**COORDINATED TEM, NANOSIMS, AND TOF-SIMS ANALYSES OF CARBONACEOUS PHASES IN IDPs**

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**Introduction:** We have investigated two chondritic IDPs using TEM coupled with EELS, NanoSIMS, and TOF-SIMS. Particle Nayeli is hydrated, and particle Chocha is anhydrous and porous. We first mapped the particles with EELS to find carbonaceous areas. We identified 5 types of morphologies of the C by bright field imaging: globular, vesicular, smooth, dirty, and solid with bubbles [1]. We then used combined monochromated low-loss and core-loss EELS to determine the bonding of the carbon in each of these morphologies. We measured the N and H isotopic compositions of the different morphologies in Chocha using NanoSIMS. Finally we looked for the nature of the molecules carrying the C using TOF-SIMS.

**TEM and EELS:** We found abundant carbon in Nayeli and Chocha. Nayeli has very discreet carbonaceous areas whose morphologies are globular [2] and smooth [1]. Chocha is >95% made of carbon and the 5 kinds of morphologies were found. The morphologies were examined with low- and core-loss spectroscopy. The globules in Chocha show a strong, broad low-loss ~6 eV (equivalent to ~ 200 nm UV) peak consistent with PAHs and a strong C=C feature (perhaps aromatic) at ~283 eV and a weak ~288 eV feature sometimes associated with -COOH side chain functionality on (poly)aromatic chromophores [3].

**NanoSIMS**: Chocha was found to have bulk $\delta^{15}N$=272±7‰ and δD=470±24‰. The isotopic compositions were spatially variable ranging from $\delta^{15}N$=240 to 970‰ and δD=-200 to 1,000‰. The H isotopic composition was clearly distinct between the vesicular C (δD=1,000‰.) and solid with bubbles C (δD=-200‰), suggesting that they formed through different processes.

**TOF-SIMS:** $CN^-$ was detected, but only very little $C_2H_3^+$ was present in Chocha. The presence of $CN^-$ suggests that N is associated with a carbonaceous, probably organic, phase. The almost absent $C_2H_3^+$, usually a major hydrocarbon peak in TOF-SIMS, shows that the molecule is not an aliphatic compound. A very low PAH signal was also observed (close to the detection limit) confirming the low-loss EELS results.

**Conclusions:** Our results show that some of the C-carriers in these particles are PAHs containing C bonded to N. The different morphologies have distinct isotopic compositions suggesting that they were formed before they aggregated into the parent body, perhaps in different regions of the Solar System. The anomalous materials likely formed at very low temperatures, either in a presolar cold molecular cloud or in very cold regions of the Solar System before they aggregated into the parent body [2].

**References:** [1] Matrajt G. 2010. Abstract #1564. 41st Lunar & Planetary Science Conference. [2] Nakamura-Messenger et al. (2006) Science 314, 1439. [3] Wirick S. 2009. Abstract #1340. 40th Lunar & Planetary Science Conference.