CARBON (AND EVENTUALLY NITROGEN AND ARGON) IN THE TAGISH LAKE (YUKON) CARBONACEOUS CHONDRITE.

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Introduction: The Tagish Lake meteorite was collected after a bright fireball was seen across the Yukon region of Canada in mid-January 2000. Preliminary optical examination revealed that it was a carbonaceous chondrite; subsequent petrographic observations suggest that it might be classified as CI2 [1]. As a matter of priority, given that Tagish Lake is the first CI/CM carbonaceous chondrite to fall since 1969, a C abundance measurement was undertaken, to verify the proportion of organic material present in the specimen. A chip of 10 mg was made available for carbon analysis. Carbon systematics were determined by high resolution stepped combustion-mass spectrometry of a 1mg chip; a second experiment, on a 5 mg chip, gave complementary data for nitrogen and argon. Carbon results are discussed here; nitrogen and argon data will be given at the meeting.

The total carbon yield was 5.4 wt%, with summed $\delta^{13}C$ ~24.3‰. The yield is high even for CI chondrites, and much higher than that of CMs [2]. The total $\delta^{13}C$ is unusually high for either CI or CM chondrites, a reflection of the abundant ^{13}C-rich carbonates. A word of caution is expressed: although an attempt was made to select a “typical” portion of the 10mg chip, avoiding any clasts or inclusions, it is possible that sample heterogeneity at the milligram level contributes in part to the high carbon abundance.

There are several carbon-bearing components present. Maxima in the yield histogram at 500°C ($\delta^{13}C$ ~43‰) and 600°C ($\delta^{13}C$ ~56‰) correspond to carbonate decrepitation. The lower temperature maximum is inferred to be from Fe-Mg-carbonate, whilst that at 600°C is from calcite. The relative abundances of the two components indicate that Fe-Mg carbonate (characteristic of CIs) dominates over calcite (characteristic of CMs) by approximately 2 to 1. Around 3.7 wt% carbon derives from carbonates, a much higher proportion than is usual for either CI or CM chondrites, where between 0.2–0.5 wt% C typically occurs as carbonate [3]. Carbon isotopic composition, however, is within the range of values for CI and CM chondrites [3].

Carbonate C accounts for well over 50% of the total carbon budget; the remainder is mostly from organic species that combust below ~ 500°C. The $\delta^{13}C$ of the organics varies from –10‰ to –1‰, a range similar to that observed for organic species in other CI/CM meteorites [4]. Studies of solvent-extractable material from carbonaceous chondrites indicate that entities such as amino acids and carboxylic acids are more enriched in ^{13}C than solvent-insoluble material [4,5]. It is possible that Tagish Lake has lost some of its water-soluble organic compounds, either following drying after recovery from the ice, or possibly through alteration on its parent asteroid.

In addition to the major C-bearing phases, excursions in isotopic composition indicate the presence of interstellar grains within Tagish Lake. Nanodiamonds (combusting at 525°–550°C, depleted in ^{13}C) and silicon carbide (combusting above 1000°C, enriched in ^{13}C) appear to occur; the presence of both components is matched by similar excursions in $\delta^{15}N$ during nitrogen release.

On the basis of its carbon systematics, Tagish Lake has more similarities with CI than CM chondrites. However, there are sufficient differences in its mineralogy, petrology and geochemistry to suggest that it has not experienced exactly the same asteroidal weathering history as the CI parent.

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