Pairing Relations Within CO3 Chondrites Recovered at the Dominion Range and Miller Range, Transantarctic Mountains.

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Introduction: Large numbers of CO3 chondrites have been recovered from the Dominion Range (DOM) and the Miller Range (MIL) dense collection areas of the Transantarctic Mountains by ANSMET (Antarctic Search for Meteorites) teams [1]. Eighteen CO3 chondrites have been recovered in the Dominion Range (DOM) during the 2008-09, 2010-11, 2014-15, and 2018-19 seasons, with more possibly recovered during the 2019-20 season (e.g., [2-4]). Over 200 CO3 chondrites have been recovered in the Miller Range (MIL) during the 2003-04, 2005-06, 2007-08, 2009-10, 2011-12, 2013-14, 2015-16 seasons (e.g., [5-7]). Because some of these samples have been recognized as primitive unmetamorphosed chondrites, containing a wealth of scientifically interesting materials [8,9], we desire a thorough understanding of pairing relations between the large number and, in some cases, massive samples. Building on efforts described previously on chondrule olivine compositions [10], we here expand the pairing assessment to include bulk and isotopic data for H, C, and N, and noble gas cosmic ray exposure (CRE) age data. We combine these new data with field relations, macroscopic observations, petrography, and olivine compositions to make a detailed assessment of pairing relations.

Samples and approach: From the Dominion Range, we examined bulk samples of DOM 08004, 08006, DOM 08139, 08351, 10101, 10104, 10121, 10299, 10847, 10900, 14019, 14127, 14305, and 14359. From the Miller Range we examined bulk samples of MIL 03377, 03442, 05013, 05024, 07182, 07193, 07709, 090010, 090038, and 090785. These samples comprise representative samples from many ANSMET field seasons and pairing groups.

Methods: Electron microprobe analyses were obtained using the Cameca SX100 electron microprobe at NASA Johnson Space Center and reported previously [9]. The bulk H, C and N abundances were determined by elemental analyzer-isotopic ratio mass spectrometer (EA-IRMS) as described in [11]. Noble gas analyses were performed at ETH Zurich following the technical procedures described by [12] and data reduction and age determinations following considerations of [13, 14].

Results for MIL: Most of the MIL CO3 chondrites yield similar "T21" CRE ages, based on the analysis of cosmogenic ^{21}Ne (9.3 to 13.2 Ma), and overlapping C, H, and N bulk and isotopic values, suggesting that pairing is likely for many of the MIL CO3s. MIL 090785 yields a much younger T21 age of 0.3 Ma; we note that MIL 090785 is highly weathered (e.g., [11]). MIL 090073 has bulk and isotopic values distinct from the MIL CO3s and is more likely a CM or heated CM [10]; it has a T21 age of 5.9 Ma distinct to the T21 ages obtained for the other MIL COs (but also most CMs [13]).

Results for DOM: Many of the DOM CO3 samples also exhibit CRE ages in the 11-12 Ma range, suggesting a large pairing group, but there are several distinct exceptions. DOM 08006 and DOM 10847 yield older CRE ages of 24-25 Ma and distinct N and C bulk abundance and isotopic values; these two samples also have higher chondrule olivine Cr contents consistent with primitive CO3.00 or 3.05 material. DOM 10121 and DOM 10299 yield much younger CRE ages of 2.5-2.6 Ma, and have H, C, and N bulk and isotopic values consistent with CM chondrites [13, 15]. DOM 14359 has a CRE age of 5.0 Ma, and distinct isotopic values that could indicate it is an unpaired mass. Future efforts will include CO3s collected from the Dominion Range in 2018 and 2019 for completeness.

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