# PETROLOGY, GEOCHEMISTRY, AND PAIRING OF LUNAR METEORITES FROM THE DOMINION RANGE

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**Introduction:** During the 2018-2019 Antarctic Search for Meteorites (ANSMET) field season in the Dominion Range (DOM), 7 lunar meteorite stones were collected: DOM 18242 (15.1 g), DOM 18244 (25.1 g), DOM 18262 (6.8 g), DOM 18509 (16.5 g), DOM 18543 (13.6 g), DOM 18666 (45.9 g), and DOM 18678 (11.6 g). Here we present the initial results of electron microprobe and X-ray computed tomography (XCT) studies of these stones and look at the details of their petrography and mineral chemistry, as well as investigate possible pairing relationships, both with each other and with previously described lunar meteorites. Most of the work presented here is on the DOM 18509, 18543, and 18678 stones; subsamples of the other stones are in hand and similar measurements will be made on them by the time of the meeting.

**Methods:** Textures in DOM 18509, DOM 18543, and DOM 18678 were characterized in 2D by optical microscopy, backscattered electron (BSE) imaging and elemental X-ray images on thin sections, as well as in 3D by X-ray computed tomography (XCT) on sample chips. Mineral compositions were assessed through a combination of wavelength dispersive spectroscopy EPMA (electron probe microanalysis) and x-ray mapping on the JEOL 8530 at NASA JSC. The bulk composition of all three meteorites was determined based on analyses of the fusion crust glass. XCT analyses were done on the Nikon XTH 320 at NASA JSC. ICP-MS data on bulk rock subsamples for each meteorite will be carried out in the near future.

**Results:** The stones are all similar in macroscopic appearance with a dark aphanitic matrix hosting a variety of small- to medium-sized angular mineral and lithic fragments (often light colored in nature) [1,2]. Based on EPMA and XCT results, the three meteorites are polymict regolith breccias comprised of mineral, glass, and lithic clasts ranging up to several mm in length. Melt veins run through all three meteorite samples. Mineral clasts in all 3 stones are dominated by pyroxene and plagioclase ($An_{82-96}$), with minor amounts of $SiO_2$, olivine ($Fo_{1-52}$), and FeTi-oxides. Pyroxene grains are mostly Fe-rich pigeonite and augite, and larger clasts are normally zoned and have fine exsolution lamellae. The lithic clasts in all stones consists of: (1) basalt clasts that contain zoned pyroxene, plagioclase laths, and ilmenite, with minor silica and Fe-rich olivine; (2) granulitic clasts; (3) anorthosite clasts; (4) Si-rich clasts that also contain ilmenite, troilite, high-Ca pyroxene, fayalite, and K-feldspar likely mesostasis from late stage basalts). All three meteorites contain glassy fusion crust that is highly vesicular, high in FeO and $Al_2O_3$ (15-17 wt% each), ferroan (Mg# of 23-24), and moderately rich in $TiO_2$ (1.4-1.8 wt%). The composition of the fusion crust can serve as a proxy for the bulk meteorite composition and is identical within error for all three meteorites.

**Implications:** The lithic and mineral clasts in all three stones are similar in clast population and assemblages as well as mineral chemistry. In addition, the fusion crust composition, a proxy for bulk composition, is within error of each other for all three stones. Thus DOM 18509, DOM 18543, and DOM 18678 are almost certainly paired. Based on similarities in macroscopic description as well as preliminary classification data [1,2], all 7 lunar stones from DOM are likely paired, though additional quantitative analyses are needed to confirm this. The presence of spherules and vesicular fusion crusts indicates that the DOM pairing group is a regolith breccia. The presence of basaltic and gabbroic clasts as well as more feldspathic materials, suggest that the regolith from which these meteorites formed contained a mixture of feldspathic highland material and mare material, suggesting a possible provenance near a mare-highlands boundary. No evidence of KREEPy lithologies have been observed so far in these meteorites, however, future ICP-MS data on bulk rock chips for the stones will reveal any KREEP component if present. The DOM pairing group has many similarities to previously described lunar breccia meteorite MET 01210, however more detailed compositional data will be needed to make a definitive comparison.

**References:** [1] Satterwhite C. and Righter K. (2019) *Ant. Met. Newsletter* Vol 42, Number 2. [2] Satterwhite C. and Righter K. (2020) *Ant. Met. Newsletter* Vol 43, Number 1.