CT CHONDRITES: A NEWLY RECOGNIZED CARBONACEOUS CHONDRITE GROUP WITH MULTIPLE MEMBERS, INCLUDING TELAKOAST 001, CHWICHIYA 002 AND CIMARRON.

A. J. Irving[1], J. Gattacceca[2], K. Ziegler[3], C. Sonzogni[2], P. K. Carpenter[4] and L. A. J. Garvie[5] [1]Dept. of Earth & Space Sciences, University of Washington, Seattle, WA, USA (irvingaj@uw.edu); [2]CNRS, Aix-Marseille Université, IRD, INRAE, CEREGE, Aix-en-Provence, France; [3]Institute of Meteoritics, University of New Mexico, Albuquerque, NM, USA; [4]Dept. of Earth & Planetary Sciences, Washington University, St. Louis, MO, USA; [5]Center for Meteorite Studies, Arizona State University, Tempe, AZ, USA.

Introduction: Although criteria have been established for assignment of carbonaceous chondrite specimens to one or other of the most familiar groups, that task has been most readily accomplished for CV, CK, CR and CO chondrites containing relatively large chondrules, and for the otherwise distinctive CI, CH and CB chondrites. The unique 'CX' chondrite NWA 11961 [1] and members of the CL chondrite group [2] also contain relatively large chondrules, facilitating their petrologic assessment. The much finer grained, black and usually quite friable chondrites are much more difficult to assess properly, and many have been regarded as CM chondrites, even though oxygen isotope analyses have not been conducted on most of them. Exceptions include the CI and CY chondrites [3] and Tarda [4, 5], which have distinctive oxygen isotopic compositions.

Here we present evidence for a separate **CT chondrite** group (named for Telakoast 001) based on detailed studies of 16 different specimens, including several previously regarded as CM2 or anomalous CM chondrites. Although some of the recently classified samples may be paired stones from the same Algerian strewnfield, there is reliable evidence that other examples were found elsewhere, including Cimarron in Kansas in 1948 and others in Morocco and Libya. We also have recognized four examples of similar appearance, but belonging to yet another group (here termed 'CZ' chondrites) distinguished on the basis of both oxygen isotopic composition and magnetic susceptibility.

Methods: The techniques used here *in combination* to discriminate among the specimens include optical petrography, electron microprobe analysis and imagery, powder X-ray diffraction (XRD), magnetic susceptibility and especially oxygen isotopes. On this basis we assign the following specimens to their specific groups:

CT3 Chondrites: Telakoast 001, Cimarron, Chwichiya 002 (found near Houza, Morocco), NWA 6862, NWA 8781 (found near Foum Zguid, Morocco), NWA 12416, NWA 12957, NWA 13671, NWA 13984, NWA 14051, NWA 14139, NWA 14179, NWA 14200

CT2 Chondrites: NWA 11699, Sarir Tazirbu 001 (found near Tazirbu, Libya), Qued Mya 002 (presence of phyllosilicates inferred by the classifiers [5])

'CZ'3 Chondrites: NWA 11024, NWA 11254, NWA 11346, NWA 11750

Petrography: As detailed in [5], all of these specimens consist of small chondrules (mean apparent diameter 280 μm) set within very fine grained matrices (see Figure 1). Olivine compositions exhibit a wide range ($Fa_{0.4-71}$), but with bimodal peaks near Fa_3 and Fa_{40}. Accessory phases include kamacite, pyrrhotite, pentlandite (some phosphoran), chromite, magnetite, maghemite, taenite, calcite and dolomite, but tochilinite is absent. Minor serpentine and smectite were detected by XRD in only NWA 11699 and Sarir Tazirbu 001, but the available XRD patterns for most samples also show a broad diffuse scattering at low-2theta values, possibly signifying some amorphous components [see 6]. No CAI were observed in any of the specimens we examined.

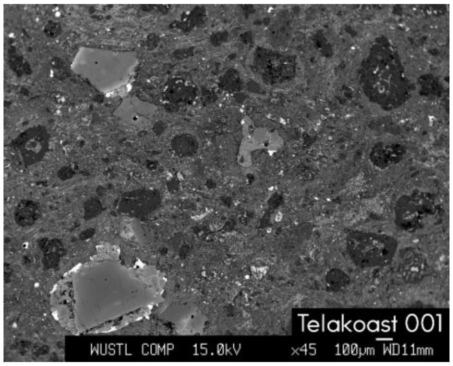
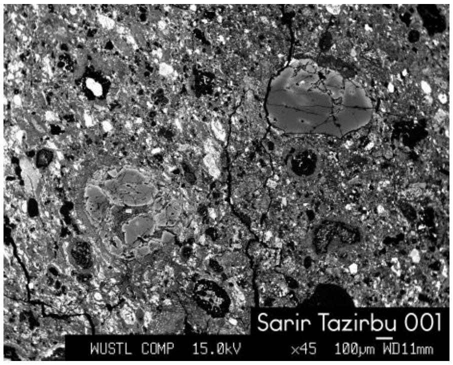


Figure 1. *Back-scattered electron images.*



Magnetic Susceptibility: Measured magnetic susceptibilities (log χ with χ in 10^{-9} m^3/kg) for CT chondrites are as follows: Telakoast 001 *4.30*, NWA 12957 *4.44*, NWA 14051 *4.56*, NWA 14139 *4.29*, NWA 14179 *4.27*, Chwichiya 002 *4.38*, Sarir Tazirbu 001 *4.26*. Two 'CZ' chondrites have lower values: NWA 11346 (previously regarded as an anomalous CM) *4.09*, NWA 11750 *4.03*.

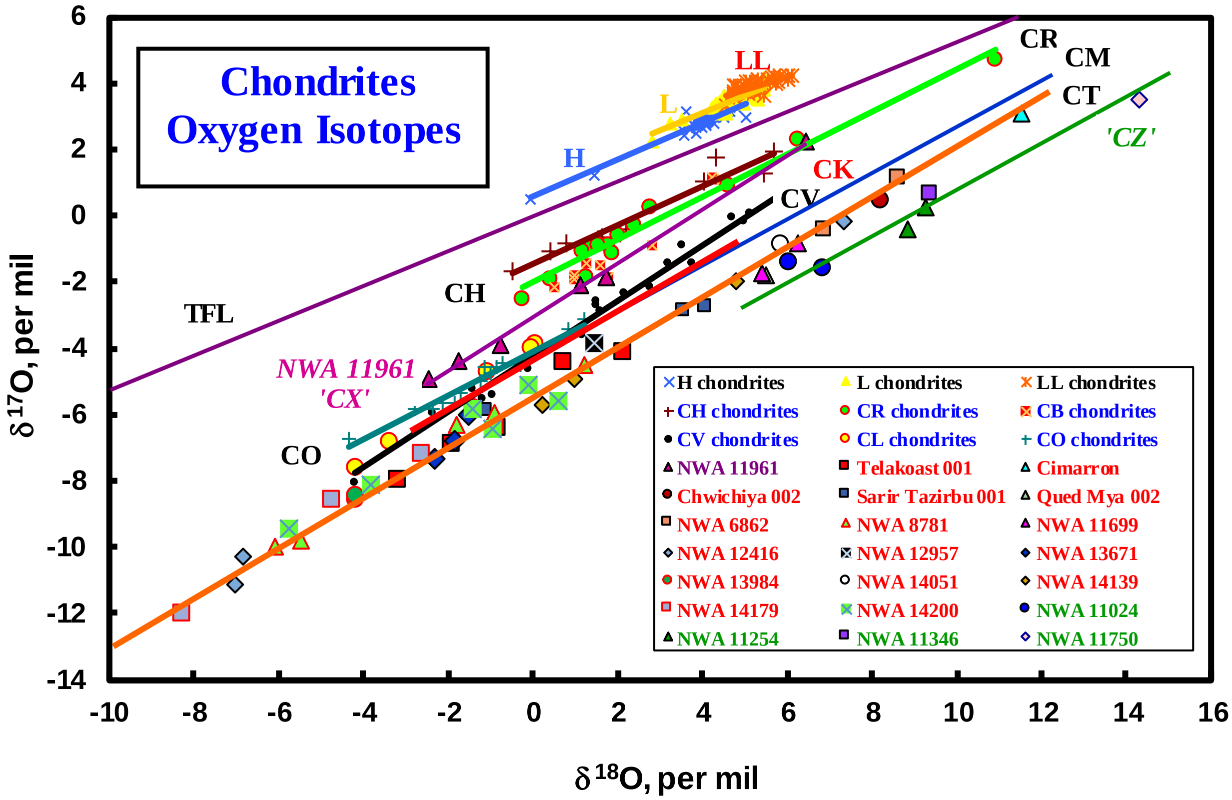


Figure 2. *Oxygen isotopic compositions of carbonaceous and ordinary chondrites. Data for CT and 'CZ' chondrites are from our analyses and [5]; data for other specimens are from [1, 2, 7, 8 and our unpublished analyses].*

Oxygen Isotopes: Laser fluorination analyses of acid-washed intact subsamples (UNM) or powdered "bulk" samples (CEREGE) yield results which consistently plot on a single linear array spanning 20 per mil in δ^{18}O and displaced by 1.3 per mil below the almost collinear arrays for CV, CO, CK and CL chondrites (see Figure 2). Results for four proposed 'CZ' chondrites plot at even more extreme values, yet three of these specimens were deemed (incorrectly by us as the classifiers) to be variants of CM chondrites. We surmise that the unusually broad field reported by [8] for specimens presumed independently to belong to the CM class may be incorrect, and that like specimens in all other carbonaceous chondrite classes true CM chondrites probably plot on a much tighter linear array.

Conclusions: Our discovery of two previously unrecognized carbonaceous chondrite groups with multiple representative members required the combined application of multiple techniques to black, very fine grained specimens initially presumed to be possibly CM chondrites on the basis of both their macroscopic and microscopic appearance alone. Given the prevalence of specimens regarded as CM2 chondrites (at least 650 classified examples [5]), it would now be imperative to conduct a critical reassessment of these with special attention to oxygen isotope results (if not already available) and powder X-ray diffraction analyses to confirm the presence or absence of phyllosilicates.

References: [1] Irving A. *et al.* (2019) *Lunar Planet. Sci.* **XL**, #2542. [2] Metzler K. *et al.* (2021) *Geochim. Cosmochim. Acta*. **304**, 1-31. [3] King A. et al. (2019) *Geochemistry* **79**, doi 10.1016/j.chemer.2019.08.003. [4] Garvie L. and Trif L. (2021) *Lunar Planet. Sci.* **XL**, #2446. [5] *Meteoritical Bulletin* [6] Garvie L. and Irving A. (2022) *This conference* [7] Clayton R. *et al.* (1991) *Geochim. Cosmochim. Acta* **55**, 2317-2337. [8] Clayton R. and Mayeda T. (1999) *Geochim. Cosmochim. Acta* **63**, 2089-2104.

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