

**SPECTROSCOPIC INVESTIGATION OF UNGROUPED CARBONACEOUS CHONDRITES.**

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**Introduction:** Carbonaceous (C) chondrites are the most primitive meteorite samples of our solar system. They retain records of their origin, formation mechanisms, evolution and secondary processes. This makes them excellent samples for studies to better understand and shed light on the early history of the solar system. A small fraction of C chondrites is type 2 ungrouped (C2-ung) chondrites. These meteorites could not be easily classified into one of the well-established groups due to compositional/petrological differences and other anomalies [1]. Different starting materials and/or complex post-accretionary processes in their parent bodies may have caused their anomalous compositional properties. As such, chemical characterization of C2-ung chondrites can potentially enable us to differentiate between processes and shed light onto the cosmochemical processes/events that cause such incompatibilities. In this work, we present detailed spectroscopic and imaging data on multiple C2-ung chondrites and compare them with various members of well-established C chondrite groups.

**Samples:** This work considers several C2-ung chondrites (QUE 99038, EET 83226, Tarda, and Tagish Lake) as well as a few C chondrites from the well-established groups (such as Aguas Zarcas, Jbilet Winselwan, Allende). Meteorites were prepared as polished sections for the investigations. For meteorites with sufficient amounts, a portion was ground into fine powder using an agate mortar and pestle set to allow further investigations. KBr pellets were made by mixing the powdered samples with pure KBr.

**Techniques:** A Zeiss EVO-LS10 scanning electron microscope (SEM) and a back scattered electron (BSE) detector were used to collect BSE images of the samples. Raman spectra were collected using a WITec alpha300R imaging system equipped with a 600 g/mm grating, 532 nm Nd:YAG laser, and a 50× objective. Fourier transform infrared (FTIR) transmission and thermogravimetric (TGA) spectra were collected for samples with sufficient amounts. FTIR spectra were collected under vacuum using a Nicolet 6700 (Thermo Scientific) FTIR system. Thermogravimetric data were collected using a Q500 (TA Instruments) thermal analyzer between 25 °C to 950 °C at a continuous heating rate of 10 °C/min and in a nitrogen gas atmosphere flowing at 60 mL/min.

**Results:** BSE images of QUE 99038 show very fine-grained matrix with abundant organic matter. Fine-grained rims around chondrules are absent in QUE 99038 and Tarda, however most chondrules in EET 83226 contain fine-grained rims. Raman spectra of QUE 99038 present the first order D and G, as well as the second order carbon bands. EET 83226, Tarda, and Tagish Lake lack the second order bands. Investigation of carbon band parameters suggests the thermal metamorphic history of QUE 99038 is quite different than the rest of these C2-ung chondrites. It plots in close proximity to CV3 chondrites [2]. EET 83226 is intermediate between CM and CO chondrites on the basis of its carbon band parameters. Tarda and Tagish Lake are consistent with being thermally metamorphosed at a lesser extent as they plot within other primitive C chondrites. Furthermore, the TGA mass loss spectrum of Tarda indicates a total mass loss of ~18.25 wt.%, of which 9.45 wt.% is due to dehydration of phyllosilicates and 3.20 wt.% is due to decomposition of carbonates. The FTIR spectrum of Tarda presents a broad and prominent 3 μm OH band as well as a sharp accompanying feature at 3680 cm<sup>-1</sup> due to structural OH. Water decomposition percentages of Tarda and Tagish Lake are very similar [3].

**References:**

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