SESSION 3

Water and Organics in Small Bodies

DAY 2 – Feb.14, 2017
8:30 am – 11:00 am

Big individuals or big collections of small inclusions — two approaches to looking for organic matter in meteorites.

ZAN PEETERS, KOTA NAITO, SILVER HSIAO, TYPHOON LEE

nanoSIMS lab, Academia Sinica Institute for Astronomy and Astrophysics, Taipei, Taiwan
(zan@asiaa.sinica.edu.tw)

Meteoritic organic matter has in the past been extensively studied in its extracted form. After dissolving away the surrounding meteoritic material (metals, silicates, sulfides) in strong acids, the insoluble organic matter (IOM) can be extracted. This was used to measure the elemental and isotopic composition, chemical information, and the degree of alteration of the IOM. The results, however, can only describe the bulk average of the IOM. By extracting the IOM, all spatial information and any sign of heterogeneity within the meteorite is lost.

In our experiments, we focus on measuring the composition of meteoritic OM in situ, without destroying the surrounding matrix. We have used our nanoSIMS (nanometer-scale secondary-ion mass spectrometer) to map the carbon and nitrogen content of a large area (typically 300 x 600 μm) of Murchison (CM2), QUE 99177 (CR3), GRA 95229 (CR2), and SaU 290 (CH3) meteorites. Meteoritic OM usually occurs as a fine-grained, sub-μm material dispersed within the matrix. We found, however, that it can also occur as large (up to 10 μm) veins of pure organic matter. We used a range of analytical tools (FIB, TEM, XANES, and again nanoSIMS) to investigate the morphology, elemental, chemical, and isotopic compositions of the these veins.

In parallel with the search for large veins, we developed a technique to automatically detect all carbon-rich inclusion in the large number of nanoSIMS images (~250 per map) that were collected for the four meteorites. The output from the automated detection (coordinates, counts, area, ellipticity, etc. of each detected inclusion, 1,000–10,000 inclusions per meteorite) was post-processed to perform statistical analysis.

The results show that there is a lot of heterogeneity amongst the various inclusions within one meteorite and distinct trends in various properties of the organic inclusions between meteorites from different classes.