NEW INSIGHTS INTO THE GEOLOGICAL EVOLUTION OF THE MOON VIA PETROLOGIC INVESTIGATION OF LUNAR BASALTIC METEORITES DOMINION RANGE 18262 and DOMINION RANGE 18666. S. M. Ireland[1], C. L. McLeod[1], A. J. Gawronska[1], J. Brum[1], B. J. Shaulis[2]. [1]Miami University, Dept. of Geology & Environmental Earth Science, 250 S. Patterson Ave, Oxford, Ohio 45056, USA (irelans@miamioh.edu), [2]Trace Element and Radiogenic Isotope Laboratory (TRAIL), University of Arkansas, Fayetteville, Arkansas, 72701.

Introduction: Developing our understanding of the formation of the rocky planets in our inner Solar System requires seeking knowledge from other planetary objects (e.g., moons, planets, comets, asteroids). Observing geological phenomena (e.g., cratering via impact, volcanism) on other celestial bodies in our Solar System gives insight into the early geological history of our own planet Earth. This is because plate tectonics and hydrologic processes on Earth have worked to reshape and rework Earth's surface over millions and billions of years. As a result, the majority of our own planet's geological history has been lost; however, on nearby celestial objects such as the Moon, plate tectonics and hydrologic processes are absent. Therefore, its geological record has the potential to yield samples which not only record early planetary-forming processes, but also record events which have characterized the geological evolution of objects in the inner Solar System (e.g., periods of impact cratering) [1,2].

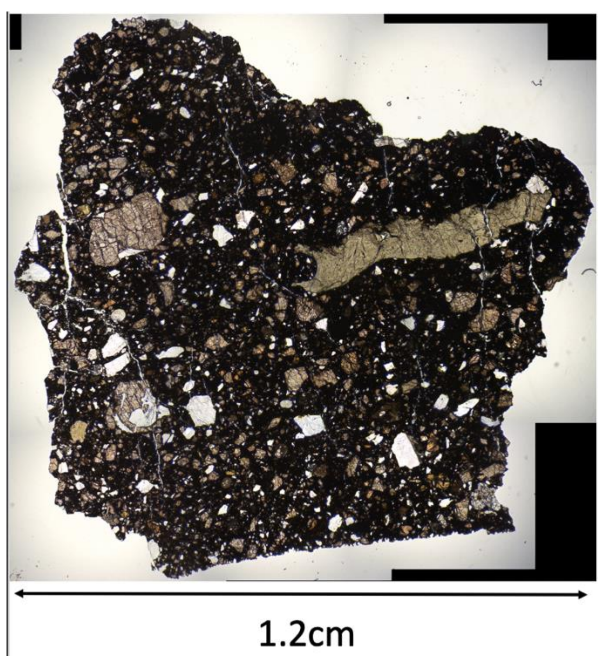
Lunar meteorites are invaluable for furthering our knowledge and understanding of the early geological evolution of the Moon. They represent a random sampling of lunar materials and therefore, meteorites found on Earth have a higher chance of having originated from regions not sampled by the six crewed Apollo missions to the lunar surface (1969-1972). In addition, lunar meteorites have the potential to originate from deeper portions of the Moon than what may have been available for sampling at the lunar surface by the Apollo missions due to their origin via impact [1].

Research associated with this contribution will focus on characterizing the mineralogies, textures, and chemistries associated with two basaltic lunar meteorites that were returned during the Dominion Range (DOM) in Antarctica during the 2018 Antarctic Search for Meteorites (ANSMET) expedition. Specifically, samples Dominion Range 18666 and Dominion Range 18262 will be studied. Both of these samples have been classified as basaltic in nature [4]. Through detailed petrographic study, complemented by textural and elemental analysis the geological processes which characterize the history of these samples will be evaluated (e.g., crystallization, shock). Results will be considered within the broader context of the Moon's geological evolution and the geological processes which are integral to the evolution of rocky planetary objects.

Methodology: Petrologic and geochemical investigation will initially be conducted via Polarized Light Microscopy (PLM) and Scanning Electron Microscopy (SEM) at the Center for Advanced Microscopy and Imaging (CAMI) in house at Miami University. Data collected via SEM will characterize the mineralogical composition at the centimeter to micron scale of these recently discovered samples. Following mineralogical characterization, the major element and trace element chemistry of major phases will be acquired via electron probe microanalysis (EPMA) at the University of Kentucky, and laser ablation with plasma mass spectroscopy (LA-ICP-MS) in house at Miami University, respectively. Microscopy methods described here will also allow for the identification of accessory phases (e.g., zircon, apatite) that may be dated using the U-Pb system.

Samples DOM 18262 and DOM 18666 will also be analyzed via X-ray computed tomography (CT). Resulting CT data will be used to evaluate the textural features and clast fabrics in 3D [5].

Results and Discussion: Initial work has focused on identifying and characterizing the major phases and clasts present in sample DOM 18666 via PLM (Figure 1) and SEM (along with Energy Dispersive Spectroscopy (EDS), Figure 2). To date, anorthite and clinopyroxene are the two most common phases that have been identified. They occur both as individual grains and in coarse-grained gabbroic clasts (see Figure 2).



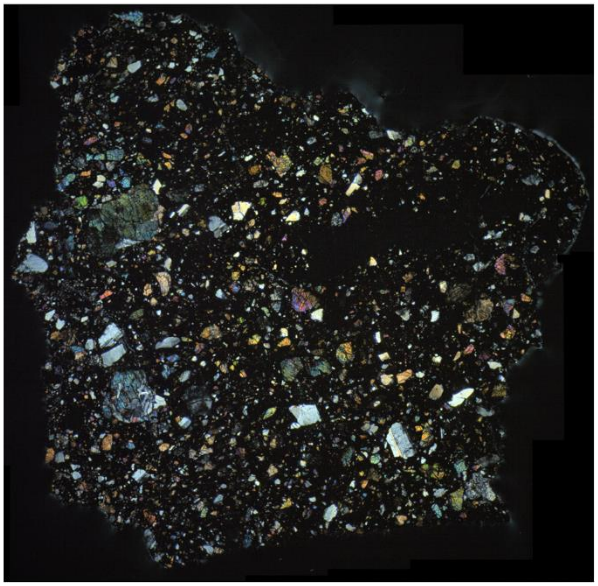


Figure 1 DOM 18666 in plane polarized light (upper panel) and cross polarized light (lower panel).

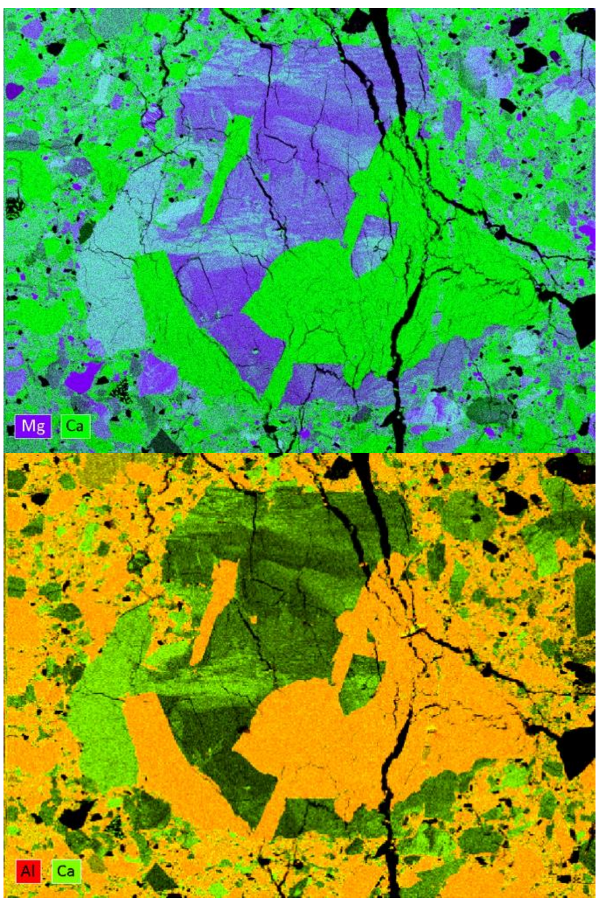


Figure 2: Elemental map of gabbroic clast in DOM 18666.

Future Work: Investigation of DOM 18666 (and 18262) via methodologies described here will continue in order to comprehensively characterize the mineralogies and textures that exist in these recently discovered meteorites [3,4]. The degree of shock that these samples experienced will be assessed and elemental maps acquired via SEM-EDS (see Figure 2) will be used to guide future *in-situ* analyses through EPMA and LA-ICP-MS. The acquired CT scans of meteorite rock chips will be processed using Blob 3D [5] to extract information regarding clast size distribution and clast mineralogy.

Collectively, the data acquired during the course of this work will contribute to our understanding of lunar meteorite petrogenesis and our knowledge of the geological diversity of the Moon.

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