LOW TEMPERATURE CARBONACEOUS COMPONENTS IN THE WINCHCOMBE METEORITE.

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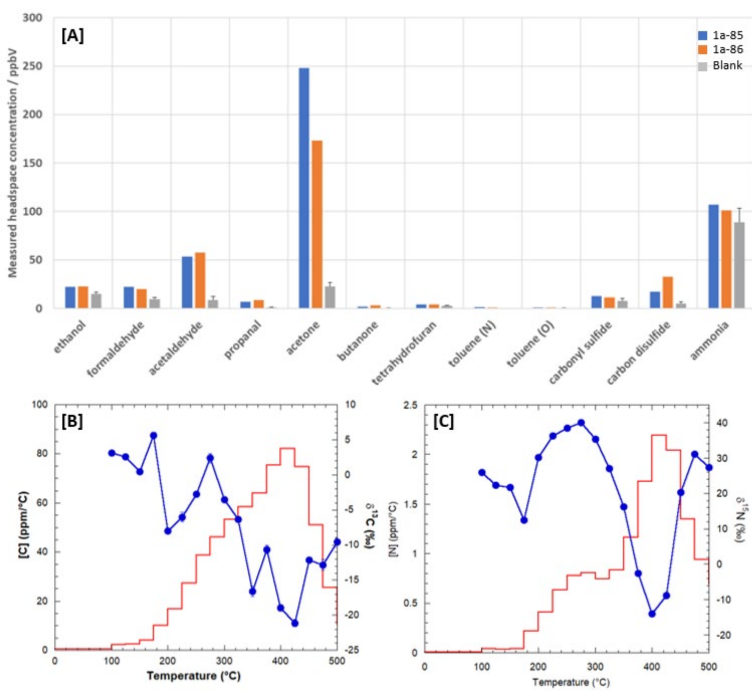
Introduction: The main mass of the Winchcombe CM chondrite fall was collected by the Wilcock family from their drive. Two fragments (1a-85 [BM.2022,M1-85] is 8.8 g and 1a-86 [BM.2022,M1-86] is 6.9 g) were taken to the Open University (OU) and stored in glass jars that had been baked in air at ~ 500 °C; the headspace was purged with dry nitrogen prior to sealing. On opening the jars to remove material for analysis, there was a strong aroma redolent of sulphur and petrol – it was clear that Winchcombe was degassing volatile compounds. In an attempt to capture and analyse these compounds, chips of 9.6125 mg and 10.0966 mg were broken from 1a-85 and 1a-86, respectively, and placed in 20 ml cleaned glass vials. The headspace was again flushed with dry nitrogen before the vials were sealed and placed in an oven at 100 °C. An empty vial was taken through the same protocol to act as a blank. After a week, the headspace gases were extracted with a syringe at 150 °C and analysed by Selected Ion Flow Tube-mass spectrometry (SIFT) at Anatune Ltd in Cambridge, UK.

In parallel with analysis of the headspace gases, an additional chip was broken from each of the whole rock samples of Winchcombe (5.0502 mg from 1a-85 and 5.0981 mg from 1a-86) for analysis at the OU on the Finesse system [1, 2]. The main feature of this instrument is its ability to analyse, simultaneously, the abundance and isotopic compositions of He, Ne, Ar, Xe, N and C extracted from a single sample. The Winchcombe samples were analysed using a high-resolution temperature program of 25° steps from 100 °C to 500 °C, the temperature range over which most of the carbonaceous matter combusted.

Results:

SIFT Analysis. Preliminary results from the SIFT analysis of the two Winchcombe samples are shown in [A]. Volatile organic compounds were degassed from the material, generally in quantities higher than the blank. Aldehydes and ketones predominate – the lack of carboxylic acids is presumably because they volatalise at temperatures higher than the 100 °C to which the samples were heated. Ammonia is the only N-bearing species identified – but at levels only slightly higher than blank.

Finesse Analysis: Results for both Winchcombe stones are similar; carbon data for sample 1a-85 are shown in [B] and nitrogen in [C]. Results are typical of CM chondrites. Below 500 °C, around 1.6 wt. % carbon and 400 ppm nitrogen combusts, with total $\delta^{13}C$ of ~ -10 ‰ and $\delta^{15}N$ ~ +5 ‰. As indicated by the shapes of the carbon and nitrogen yield histograms, and the variations in isotopic composition, several distinct components are present. The material released on combustion between room temperature and 100 °C has $\delta^{13}C$~ +4 ‰ and $\delta^{15}N$ ~ +25 ‰ and may correspond with the species identified in the SIFT-MS analysis. There is a maximum in nitrogen yield at 250 - 300 °C with $\delta^{15}N$ around +50 ‰ and $\delta^{13}C$~ 0 ‰, isotopic compositions characteristic of meteoritic organic acids [3]. The bulk of the carbon and nitrogen is from combustion of macromolecular material, depleted in both ^{15}N and ^{13}C relative to the less refractory organics. The sharp and pronounced drop in $\delta^{15}N$ at 400 °C is a sign that nanodiamonds are co-combusting with the organic material.



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References: [1] Verchovsky A. B. et al. (1998) *Science* 281:1165-1168. [2] Mortimer J. et al. (2015) *Icarus* 255:3-17. [3] Sephton M. A. (2014) In: *Treatise on Geochemistry* Vol. 1, Ch. 12. Elsevier, 2nd Edition.