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Raman Spectroscopy of Fossil-like Feature in Sooke #1 from Vancouver Island

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Abstract : The first geochemical, petrological, X-ray diffraction, Raman, Mössbauer, and oxygen isotopic analyses of very intriguing 13-kg Sooke #1 stone covered in 70% of its surface with black fusion crust, found in and recovered from Sooke Basin, near Juan de Fuca Strait, in British Columbia, were reported as poster #2775 at LPSC52 in March. Our further analyses reported in poster #6305 at 84AMMS in August and comparisons with the Mössbauer spectra of Martian meteorite MIL03346 and Martian rocks in Gusev Crater reported by Morris et al. suggest that Sooke #1 find could be a stony achondrite of Martian polymict breccia type ejected from early watery Mars. Here, the Raman spectra of a carbon-rich ~1-mm² fossil-like white area identified in this rock on a surface of polished cut have been examined in more detail. The low-intensity 532 nm and 633 nm beams of the InviaRenishaw microscope were used to avoid any destructive effects. The beam was focused through the microscope objective to a 2 □m spot on a sample, and backscattered light collected through this objective was recorded with CCD detector. Raman spectra of dark areas outside fossil have shown bands of clinopyroxene at 320, 660, and 1020 cm-1 and small peaks of forsteritic olivine at 820-840 cm-1, in agreement with results of X-ray diffraction and Mössbauer analyses. Raman spectra of the white area showed the broad band D at ~1310 cm-1 consisting of main mode A1g at 1305 cm^{-1}, E2g mode at 1245 cm^{-1}, and E1g mode at 1355 cm^{-1} due to stretching diamond-like sp3 bonds in diamond polytype lonsdaleite, as in Ovsyuk et al. study. The band near 1600 cm-1 mostly consists of D2 band at 1620 cm-1 and not of the narrower G band at 1583 cm^{-1} due to E2g stretching in planar sp2 bonds that are fundamental building blocks of carbon allotropes graphite and graphene. In addition, the broad second-order Raman bands were observed with 532 nm beam at 2150, ~2340, ~2500, 2650, 2800, 2970, 3140, and ~3300 cm^{-1} shifts. Second-order bands in diamond and other carbon structures are ascribed to the combinations of bands observed in the first-order region: here 2650 cm^{-1} as 2D, 2970 cm^{-1} as D+G, and 3140 cm^{-1} as 2G ones. Nanodiamonds are abundant in the Universe, found in meteorites, interplanetary dust particles, comets, and carbon-rich stars. The diamonds in meteorites are presently intensely investigated using Raman spectroscopy. Such particles can be formed by CVD process and during major impact shocks at ~1000-2300 K and ~30-40 GPa. It cannot be excluded that the fossil discovered in Sooke #1 could be a remnant of an alien carbon organism that transformed under shock impact to nanodiamonds. We trust that for the benefit of research in astro-bio-geology of meteorites, asteroids, Martian rocks, and soil, this find deserves further, more thorough investigations. If possible, the Raman SHERLOCK spectrometer operating on the Perseverance Rover should also search for such objects in the Martian rocks.

Keywords : achondrite, nanodiamonds, lonsdaleite, raman spectra
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