

THE FOUNTAIN HILLS METEORITE: A NEW CB_a CHONDRITE FROM ARIZONA. D. S. Lauretta¹ M. Killgore², R. C. Greenwood³, A. B. Verchovsky³, I. A. Franchi³ ¹Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA, lauretta@lpl.arizona.edu. ²Southwest Meteorite Laboratory, PO Box 95, Payson, AZ 85547, USA. ³Planetary & Space Sciences Research Institute, Open University, Walton Hall, Milton Keynes MK7 6AA, United Kingdom.

Introduction: The CR clan of meteorites has been established by [1] and a detailed review of these meteorites is presented in [2]. There are several kinds of carbonaceous chondrites included in this clan: Carbonaceous Renazzo-like (CR), Carbonaceous with High metal (CH), Carbonaceous Bencubbin-like (CB), and LEW 85332, a unique-metal rich meteorite. The CB chondrites are further divided into two subgroups: CB_a and CB_b. Here we describe a new member of the CR chondrite clan, Fountain Hills, a recent find with a total mass of ~60 g.

Analytical Techniques: A polished slab of the Fountain Hills chondrite was surveyed with back-scattered electron imaging and X-ray mapping using the Cameca SX-50 electron microprobe at the U of AZ. Mineral compositions were determined by EMPA. Different analytical conditions were used to analyze silicates and metals.

Oxygen and nitrogen isotope ratios of silicates from Fountain Hills were analyzed at the Open University, Milton Keynes, U.K. Details of the analytical techniques are given in [3] and [4].

Results: The bulk oxygen isotopic composition of Fountain Hills was analyzed twice and averaged. The results are $\delta^{17}\text{O} = -1.45\text{‰}$ and $\delta^{18}\text{O} = +1.28\text{‰}$, relative to VSMOW. These values are compared to those from other major chondrite groups in Figure 1. The O-isotopic composition of Fountain Hills is indistinguishable from that of Bencubbin and Weatherford.

Fountain Hills contains about 1ppm of indigenous nitrogen with a moderate enrichment in ¹⁵N observed in a high temperature release. The peak $\delta^{15}\text{N}$ value is +48‰ (Figure 2).

A back-scattered electron image of Fountain Hills is shown in Figure 3 and a Mg-Ca-Al combined X-ray map is presented in Figure 4. Observed chondrules in Fountain Hills range in size from 250 microns to 3500 microns in diameter. The average chondrule size has a diameter of ~1200 microns. Porphyritic and barred-olivine chondrules are the most abundant. All analyzed chondrule olivines are MgO-rich, with an average composition of Fo₉₇ and Fe/Mn ratios of ~35. There is very little variation in bulk olivine compositions with olivines ranging from Fo₉₆ to Fo₉₈. These olivines contain 0.14 – 0.29 wt.% CaO, 0.04 – 0.17 wt.% Al₂O₃, 0.06 – 0.12 wt.% MnO, and 0.48 – 0.58 wt.% Cr₂O₃. Low-Ca pyroxene has a composition of En₉₆ and an

Fe/Mn ratio of ~23. It contains 1.7 – 1.9 wt.% CaO, 1.1 – 1.5 wt.% Al₂O₃, 0.09 – 0.11 wt.% MnO, and 0.9 – 1.0 wt.% Cr₂O₃. Plagioclase is extremely alkali-poor with a composition of An₉₉ and contains ~1.0 wt.% MgO and ~0.4 wt.% FeO. High-Ca pyroxene appears to be augite with a composition of En₅₉Wo₃₅ and an Fe/Mn ratio of ~23.

Metal in Fountain Hills occurs interstitial to chondrules and silicate fragments. The composition of metal is fairly constant throughout the meteorite. We performed 76 analyses of metal at random locations. In all cases the metal is kamacite, which contains 6.3 – 6.8 wt.% Ni, 0.17 – 0.36 wt.% Co, 0.16 – 0.25 wt.% P, 0.05 – 0.19 wt.% Cr, 0 – 0.16 wt.% Cu, and 0 – 0.10 wt.% Si.

Discussion: The Fountain Hills meteorite is similar to the CB chondrites in bulk oxygen isotopes and metal and silicate compositions. The nitrogen isotopic measurement suggests the presence of trace amounts of nitrogen with a ¹⁵N enrichment typical of Bencubbin-like meteorites. We have not located any CAIs in Fountain Hills. These inclusions are also rare in other CB chondrites. There are some intriguing differences between Fountain Hills and the other CB chondrites. Primarily, porphyritic chondrules are abundant in Fountain Hills and are extremely rare in the other CBs. However, Fountain Hills is most closely related to the CB_a subgroup, making it the fourth member of this set.

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References:

- [1] Weisberg M. K. (1995) *Proc. NIPR Symp. Ant. Met.*, 8, 11-32. [2] Krot A. N. et al. (2002) *MAPS*, 37, 1451-1490. [3] Miller M.F. et al (1999) *Rapid Commun. Mass Spectrom.* 13, 1211-1217. [4] Verchovsky A. B. and Fisenko A. V. (1998) *Science* 281, 1165-1168.

Table 1. FH Avg Metal Composition

Element	wt.%
Mg	BDL
Si	0.05
P	0.21
S	BDL
Ti	BDL
Cr	0.12
Mn	BDL
Fe	92.9
Co	0.25
Ni	6.63
Cu	0.03
Total	100.2

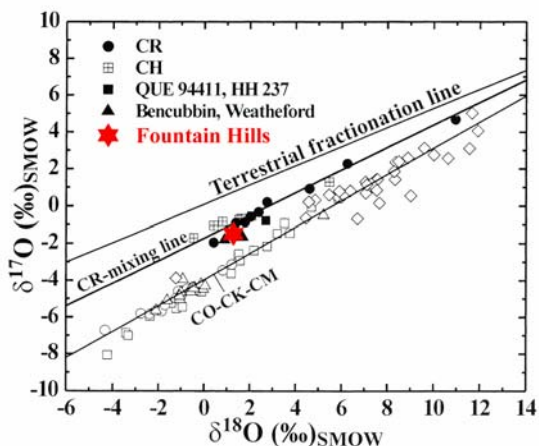


Figure 1. Bulk oxygen-isotopic composition of the Fountain Hills meteorite compared to that of other major carbonaceous chondrite groups. Figure modified from [2].

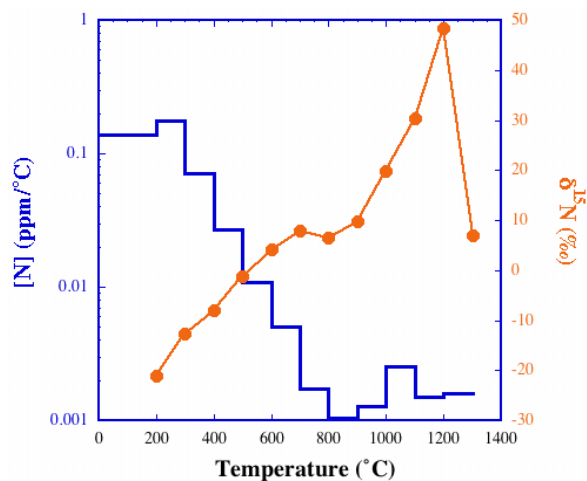


Figure 2. Nitrogen-isotopic composition of the Fountain Hills meteorite as a function of release temperature. The N released at low temperature (< 800 °C) is likely terrestrial contamination.

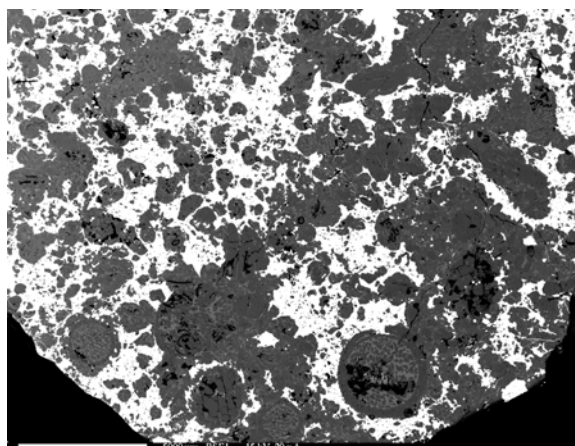


Figure 3. Back-scattered electron image of the Fountain Hills chondrite. The meteorite contains ~25 vol.% kamacite metal, which serves as a matrix for refractory silicates, mostly forsterite and anorthite.

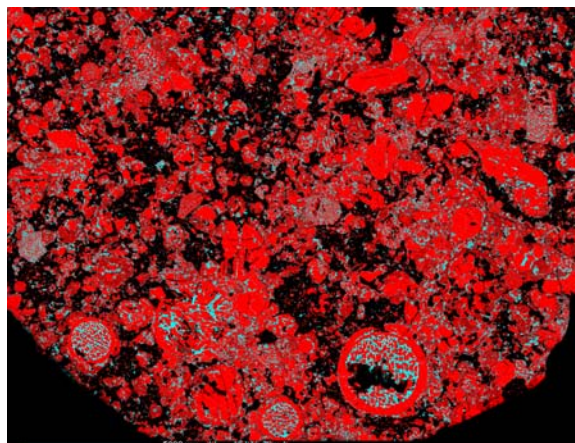


Figure 4. Combined X-ray elemental maps in Mg (red), Ca (green), and Al K α (blue) of the CB chondrite Fountain Hills. The meteorite contains abundant forsteritic olivine (red). Anorthite is a combination of Ca and Al and appears light blue. Several anorthite-rich chondrules are evident.

Table 2. Average Compositions of Major Silicate Phases in Fountain Hills (wt. %)

Phase	Na ₂ O	P ₂ O ₅	K ₂ O	SiO ₂	MgO	CaO	FeO	Al ₂ O ₃	MnO	Cr ₂ O ₃	NiO	Total
Olivine	BDL	BDL	BDL	41.9	54.1	0.19	3.24	0.09	0.09	0.52	BDL	100.15
Orthopyroxene	BDL	BDL	BDL	57.5	35.9	1.80	2.42	1.33	0.10	0.98	BDL	100.02
Augite	BDL	BDL	BDL	53.9	21.0	17.3	3.50	2.64	0.15	1.15	BDL	99.56
Plagioclase	0.07	0.03	BDL	48.1	0.98	18.7	0.37	32.7	BDL	BDL	BDL	101.06

BDL = below detection limit