**METEORITE MODELS OF ASTROCHEMISTRY AND ASTROBIOLOGY. 2. SOLUBLE CARBON AND ELECTROLYTES IN CARBONACEOUS CHONDRITES.** Michael N. Mautner, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284. (mmautner@vcu.edu)

**Introduction:** Soluble materials in carbonaceous chondrites reflect formation processes in the parent objects, may contribute to early life, and offer future space resources. [1,2] In these respects, the total and soluble C and N and soluble electrolytes were analyzed in carbonaceous chondrite meteorites.

**Experimental Methods:** The meteorites, grinded to 2 – 40 micron particle size, were extracted in deionized water at 20 C for 4 days. C and N in the powders were analyzed with a Europa isotope mass spectrometer, and the extracts analyzed by ion-exchange chromatography.

**Results and Discussion:** The soluble cation concentrations vary generally as $Na^+$, $Ca^{2+}$, $Mg^{2+}$ >> $NH_4^+$, $K^+$ and the anions as $SO_4^{2-}$, $Cl^-$ >> $NO_3^-$ > $PO_4^{3-}$. Among various meteorites, the electrolyte contents vary in the order CM2 > CR2 > CV3, CO3 > CK4, CK5. The total C is comparable, but soluble C varies significantly, among CM2 meteorites, and similarly for CV3 meteorites. The total C varies in parallel with soluble salt contents, consistent with the origins of both C and water from captured volatiles.

The data allow modeling solutions in meteorite/asteroid pores, suggesting high concentrations of organic C (up to 4 mol/L) and electrolytes (up to 8 mol/L total ions) (Table 2).

**Implications for Astrobiology and Space Resources:** Asteroid/meteorite interiors could form concentrated solutions, suitable for complex prebiotic chemistry and for sustaining early microorganisms. As potential in-situ space resources, the soluble nutrients C, N, P, K, quantify the biomass that carbonaceous chondrite soils can support.

**References:** [1] Mautner M. N., et al. (1995) *Planet. Space. Sci.*, *43,* 139-148. [2] Mautner, M. N. (2002) *Icarus, 158,* 72-86.

**Table 1. Water-soluble contents in carbonaceous chondrites (g element/kg solid)**

| | | C | N | $Na^+$ | $K^+$ | $Mg^{2+}$ | $Ca^{2+}$ | $NH_4^+$ | Nitrate-N | Phosphate-P | Sulfate-S | $Cl^-$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Murchison** | **CM2** | 4.8 | 0.15 | 2.17 | 0.24 | 2.57 | 2.93 | 0.30 | 0.008 | 0.0010 | 6.09 | 0.35 |
| **ALH 83102** | **CM2** | 0.3 | 0.03 | 5.03 | 0.24 | 2.75 | 3.47 | 0.29 | 0.003 | 0.0012 | 8.07 | 0.33 |
| **GRA 95229** | **CR2** | 1.8 | 0.26 | 1.43 | 0.13 | 0.79 | 0.59 | 0.19 | 0.008 | 0.0005 | 2.06 | 0.16 |
| **Allende** | **CV3** | 1.0 | 0.12 | 0.07 | 0.03 | 0.10 | 0.08 | 0.04 | 0.004 | 0.0030 | 0.18 | 0.09 |
| **ALH 84028** | **CV3** | 0.0 | 0.03 | 0.22 | 0.01 | 0.18 | 0.12 | 0.02 | 0.017 | 0.0010 | 0.29 | 0.08 |
| **ALH 83108** | **CO3** | 0.8 | 0.04 | 0.31 | 0.02 | 0.09 | 0.13 | 0.03 | 0.044 | 0.0007 | 0.29 | 0.16 |
| **ALH 85002** | **CK4** | 0.2 | 0.05 | 0.05 | 0.004 | 0.18 | 0.13 | 0.01 | 0.046 | 0.0014 | 0.37 | 0.07 |
| **EET 92002** | **CK5** | 0.0 | 0.10 | 0.08 | 0.008 | 0.16 | 0.20 | 0.01 | 0.006 | 0.0012 | 0.49 | 0.04 |

**Table 2. Carbon and electrolyte concentrations in asteroid/meteorite pore solutions (mol/L) calculated from Table 1 for 0.084 kg pore water/kg meteorite solids**

| | | C | N | $Na^+$ | $K^+$ | $Mg^{2+}$ | $Ca^{2+}$ | $NH_4^+$ | Nitrate-N | Phosphate-P | Sulfate-S | $Cl^-$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Murchison** | **CM2** | 4.7 | 0.13 | 1.12 | 0.074 | 1.26 | 0.87 | 0.19 | 0.007 | 0.0004 | 2.26 | 0.118 |
| **ALH 83102** | **CM2** | 0.3 | 0.03 | 2.60 | 0.073 | 1.35 | 1.03 | 0.19 | 0.003 | 0.0005 | 3.00 | 0.111 |
| **GRA 95229** | **CR2** | 1.8 | 0.22 | 0.74 | 0.040 | 0.38 | 0.18 | 0.13 | 0.007 | 0.0002 | 0.77 | 0.055 |
| **Allende** | **CV3** | 1.0 | 0.11 | 0.04 | 0.008 | 0.05 | 0.03 | 0.03 | 0.003 | 0.0011 | 0.07 | 0.029 |
| **ALH 84028** | **CV3** | 0.0 | 0.03 | 0.11 | 0.003 | 0.09 | 0.04 | 0.01 | 0.014 | 0.0004 | 0.11 | 0.028 |
| **ALH 83108** | **CO3** | 0.8 | 0.03 | 0.16 | 0.005 | 0.05 | 0.04 | 0.02 | 0.037 | 0.0003 | 0.11 | 0.052 |
| **ALH 85002** | **CK4** | 0.2 | 0.01 | 0.02 | 0.001 | 0.09 | 0.04 | 0.01 | 0.039 | 0.0005 | 0.14 | 0.025 |
| **EET 92002** | **CK5** | 0.0 | 0.08 | 0.04 | 0.002 | 0.08 | 0.06 | 0.01 | 0.005 | 0.0005 | 0.18 | 0.012 |