Meteorite NWA 7533, the Confirmation of the CI-Mars Hypothesis, and The Mars Age Paradox

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Introduction: The recovery of NWA7533 and its sister fragments and the determination of its age of 4.4 Gyr [1]and ΔO17 at 0.57 has confirmed the Martian origin of the CI Carbonaceous chondrites [2], which have matching oxygen isotopes (see Fig, 1). Not only do its oxygen isotopes identify it and the similarly aged CI as Martian, but its elevated ΔO17 at 0.57 confirms a picture of two distinct oxygen reservoirs on Mars: a lithosphere reservoir at 0.4 and a hydrosphere at ~ 0.6-0.8 which exist separately due to the lack of plate tectonics on Mars. The age of NWA7533 at 4.4Gyr. confirms, with ALH84001, a highly bimodal pattern of surface ages on Mars , first proposed by Nadine Barlow [3] that serve as the source terrains for the Mars meteorites. However, NWA7533 does much more than this. By showing the oxygen isotopes of identified Mars meteorites and the CI are now indistinguishable, NWA 7533 doubles the number of recognized Mars meteorites and greatly enhances our understanding of the early Mars environment. **Isotopes , Chemistry and Morphology:** The elevated NWA 7533 ΔO17 at 0.57, together with the ΔO17 of 0.8 from the ALH84001 carbonates [4], bracket the ΔO17 of aqueously altered portions of the CI carbonaceous chondrites,(Fig. 1) and identify the dozen or so CIs as Martian Sediments as proposed by Franchi et al.[5] , formed from a post accretion veneer. Thus, with the inclusion of the CI the number of Mars meteorites has been doubled. The CI are old, 4.5Gyr, and thus erase the Age Paradox in Mars meteorite ages [6] making the Mars crustal dichotomy fully reflected in the age statistics of the meteorite collections. The CI are the "missing old meteorites of Mars." The identity of Mars as the Parent Body of the CI is further confirmed by fact that the CI match the Chromium isotope signature of Mars [7,8] (see Fig. 2), and explains why the CI , unique among chondrites, lack any evidence of hypervelocity impacts and possess clasts with a highly lamellar internal structure (see Fig. 3) , both morphological traits consistent with a CI parent body of high gravity and possessing an atmosphere. A CI-like chemical component is noted to be present in NWA 7533 [1] **Summary and Conclusions:** The addition of the CI to the Mars meteorite collection means Mars surface is well sampled and we now have examples of Martian rock over its entire geologic history. Also, the fact that the CI are old and are 2% organic matter shows that early Mars was, warm, wet and rich in organic matter, and thus strongly supports the finding of bio-relic signatures in ALH84001 found by Mckay, Gibson and company[9] as well as earlier findings of organic matter in Mars meteorites by the Pillinger group [10].

[1] M. Humayun,et al. , Nature 503,p.513 (2013) [2] Brandenburg J. E., (1996), Mars Geophys. Res. Lett., 23,9, p.961.[3] Barlow N. G.(1988) Icarus 75,p285.[4]Farquahar et al. (1998) LPS Conf. [5] Franchi, I. A.; Wright, I. P.; Pillinger, C. T. (1997) LPSConf., p. 381.[6] Nyquist et al. (1998) Jou. Geophys. Res.: Planets Vol. 103, E13, p. 31445.[7]Endress, et al(1996) Nature 379, p701.[8] Lugmair et. al (1998) GCA, 62, 2863.[9] McKay et al.,Sci*ence 16 1996: Vol. 273 no. 5277 p. 924.*[10] Wright et al. GCA, 56, pp 817-826.

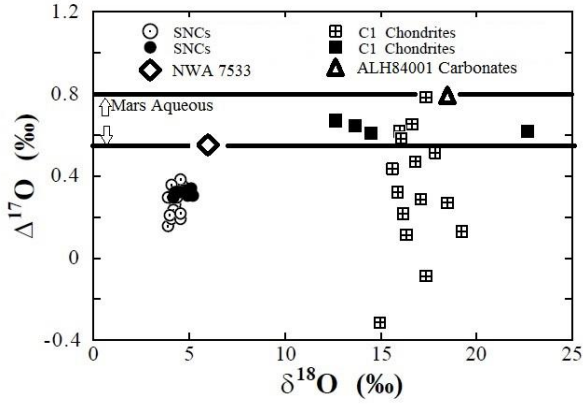

Figure 1. oxygen isotope data from recognized Mars meteorites versus CI , Figure adapted from Franchi et al. [5] and data taken from [1]and [4]

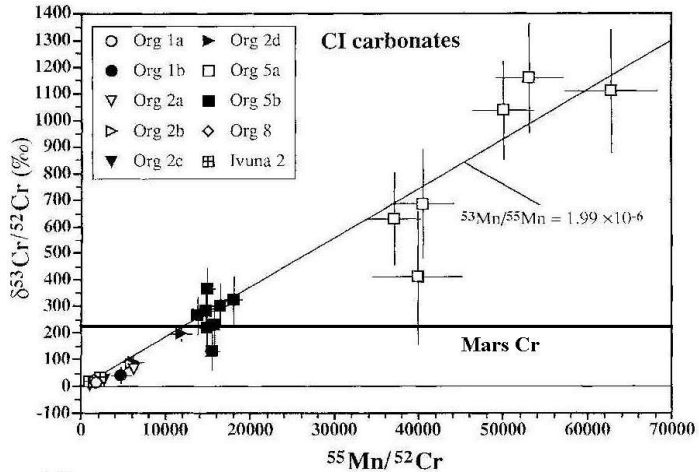

Figure 2. A comparison of $^{53}Cr/^{52}Cr$ for CI materials and Mars , adapted from [7]

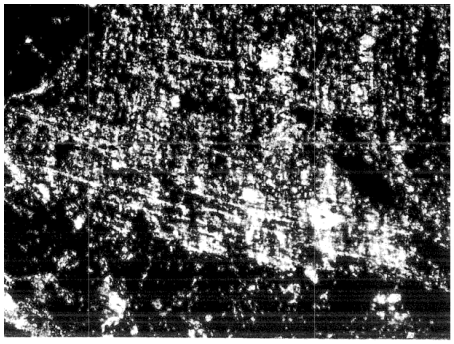

Figure 3. Clay clast in the CI Chondrite Orgueil , composed mostly of ill defined hydrated silicates, showing pronounced lamellar texture. Width of field of view is 1 mm. taken from Kerridge and Bunch.