CARBON ISOTOPE MEASUREMENTS OF IRON METEORITES. J. Newton and N. Sugiura, Department of Earth and Planetary Physics, University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo, 113-0033, Japan. (newton@space.eps.s.u-tokyo.ac.jp).

We present preliminary carbon isotopic measurements of four IAB irons: Canyon Diablo, Toluca, Deport and San Cristobal. Powdered irons were step-combusted with 50°C and 25°C increments.

Carbon in IAB irons is distributed in a variety of minerals: graphite, the carbides cohenite (Fe_3C) and haxonite ($Fe_{23}C_6$), and in solid solution with taenite (a few 1000 ppm) or kamacite (a few 100 ppm) [1–3]. During stepped combustion experiments, graphite generally combusts around 600–900°C with the main release around 650°C [4,5], iron carbide (cohenite, at least) combusts around 800–1100°C, peaking around 900°C [4,5], and carbon which is in solid solution with FeNi combusts above 1000°C [5].

Although graphite is present in all four samples, as indicated by a marked increase in $\delta^{13}C$ around 550–650°C, it is masked by low temperature organic contaminants, hence the isotopic ratio we obtained is the not the true one. This is currently being rectified. However, we have isotopic data for carbide and "metallic carbon" in all four meteorites. The results are summarised in the table below.

Carbon abundance measurements on metallic carbon are several times higher than those obtained by SIMS [6], although the abundances for Canyon Diablo metallic carbon are lower than earlier conventional IRMS measurements [2]. The highest carbon abundance for metal is seen in San Cristobal, which is unsurprising since it is a taenite ataxite [7]. All four stepped combustions show a bimodal carbon peak of varying prominence. The most marked example of this is San Cristobal, where the two components are also isotopically different. However since San Cristobal is an ataxite one cannot ascribe this bimodal carbon distribution to separate combustion of kamacite and taenite.

Carbon Dioxide is released from iron carbide in Canyon Diablo, Toluca, and Deport at the same temperature (800–950°C), yet in San Cristobal the nearest carbon peak occurs at 700–800°C. We ascribe this CO_2 release to carbide, despite its low temperature; it is possible that some of this is haxonite rather than cohenite. The combustion temperature of haxonite is unknown, but it certainly coexists with cohenite in the San Cristobal iron [7]. However haxonite has also been identified in Toluca [8] and Deport [1]. The small sample size (1–2 mg) and the heterogeneous distribution of carbon minerals in irons makes identification difficult.

The carbon isotope analyses of carbide broadly agree with earlier measurements [2,6,9,10], although those of the metallic carbon are a few permil lighter than SIMS analyses of taenite [6]. Small discrepancies may be due in part to the fact that the SIMS analyses of both carbide and taenite are normalised using an instrumental fractionation based on the Craig (1953) [9] analysis of cohenite.

Whilst the absolute $\delta^{13}C$ values do not appear to correlate with any particular parameter, it is interesting that the difference in $\delta^{13}C$ between carbide and metallic carbon in these samples may be related to the Ni content and/or cooling rate. There is a 6.2‰ difference between Canyon Diablo carbide and metallic carbon; this difference is only 2.2‰ in Toluca. For Deport and the fast-cooled, Ni-rich San Cristobal, the two constituents are isotopically indistinguishable.

More IAB irons will be measured to see if this correlation is substantiated.

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	T-range °C	$\delta^{13}C$ ‰	ppmC (metal)
Canyon Diablo 1 (carbide-rich)			
Carbide	650–1050	−22.58 ± 3.26	
Metal	1050–1300	−28.94 ± 1.54	1423
Canyon Diablo 2			
Carbide	800–950	−22.68 ± 0.60	
Metal	950–end	−28.61 ± 1.70	—
Toluca			
Carbide	850–925	−23.39 ± 0.31	
Metal	975–1275	−25.22 ± 2.27	1306
Deport			
Carbide	800–950	−32.22 ± 0.76	
Metal	975–1300	−31.81 ± 1.35	620
San Cristobal			
Carbide	700–800	−0.58 ± 0.88	
Metal	900–1300	−0.90 ± 1.85	2059
low-T metal	900–1150	0.38 ± 1.22	
high-T metal	1150—1300	−3.03 ± 0.45	