CHARACTERIZATION OF AN OLIVINE-RICH CLAST IN BLACK BEAUTY.

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Introduction: The Martian meteorite NWA 7034 is a unique polymict breccia (e.g., [1-6]) characterized by a fine-grained matrix that hosts diverse clast types that record a diversity of ages, indicating that this meteorite had a complex history punctuated by major thermal disturbances (e.g., [1, 7-9]). The clast types include differentiated igneous clasts, impact ejecta melt clasts, and breccia recycled from more ancient breccia. Here we describe a previously uncharacterized clast type, a large, olivine-rich clast (named *Valentine* due to its resemblance to a heart).

Methods: A 2.5 cm^2 sawn fragment of Black Beauty specimen FMNH ME 6118.1 was mounted in epoxy and polished by hand to reveal a cross section (polished section FMNH ME 6118.2). The petrology and mineral chemistry of the specimen was determined using X-ray microtomography (μCT), scanning electron microscopy, and quantitative energy dispersive X-ray spectroscopy (SEM/EDS):

μCT. Specimen FMNH ME 6118.1 was scanned at 27.5 μm voxel resolution using the General Electric Phoenix v|tome|x S240 μCT scanner in the Department of Organismal Biology and Anatomy at the University of Chicago. Data were acquired with a transmission 240 kV microfocus X-ray tube using a diamond anode.

SEM/EDS. To evaluate petrologic textures of the cross sectioned sample, high-resolution, backstattered electron (BSE) images were obtained from ME 6118.2 using a TESCAN LYRA3 field emission SEM equipped with an in-column BSE detector in the Department of the Geophysical Sciences at the University of Chicago. To generate quantitative chemical maps (TruMaps), the SEM is also equipped with two Oxford Instruments XMax 80 silicon drift energy dispersive X-ray spectroscopy (EDS) detectors; these, coupled with Oxford Instruments AZTec software, were used for simultaneous determination of C, O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Ni, and Zr compositions. The system was calibrated with mineral and metal standards; the current stability and intensity was monitored using a Co standard and the beginning and end of each analysis session. Quantitative compositional analyses of the entire surface and of individual clasts larger than 0.1 mm^2 (as in [5]) were made.

Petrographic description: Euhedral phenocrysts and phenocryst fragments of dominant low-Ca pyroxene, pigeonite, and augite are set in a very fine-grained matrix which is composed of pyroxene, plagioclase, phosphate, and Fe–Ti oxide phases. As observed in previous studies, igneous clasts, proto-breccia clasts, and spherical melt clasts with accreted dust rims are present. *Valentine* is a large (~1 cm) clast that is composed primarily of porphyritic subhedral to anhedral grains of magnesian (Fo_{60-73}) olivine and which represents, to our knowledge, the first documentation of an olivine-rich clast in a study of Black Beauty. Some of *Valenitne's* olivine grains contain accessory euhedral chrome-spinel inclusions 0.1-0.2 mm in size. The clast also contains several 0.5-2 mm subhedral to anhedral feldspar microphenocrysts, much more calcic and uniform (An_{51-62}, Ab_{37-46}, Or_{1-3}) than the variable and primarily alkali (An_{9-33}, Ab_{9-63}, Or_{12-74}) feldspar clasts in the matrix surrounding *Valentine*. Apatite is also present as 0.5-1 mm anhedral inclusions within *Valentine's* silicate phases. Calcium carbonate veins cut through *Valentine* and other clasts and extend to sample's exterior surfaces.

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