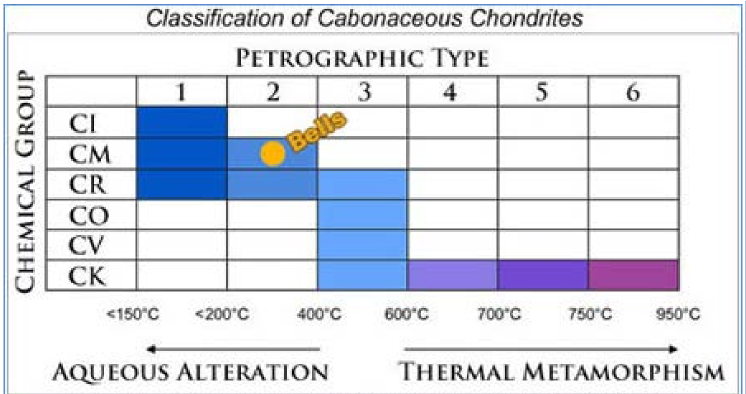
PLANETARY SCIENCE RESEARCH DISCOVERIES

CosmoSparks

Quick Views of Big Advances

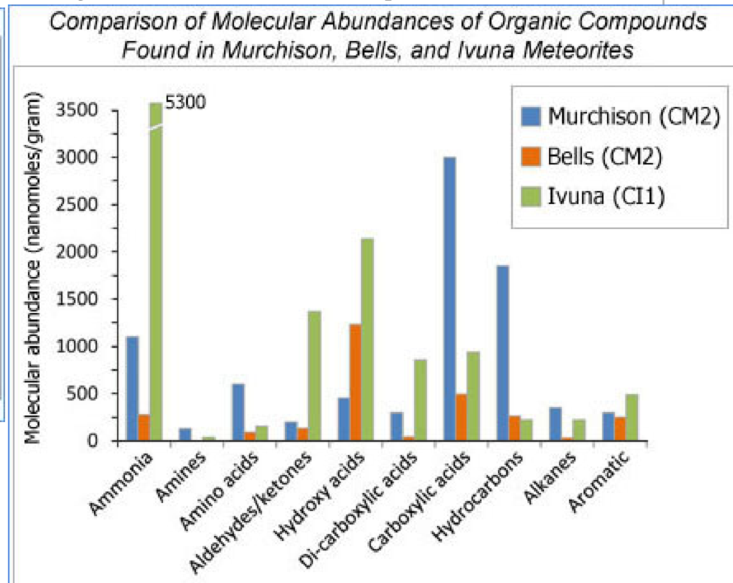
Soluble Organics of the Bells Meteorite

Researchers working on the chemistry of life's origins have, for decades, looked at the assortment of organic compounds contained in carbonaceous chondrite meteorites. Comparative studies between aqueously-altered CM and CI meteorites of petrographic types 1 and 2 (see figure below) are helping to tease out aspects of the environmental conditions and processes on the asteroidal parent bodies that affected the development of the prebiotic organics in these abundant samples.



(Adapted from Sephton, M. A. (2002) *Nat. Prod. Rep.*, v. 19, p. 292-311. doi: 10.1039/b103775g)

Above: Carbonaceous chondrites are classified by their bulk chemical composition (CI, CM, CR, etc.) and by the amount of aqueous alteration (types 1 and 2) or heating without much water (3–6). Boxes are colored to signify which categories have been seen. Darker blue colors=more aqueous alteration; redder colors=increased thermal metamorphism. Bells is a CM2. Right: Molecular abundances of organic compounds in Murchison, Bells, and Ivuna.



(Based on data in Monroe and Pizzarello (2011) *Geochim. et Cosmochim. Acta*, v. 75, p. 7585-7595, Table 1, and references therein.)

The conditions and processes include temperature, exposure to water (ice), and duration of aqueous alteration of the organic compounds and minerals. Adam Monroe and Sandra Pizzarello (Arizona State University) have added data about the soluble organic compounds from the Bells meteorite [***Data link*** from the Meteoritical Bulletin] to the growing database of diverse organic molecules and compounds found in meteorites. This particular meteorite fell near Bells, Texas on the night of September 9, 1961. Seven fragments were found eventually, one of which hit the roof of a house and was picked up the next day; it was the only stone, out of the seven, recovered before a hurricane swept through the area.

Bells is an anomalous CM chondrite, with mineralogy not completely typical of CMs and somewhat more like CIs, especially in its matrix. The organic-rich areas are associated with phyllosilicates (clays). Monroe and Pizzarello chose a sample from the unweathered fragment of Bells and crushed it to a powder for a battery of analyses. They found predominantly hydroxy- and carboxylic acids, carbonyl-containing compounds and hydrocarbons. See the chart, on the left, for comparisons of Bells with two well-known and well-studied meteorites, Murchison and Ivuna.

Monroe and Pizzarello conclude Bells is not unique or unusual in its organic composition and the amino acid suites are similar among Bells, Ivuna, and a CR1 sample (not shown). Whether or not the meteorites are from different asteroids, the authors suggest aqueous processing had the common effect of destroying the most reactive water-soluble compounds. The details and timing of the aqueous processing is a rich area of research. This ongoing work underscores the importance of cataloguing the effects of water alteration on minerals and organic compounds in a variety of carbonaceous chondrites in the quest to understand the chemistry of life's origins.

See: Monroe, A. A. and Pizzarello, S. (2011) The Soluble Organic Compounds of the Bells Meteorite: Not a Unique or Unusual Composition, *Geochimica et Cosmochimica Acta,* v. 75, p. 7585-7595, doi: 10.1016/j.gca.2011.09.041.

See also the PSRD article: ***Wet, Carbonaceous Asteroids: Altering Minerals, Changing Amino Acids*** and the CosmoSparks report: ***The Role of H_2S in Amino Acid Synthesis on Primordial Earth and Elsewhere***.

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