EXPLORING THE RELATIONSHIPS OF APOLLO 17 MG-SUITE SAMPLES THROUGH NEW PETROLOGICAL AND CHEMICAL INSIGHTS. D. F. Astudillo Manosalva[1] and S. M. Elardo[1], [1]The Florida Planets Lab, Department of Geological Sciences, University of Florida, Gainesville, FL 32611, USA. daniel.astudillo@ufl.edu.

Introduction: The Mg-suite is a group of plutonic crustal rocks defined by its ancient ages, very high Mg# in mafic minerals, and Na-poor plagioclase. These rocks are interpreted to be a result of early magmatism at the end of or immediately after lunar magma ocean solidification. The largest and most pristine Mg-suite samples were retrieved by the Apollo 17 mission from the Taurus-Littrow valley and present many textural similarities, such as grain sizes, late entrapment phases, and disequilibrium textures. These similarities have brought some to think these samples might be originated from a single magmatic system, such as a mafic layered intrusions. Most Mg-suite samples have been studied separately rather than as a coherent group [1–4], and therefore, if there is in fact a co-magmatic relationship between all or a subset of samples, a certain degree of bias may be present in the interpretations for early lunar magmatism that heavily relies on these rocks.

To investigate any potential relationships between these rocks, petrographic analyses and major element chemistry are currently being used to find additional similarities between a large subset of samples [5]. The previous identification of abundant chromite-pyroxene symplectites in most lithologies has been interpreted as a reaction that occurs during the cooling of these samples at similar temperature and pressure conditions [5]. In addition, the common minor phase assemblages and exolution textures shared between most samples is also consistent with shared physical conditions [5]. Future trace element analyses, such as those done in the past ([1,6]), together with additional petrographic observations and chemical associations will allow us to identify new common primary and secondary processes to assess the question a co-magmatic origin.

Methods: Thin sections from 20 samples of Apollo 17, encompassing the range of Mg-suite rocks that includes dunites, troctolites, norites, and gabbronorites, have been considered for analysis. Petrography is performed via optical microscope and back scattered electron (BSE) imaging in both scanning electron microscopy and electron-probe microanalysis (EPMA). Analysis of major and minor elements in minerals is done using a Cameca SXFive FE EMP at the University of Florida at 15 kV and 20 nA. Trace elements will be obtained through laser ablation inductively coupled plasma mass spectrometry, mainly on pyroxene and plagioclase in the larger samples. Compositional inversions to calculate parental melt compositions will be carried out using trace element partition coefficients that are appropriate for a lunar environment [7–10].

New observations and results: Given the abundance of exsolution textures in pyroxenes, we have obtained estimates of the equilibration temperatures of a subset of samples using the two-pyroxene thermometer (Fig. 1, [11]), and most samples seem to record temperatures around 1000°C with the exception of a few outliers, such as sample 78527. This sample has a granulitic texture with small crystals that is unique among the other samples. Also, 76535 and 78235 are a poorer fit to the two pyroxene model (i.e., larger uncertainties), which may indicate pyroxenes are not fully in equilibrium. Furthermore, a trend in the TiO_2 contents with the Cr# of chromite is consistent with crystallization of the samples from a single magmatic source. Additionally, we have found evolved mineral phases, particularly an assemblage of baddeleyite, cristobalite, and Rb-Ba bearing K-feldspar (Fig. 2), in all lithology types, except for the dunite, and in the majority of samples. These assemblages seem to be more abundant and richer in incompatible elements the more evolved the lithology is, as would also be expected for cumulates forming from the evolution of a single source.

Discussion: In addition to textural and grain size similarities, we have now identified chemical trends in chromite and apparent trends that can be observed in the most evolved phases of the rocks. When paired with the physical constraints in temperature and pressure provided by thermometry and the presence of symplectites, there is strong evidence that supports the common origin of many of the Apollo 17 Mg-suite samples from a single mafic layered intrusion. However, upcoming trace element analyses and calculations of parental melt compositions will offer more robust insights into possible co-magmatic relationships.

References: [1] Papike, J. J., *et al.* (1996) *Geochim. Cosmochim. Acta* 60, 3967–3978. [2] Shearer, C. K., *et al.* (2005) *Geochim. Cosmochim. Acta* 69, 3445–3461. [3] Elardo, S. M., *et al.* (2012) *Geochim. Cosmochim. Acta* 87, 154–177. [4] Shearer, C. K., *et al.* (2015) *Am. Mineral.* 100, 294–325. Astudillo Manosalva., et al. (2022) *LPS LIII* abstract #2778 [6] Papike, J. J., *et al.* (1994) *Am. Mineral.* 79, 796–800. [7] Sun, C., *et al.* (2012) *Contrib. Mineral. Petrol.* 163, 807–823. [8] Yao, L., *et al.* (2012) *Contrib. Mineral. Petrol.* 164, 261–280. [9] Sun, C., *et al.* (2013) *Geochim. Cosmochim. Acta* 119, 340–358. [10] Sun, C., *et al.* (2017) *Geochim. Cosmochim. Acta* 206, 273–295. [11] Andersen *et al*., (1993) *Comput. Geosci. 19, 1333-1350.* **Acknowledgements**: The authors acknowledge support from NASA Solar System Workings grant 80NSSC19K0752 and UF.

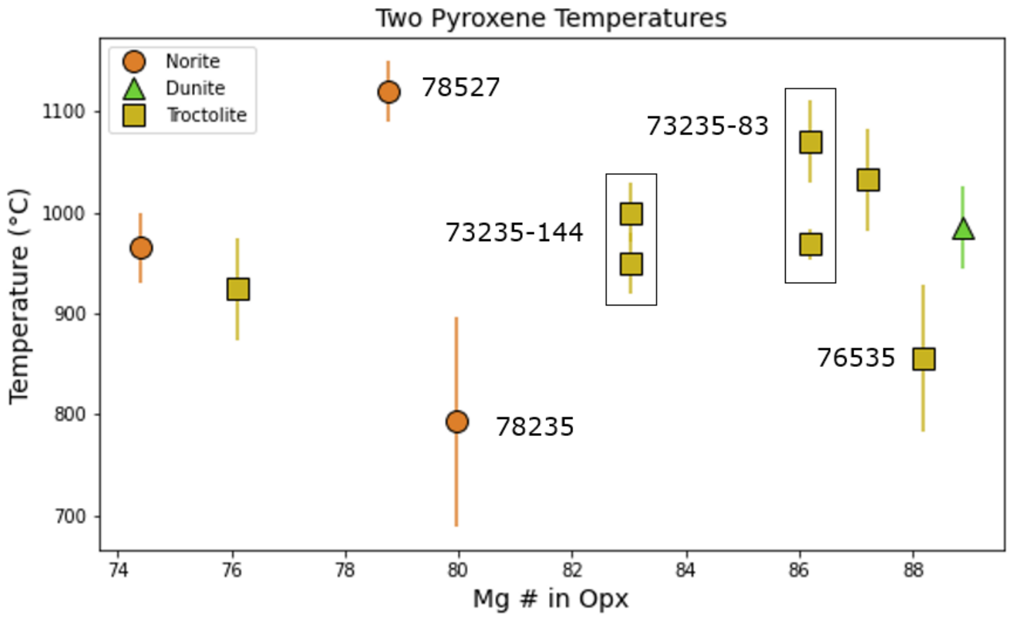

Figure 1: Two-Pyroxene thermometry [11] of Mg-suite samples including symplectite, lamellae and two-crystal pairs.

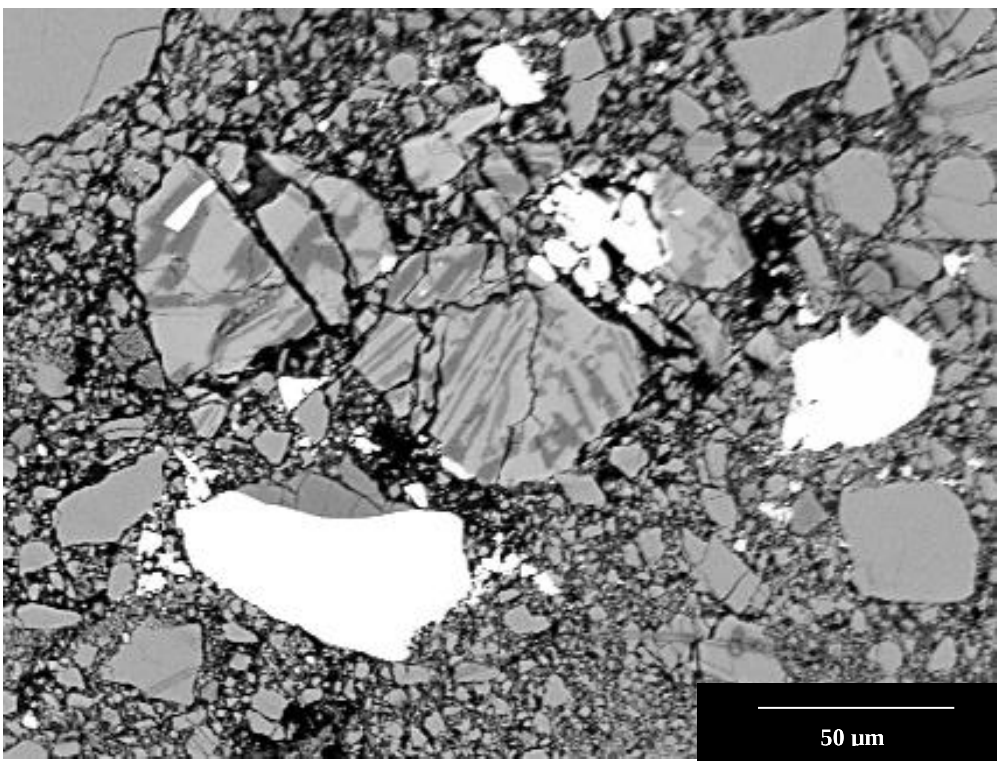

Figure 2: Assemblage of baddeleyite (white) and myrmekitic arrangement of K-feldspar (light grey) and cristobalite (dark grey) in norite sample 77077-6. K-feldspar also contains around 3% Rb+Ba in it. Additional Ti oxides and orthopyroxene are present in the image.