OLIVINE-GABBROIC SHERGOTTITE NORTHWEST AFRICA (NWA) 13227: A LINK BETWEEN GABBROIC AND POIKILITIC SHERGOTTITES? S. Benaroya[1], J. Gross[1,2,3,4], P. Burger[1], M. Righter[5], T. J. Lapen[5]. [1]Dept. of Earth & Planetary Science, Rutgers University, Piscataway, NJ 08854 (sb1541@scarletmail.rutgers.edu); [2]NASA, Johnson Space Center, Houston, TX, 77058, [3]Dept. of Earth & Planetary Sciences, American Museum of Natural History, New York, NY 10024; [4]Lunar and Planetary Institute, Houston, TX 77058. [5]Dept. of Earth & Atmospheric Sciences, University of Houston, TX.

Introduction: Martian meteorites are valuable tools to study Mars, as they are the only samples available for direct analysis. Martian meteorites can be grouped based on texture and mineralogy into shergottites, nakhlites, chassignites, orthopyroxenite Allan Hills (ALH) 84001, and polymict breccia Northwest Africa (NWA) 7034 and its pairs [1]. Shergottites can be further subdivided into fine-grained basaltic and olivine-phyric samples and coarse-grained gabbroic and poikilitic samples [1]. Geochemical groupings based on incompatible trace element (ITE) and radiogenic isotopic compositions can be used for additional classification; samples can be sorted as either ITE enriched, intermediate, or depleted, with the different groups hypothesized to represent distinct source regions [e.g., 1]. Various studies have proposed potential petrogenetic links between the different groups, with most research focused on finding connections between basaltic and olivine-phyric shergottites, and more recently, basaltic and gabbroic shergottites [e.g., 1-3]. Understanding any potential link between sample types is critical as it helps to better understand the martian interior and its evolution over time.

Here we present compositional and textural evidence of olivine-gabbroic shergottite NWA 13227 as a potential link between gabbroic and poikilitic shergottites. Olivine-gabbroic shergottites such as NWA 13227 are pyroxene and olivine-rich samples that are relatively new finds and have yet to be extensively studied [4]. Gabbroic shergottites include pyroxene cumulate NWA 6963 [2] and plagioclase cumulate NWA 7320 [1,3] (which may be related to basaltic shergottites [1]), both of which are olivine-poor. Poikilitic shergottites have a more varied mineralogy, comprising of pyroxene, olivine, and plagioclase.

Sample & Methods: NWA 13227 has been classified as an olivine-gabbroic shergottite whose mineral chemistry and crystallization conditions have previously been described in [4]. Qualitative backscattered-electron (BSE) images (Fig. 1), and quantitative point analyses on a thick section of NWA 13227, were obtained using the JEOL JXA-8200 Superprobe at Rutgers University [4]. X-ray Computed Tomography images of chip NWA 13227,6 [4] were rendered using the software Dragonfly [6].

Mineralogy & Mineral Chemistry: NWA 13227 is coarse-grained and composed of pyroxene and olivine phenocrysts set in a groundmass of smaller pyroxene and olivine grains, maskelynite, oxides, phosphates, and sulfides [4] (Fig. 1). The specimen displays both gabbroic and poikilitic textures in 2D & 3D, with pyroxene oikocrysts enclosing olivine and oxide chadacrysts (Figs. 1, 2). A video rendering of the XCT

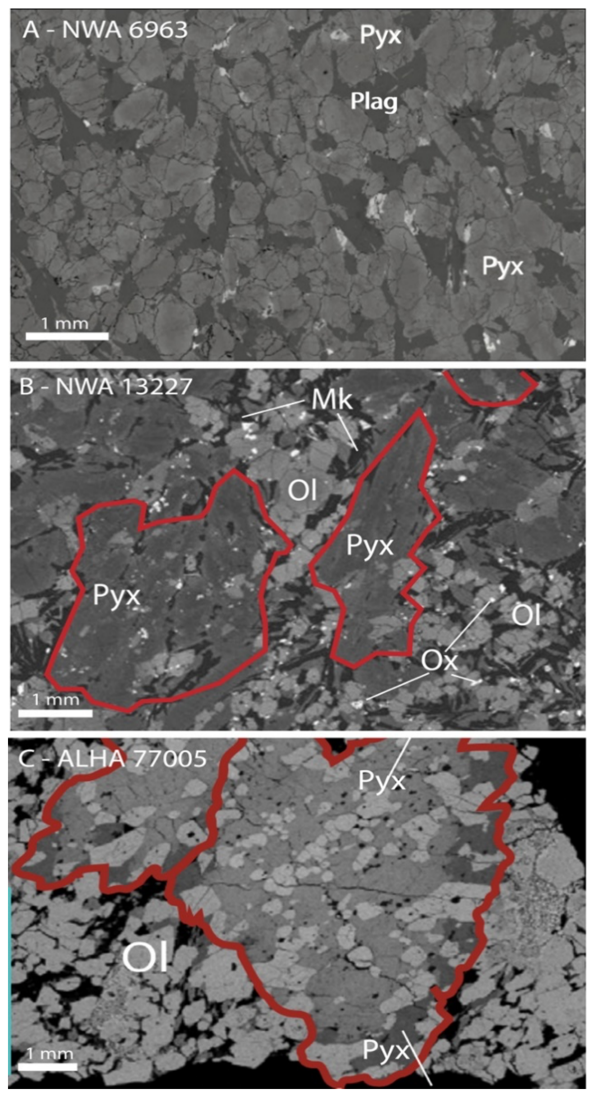

Fig. 1: Close up BSE images of shergottites: A. Gabbroic sample NWA 6963 [7], B. Olivine-gabbroic sample NWA 13227 [4], C. Poikilitic Shergottite Allan Hills (ALHA) 77005 [5]. Red outline indicates poikilitic regions. Pyx = pyroxene, Ol = olivine, Mk = maskelynite, Plag = plagioclase.

data of a chip of NWA 13227 can be found at https://www.dropbox.com/s/uhbupo9keynfl2s/NWA13227%2C6-petro.avi?dl=0. NWA 12241, another specimen initially

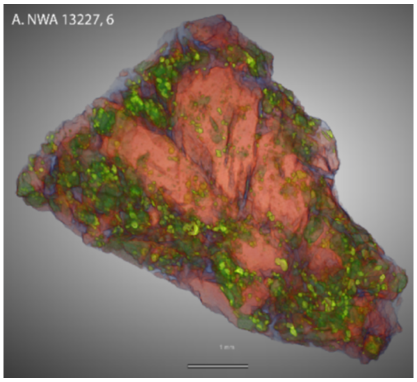

Fig. 2: 3D false color "Edge Contrast" renderings of NWA 13227 XCT data, scale bar = 1 mm. Orange = pyroxene, Green = olivine, Blue = maskelynite, Yellow = accessory phases.

characterized as olivine-gabbroic, is suggested to be a poikilitic shergottite based on texture and mineralogy [8]. Mineralogically, NWA 13227 more closely resembles poikilitic shergottites, as gabbroic shergottites are composed mainly of pyroxene and maskelynite [2,3], while poikilitic shergottites generally have abundant olivine [5]. Pyroxene compositions of NWA 13227 are between poikilitic shergottites and the gabbroic shergottite NWA 6369 (Fig. 3). The more ferric NWA 13227 pyroxenes have similar compositions to the most magnesian pyroxenes in NWA 7320 (Fig. 3).

Crystallization conditions: NWA 13227 is interpreted to have undergone a multi-stage crystallization process, evidenced from its pyroxene Ti/Al ratio, with core and mantle compositions indicating crystallization in the upper mantle/lower crust, and rim and matrix compositions forming closer to the surface [4], similar to what is seen in poikilitic samples [5]. NWA 13227 began crystallizing at reducing conditions of QFM-3 and finished crystallizing around the QFM buffer (Fig. 4). The temperature and redox trend seen in NWA 13227 is similar to that of enriched poikilitic shergottites, although with higher maximum temperatures recorded in NWA 13227. Gabbroic shergottites appear more oxidized, however, few data points exist for these samples. Rim and matrix oxides in NWA 13227 and oxides found in non-poikilitic textures within poikilitic shergottites overlap with basaltic shergottites.

Discussion & Conclusion: Texturally and compositionally, NWA 13227 shares many characteristics of both poikilitic and gabbroic shergottites. Preliminary trace element analysis of NWA 13227 characterized it as an intermediate sample [10]. More detailed trace element data, and comparison to poikilitic and gabbroic shergottites, are forthcoming and will help better understand any potential relationship between these groups. It is possible that NWA 13227 represents a link between poikilitic and gabbroic shergottites, which may indicate formation in a common system for all these shergottite groups.

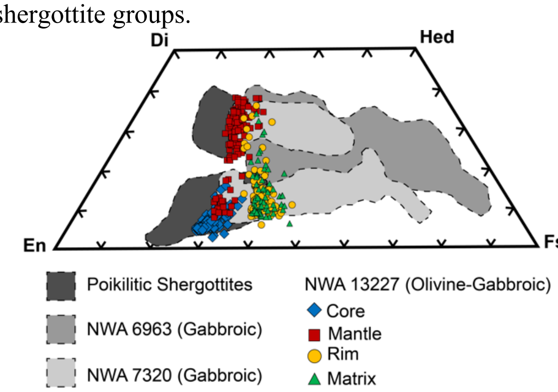

Fig. 3: Pyroxene quadrilateral containing NWA 13227 data [4 & this study) as well as compositional envelopes for poikilitic shergottites in dark grey [5] and gabbroic samples NWA 6963 in medium grey [2] and NWA 7320 in light grey [3].

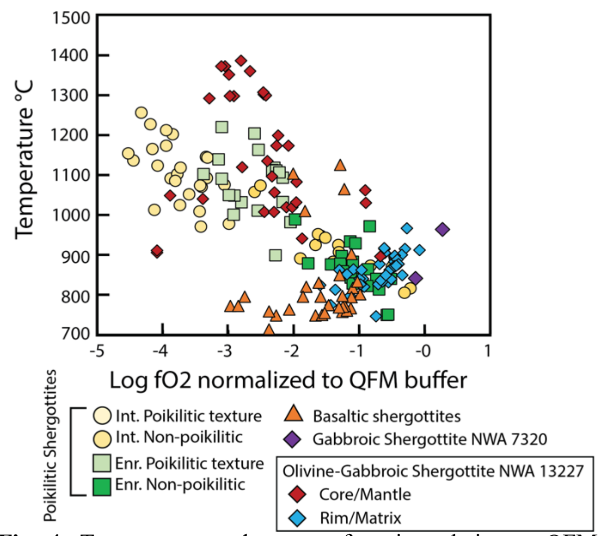

Fig. 4: Temperature and oxygen fugacity relative to QFM buffer shown for: Intermediate poikilitic shergottites (yellow circles) [5], enriched poikilitic shergottites (green squares) [5], basaltic shergottites (orange triangles) [9], gabbroic shergottite NWA 7320 (purple diamonds) [3], core/mantle oxide data for NWA 13227 (red diamonds), and rim/matrix for NWA 13227 (blue diamonds).

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