidence angle was set to 1°.

Raman images were acquired with WITec Raman Spectrometer alpha 300RSA+ model with Olympus microscope, coupled with an UHTS spectrometer and a Newton – CCD camera. The doubled SH6 of the Nd:YAG laser beam wavelength was 532 nm.

Micro-Spectrofluorometric studies were performed using a FLS 980 fluorescence spectrometer (Edinburgh Instruments Ltd.) combined with an inverted optical microscope (Olympus). Both excitation and emission spectra were collected.

Results: The registered XRD spectra appears to be complicated with many overlapping peaks originating from different phases present in the analyzed sample. The analysis is further complicated since the investigated sample may present strong texture and anisotropy. Among the registered peaks we identified these characteristic for phases based on iron and nickel (FeNi ICDD Ref. 01-081-8231, Fe ICDD Ref. 04-014-0360), troilite (FeS ICDD Ref. 01-071-4468), cohenite (Fe_3C ICDD Ref. 00-034-0001) and isovite ($Cr_{23}C_6$ ICDD Ref. 04-007-8810). Peaks originating from carbon also appeared in the spectra. The analysis of available ICDD patterns led to conclusion that most probably carbon present in the sample corresponded to a defective diamond structure which is a metastable state between the FCC and diamond structure (ICDD Ref. 00-060-0053) also reported by [3].

There is a deep difficulty to discuss Raman results of carbon investigations in meteorites. On the one hand, many forms of carbon have similar Raman spectra, and. in meteorites, it is possible to find many kinds of carbon with different levels of order all in one sample. On the other hand, it is possible to sometimes detect „strange peaks" in meteorites. In this investigations, there are several Raman peaks that still remain unclear. The most important peaks present in many places of the sample are: 1340 cm^{-1},1388 cm^{-1}, 1428 cm^{-1}, 1450 cm^{-1}, 1487 cm^{-1} and 1526 cm^{-1}. There is no clear evidence of diamond in the Raman spectra. In the place where diamond was detected by micro-spectrofluorimetric studies, it fluoresced strongly but no peaks were observed by Raman spectroscopy. However, in a few places in the Raman map there are small peaks about 1338 cm^{-1} which could be attributed to "shifted" diamond and would agree with the XRD results that identifies a defective diamond.

Emission spectra recorded for excitation wavelength 355 nm exhibit characteristic for diamond fluorescence with maximum at 420-435 nm. Micro-spectrofluorimetric studies showed unequivocally that this emission relates only for carbonaceous phases.

Conclusions: X-ray diffraction, Raman mapping and micro-spectrofluorimetric studies have been used in investigations of carbon in Canyon Diablo meteorite. Results show the presence of defected diamond and not well recognized carbon phases (unclear Raman peaks). Further investigations which will systematize the meteoritic carbon research are needed.

References:

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