^{21}NE COSMIC-RAY EXPOSURE AGES OF BRACHINITES AND BRACHINTE-LIKE ACHONDRITES.

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Introduction: Cosmic-ray exposure (CRE) ages measure the time since a meteorite was ejected from its parent body resulting from an impact or break-up event. Analysis of CRE clusters was used in addition to oxygen isotopic measurements to support the idea that the howardites, eucrites, and diogenites (HED) meteorites originated from the same parent body [1] as well as e.g. demonstrating a common break up event among acapulcoites [2]. Brachinites are a small group of achondrites that have a poorly-understood history. The majority of studies on brachinites have focused on petrology and bulk chemistry [3-5], with little focus on chronology. For this purpose, we investigate the exposure history of 15 brachinites/brachinite-like samples.

Samples and Methods: Brachinites/brachinite-like samples in this study are Ramlat as Sahmah (RaS) 309, North West Africa (NWA) 595, NWA 1500, NWA 3151, NWA 4518, NWA 4874, NWA 4876, NWA 4882, NWA 4969, NWA 6077, NWA 6474, NWA 6962, NWA 7297, NWA 7605, NWA 8777, and NWA 10637. The 15 (bulk) samples were divided into two aliquots each (as permitable by available mass; ranging from 8-95 mg; average ~46 mg) in order to have their noble gases (He, Ne, Ar, Kr, and Xe) measured using the custom-built sector-field noble gas mass spectrometer "Albatros" at ETH Zurich . Gas extraction (by fusion in one ~1700°C step), cleaning, and measurement followed established methods [6,7]. The measured ^{21}Ne is entirely cosmogenic, and production rates are based on appropriate shielding parameters [8].

Results and Discussion: The ^{21}Ne CRE ages measured in this work are shown in a histogram in Figure 1 (blue and magenta squares). The ages of brachinite samples range from ~22-66 Ma, while brachinite-like samples range from ~9-26 Ma. Three possible groupings can be identified in Figure 1. The youngest possible grouping is at ~10.5 ± 1.1 Ma and includes four samples (2 from this work: NWA 1500, NWA 4518, and 2 from literature). Interestingly, half of these samples are brachinite-like. Another possible grouping is at ~25.0 ± 3.4 Ma and includes nine samples in total (7 from this work: NWA 315, NWA 595, NWA 8777, NWA 6077, NWA 4874, NWA 7297, RaS 309, and two others from literature). Two of these are brachinite-like. The oldest possible group is at ~49.9 ± 4.1 Ma and includes six total samples (3 from this work: NWA 7605, NWA 4969, NWA 10637, and three others from literature). All of these samples are brachinites. Brachinite-like achondrites populate the same clusters as the brachinites and could originate from the same source.

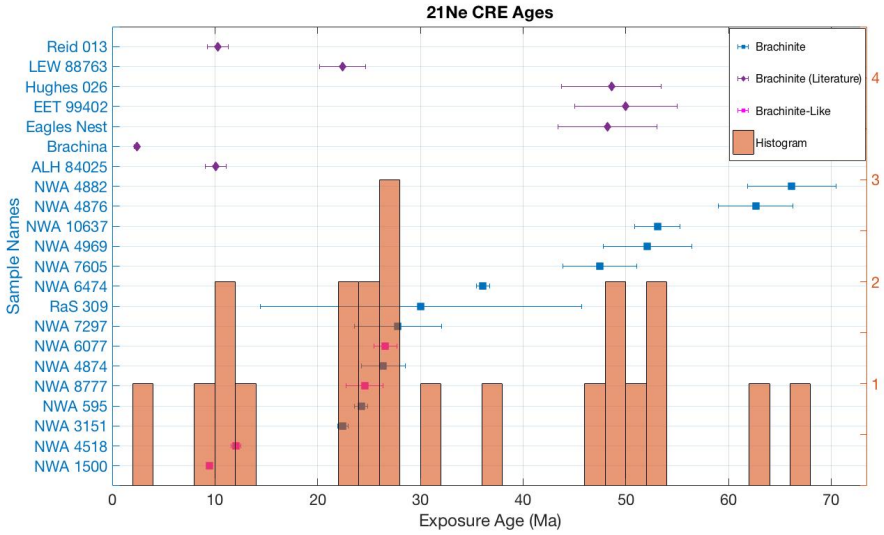

Figure 1: ^{21}Ne CRE ages of 15 newly measured brachinites and brachinite-like samples (blue and magenta squares) and literature values (purple diamonds [9,10,11]). Histogram (right-y axis) has 2-Ma bins.

References: [1] Eugster O. and Michel T. (1995) GCA 59, 117-199. [2] Eugster O. and Lorenzetti S. (2005) GCA 69, 2675-2685. [3] Mittlefehldt D.W. et al. (2003) *Meteoritics & Planet. Sci.* 38, 1601-1625. [4] Goodrich C.A. et al. (2010) *Meteoritics & Planet. Sci.* 45, 1906-1928. [5] Day J. M. D. et al. (2012) *GCA 81,* 94-128. [6] Busemann H. et al. (2000) *Meteoritics & Planet. Sci.* 35, 949–973. [7] Riebe M. E. I. et al. (2017) *Meteoritics & Planetary Science* 52:2353-2374. [8] Leya I. and Masarik J. (2009) *Meteoritics & Planet. Sci.* 44, 1061-1086. [9] Patzer A. et al. (2003) *Meteoritics & Planet. Sci.* 38, 1485-1497. [10] Ott U. et al. (1985) *Meteoritics* 20, 69-78. [11] Swindle T.D. et al. (1998) *Meteoritics & Planet. Sci.*, 33, 31-48.