USING MULTISCALE X-RAY COMPUTED TOMOGRAPHY (XCT) TO CHARACTERISE THE LITHOLOGICAL VARIABILITY WITHIN THE NORTHWEST AFRICA 11220 "BLACK BEAUTY" MARTIAN REGOLITH BRECCIA

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Introduction: The martian regolith breccia Northwest Africa (NWA) 11220 is a paired stone of NWA 7034, colloquially known as the 'Black Beauty' meteorite [1]. This polymict breccia is thought to be representative of the near-surface martian regolith [2]. Previous work on paired meteorites suggest a complex history of surface processes preserved within "proto-breccia" clasts [3,4] – including aqueous transport and weathering of surface rocks. Restriction of this variability to only a subset of proto-breccia clasts suggests derivation of material from different sedimentary catchments [5]. In this study, we used X-ray computed tomography (XCT) at different spatial scales to better characterise the textural complexity within the breccia.

Methods: XCT data of the 36.62 g main mass of NWA 11220 was collected at the Natural History Museum, London, with a voxel size of 24.9 μm. We then carried out higher resolution (1.6–2.1 μm voxel size) XCT scans of nine ~1 mm fragments from the main mass, weighting 0.11 g in total, using a Zeiss Versa 620 instrument at The University of Manchester. The centre of one of these samples was scanned at higher resolution (0.4 μm voxel size), creating a multiscale dataset.

Discussion: The textural complexity observed using XCT data obtained on NWA 11220 suggests a minimum of three episodes of brecciation and lithification in order to account for clasts included within the proto-breccia, as well as isolated fracturing restricted to specific clasts. The observation of an ashy coating around a proto-breccia clast (i.e. an armoured lapilli) is evidence of impact reworking of previously impacted material, and also suggests that this material was at least semi-lithified in order to be fractured. By assessing the textural complexity of NWA 11220 at different scales, we further constrain previously developed and summarised clast classification schemes [6,7] and pair lithological observations with working hypotheses on the formation history of this unique meteorite.

References: [1] Agee, C. B. et al. (2013) *Science* 339:780–785. [2] MacArthur, J. L. et al. (2019) *Geochimica et Cosmochimica Acta* 246:267–298. [3] Jacobs G. M. et al. (2016) *Lunar and Planetary Science Conference*, Abstract #2787. [4] McCubbin, F. M. et al. (2016) *Meteoritics & Planetary Science* 51:2036–2060. [5] Liu, Y. et al (2021) *Icarus* 364:114471. [6] Santos A. R. et al. (2015) *Geochimica et Cosmochimica* 157:56–85.[7] Goodwin A. et al. (2022) *Astrobiology*, doi: 10.1089/ast.2021.0069.