Cr, Cd, Si, Te, Ti, Zn AND O-ISOTOPE COMPOSITION OF THE WINCHCOMBE (CM2) METEORITE

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Introduction: On the evening of Sunday 28th February 2021 a bright fireball was witnessed from many parts of southern England and adjacent areas [1, 2]. The main mass of over 300 g was recovered the following morning by the Wilcock family from their driveway in Winchcombe, Gloucestershire and stored in clean plastic bags [1, 2]. Two days later, the material collected from the driveway was tentatively identified as a CM2 chondrite, with similarities to the historic Cold Bokkeveld (CM2) meteorite. In order to provide additional corroboration for this initial identification, O-isotope analysis was undertaken on 5th March, with the results confirming that the Winchcombe material did have a composition consistent with a CM2, and was indeed close to that of Cold Bokkeveld. The O-isotope analysis was completed within 5 days of the meteorite's fall – perhaps a record? Subsequent detailed petrographic and geochemical studies confirmed the initial identification and the meteorite is now officially classified as a CM2 [1, 2, 3].

In order to investigate Winchcombe in greater detail a consortium study is ongoing and the results discussed here summarize the initial findings of the "Winchcombe Isotope Team" (WIT). The initial remit of WIT was to undertake high-precision isotopic analysis on a range of elements (Ca, Cd, Cr, K, Li Mg, Mo, Ni, O, Si, Ti, Te, U, W, and Zn) and to also undertake presolar grain studies. Noble gas and light stable isotope analysis (Ne, Ar, Xe, H, C, N) is being covered by another team [1]. Presolar grain studies are ongoing and the results will be reported at a later date. Here we discuss the initial results of our measurements of the Cd, Cr, O, Te, Ti and Zn isotopic composition of the Winchcombe meteorite. Si isotope data is currently being collected and the results will be discussed at the meeting.

Methods*: O-isotopes*: Analyses were undertaken by laser fluorination [4] at the Open University on powdered 100 – 150 mg chips of Winchcombe. *Zn, Cd and Te-isotopes:* Analyses were undertaken at Imperial College on a 1.94 g sample of Winchcombe. *Cr isotopes*: Analyses were undertaken at the University of St. Andrews on 20 mg of Winchcombe material. *Ti isotopes:* Analyses were undertaken at the University of Bristol on a 101 mg sample of Winchcombe. Full analytical details for O-isotope analysis are given in [1, 5] and for Cd, Cr, Si, Te, Ti and Zn in [5].

Results: O-isotope analyses of two Winchcombe fragments have distinct O-isotope compositions: $\delta^{17}O$ 2.75 ± 0.40‰; $\delta^{18}O$ 9.48 ± 0.50‰; $\Delta^{17}O$ -2.18 ± 0.14‰ (2SD, n=2) and $\delta^{17}O$ 0.98 ± 0.31‰; $\delta^{18}O$ 7.29 ± 0.62‰; $\Delta^{17}O$ -2.23 ± 0.00‰ (2SD, n=2); with both plotting at the isotopically heavy, more aqueously altered, end of the CM2 array close to Cold Bokkeveld and Murchison [5]. Our analysed fragments sample the two most abundant lithologies in Winchcombe. These are both highly altered (<CM2.4) tochilinite-cronstedtite intergrowth (TCI)-rich materials [6]. The O-isotope data and pertrography therefore appear to be providing a consistent picture concerning the extent of aqueous alteration experienced by the Winchcombe parent body. $\delta^{66}Zn$ values determined for two Winchcombe aliquots are +0.29 ± 0.05‰ (2SD) and +0.45 ± 0.05‰ (2SD). The small difference between these analyses likely reflects minor sample heterogeneity. Zn isotope compositions for Winchcombe show excellent agreement with published CM2 data [7, 8, 9]. $\delta^{114}Cd$ for a single Winchcombe aliquot was +0.29 ± 0.04‰ (2SD), which is close to a previous result for Murchison [10]. A higher $\delta^{114}Cd$ value for Cold Bokkeveld [10] may reflect parent body processing [11]. $\delta^{130}Te$ values for three aliquots gave indistinguishable results, with a mean value of +0.62 ± 0.01‰, and are essentially identical to published values for five CM2s [12]. $\varepsilon^{53}Cr$ and $\varepsilon^{54}Cr$ for Winchcombe were 0.319 ± 0.029 (2SE) and 0.775 ± 0.067 (2SE) respectively. Based on its Cr isotopic composition, Winchcombe plots close to other CM2 chondrites [13]. $\varepsilon^{50}Ti$ values for Winchcombe are in line with recently published data for CM2s [13]

Discussion and conclusions: Zn, Cd, Te, Ti and Cr isotope data are consistent with a CM2 classification for Winchcombe. O-isotope analysis indicates that it experienced extensive parent body aqueous alteration. However, like other CM2s, Winchcombe displays significant lithological variation [6]. Further O-isotope analysis will be undertaken on the less altered material from Winchcombe to better constrain the extent of hydration on its parent body. In addition, we will be undertaking leaching experiments (Ni, Cr and Zn) following the methodology outlined by [14].

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