SOLAR WIND NE IN WINCHCOMBE: INDICATION OF THE ORIGIN FROM THE PARENT BODY REGOLITH

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Introduction: We report here the first results of the Ne, Ar and Xe isotopic compositions analysed in two fragments (1a-85 [BM.2022,M1-85] and 1a-86 [BM.2022,M1-86]) of the Winchcombe CM2 meteorite that fell last year in the UK. A description of the fragments and aliquots (W1 and W2, respectively) taken from them is given in the accompanying abstract by Grady et al. [1]. The noble gases were analysed by stepped combustion simultaneously (i.e., in the same temperature steps) with carbon and nitrogen (for data and experimental details see [1]).

Results: The noble gas concentrations in the samples analyzed are different: ^{4}He – 145, 790; ^{20}Ne – 3, 15; ^{36}Ar 2.9, 2 in 10x10^{-6} cm^3 STP g^{-1} for W1 and W2 correspondingly. Xe was analyzed only in the W2 samples where its concentration was found to be 0.67x10^{-6} cm^3 STP g^{-1}. These concentrations are rather high compared to other CM meteorites recently analyzed [2]: only two of 39 samples have Ne concentrations comparable with that in W1. This allows Winchcombe to be identified as gas-rich meteorite similar to Pesyanoe, Fayetteville or Kapoeta.

The Ne isotopic composition of the individual temperature steps mostly plot on the Ne fractionation line which goes through the Solar Wind (SW) Ne isotopic composition (Fig. 1), indicating that Winchcombe Ne is mostly represented by a solar wind component, implying that the meteorite is from the regolith of its parent body. Since the isotopic composition of Q Ne is on the fractionation line, some contribution from the Q component cannot be ruled out.

Figure 1 also shows that some data points fall off the fractionation/SW-Q mixing line, lying within the SW-Q-COS triangle, suggesting the presence of cosmogenic Ne. This is more pronounced for the W1 sample, which has a lower overall concentration of Ne. The calculated concentration of cosmogenic ^{21}Ne in the sample is (1.6 ± 0.8) x 10^{-9} cm^3 STP g^{-1}, which corresponds to a ^{21}Ne exposure age of (0.55 ± 0.3) x 10^6 yr (assuming a $^{21}Ne_{cosm}$ production rate of 0.288 x 10^{-8} cm^3 g^{-1} yr^{-1}; [3]). This relatively short age is close to the main cluster of exposure ages for CM meteorites [3].

The relative abundance of the noble gases in the sample 1a-86 (W2) compared with SW and planetary noble gases shows that the lighter noble gases (He, Ne) are closer to SW in composition whilst Xe is closer to Q.

Conclusions: The Winchcombe meteorite represents a regolith breccia of the CM2 parent body. It contains a large contribution of the SW component as well as the Q noble gases.

References:

[1] Grady M. M. et al.. (2022) *this conference abstract*. [2] Krietsch D. et al. (2021) *Geochim. Cosmochim. Acta,* **210**, 240-280. [3] Mazor E. et al. (1970) *Geochim. Cosmochim. Acta*. **34**, 781–824. [4] Meshik. et al. (2012) In: *Exploring the Solar Wind (ed. M. Lasar),* 93–121. [5] Wieler R. et al. (1992) *Geochim. Cosmochim. Acta* **56**, 2907-2921.

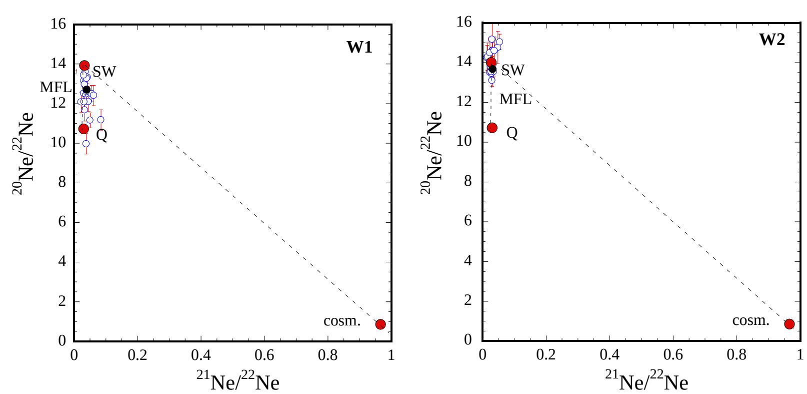

Figure1. Isotopic composition of Ne in the temperature steps of W1 and W2. SW – solar wind composition [4]; Q - planetary composition [5] MFL - mass fractionation line; cosm. – cosmogenic Ne. The total (summed) Ne isotopic composition is shown in black.