SPECTRAL CHARACTERIZATION OF LUNAR ANALOG SAMPLES: PHYSICAL MIXTURES OF HIGHLY CALCIC PLAGIOCLASE AND MG-SPINEL

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Introduction

Since their discovery, Mg-spinel bearing pink spinel anorthosites (PSA) have intrigued researchers and been identified at over 50 locations on the Moon [1, 2]. The abundance of plagioclase associated with the Mg-spinel exposures is not well-constrained, leading to lingering questions about how it may have formed and was brought to the lunar surface [3, 4].

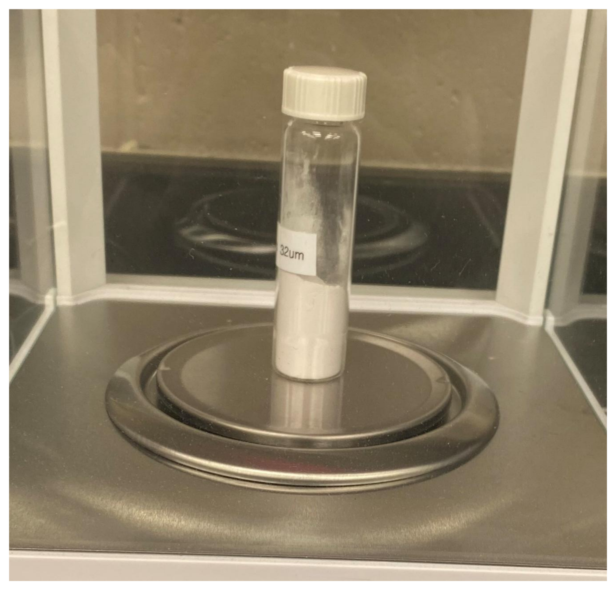
Our Goals:

- ❖ To better interpret the compositions of these Mg-spinel rich regions and understand the implications for how they formed.
- ❖ We present visible to near infrared (VNIR) and mid infrared (MIR) laboratory spectral measurements of spinel and plagioclase mineral mixtures.

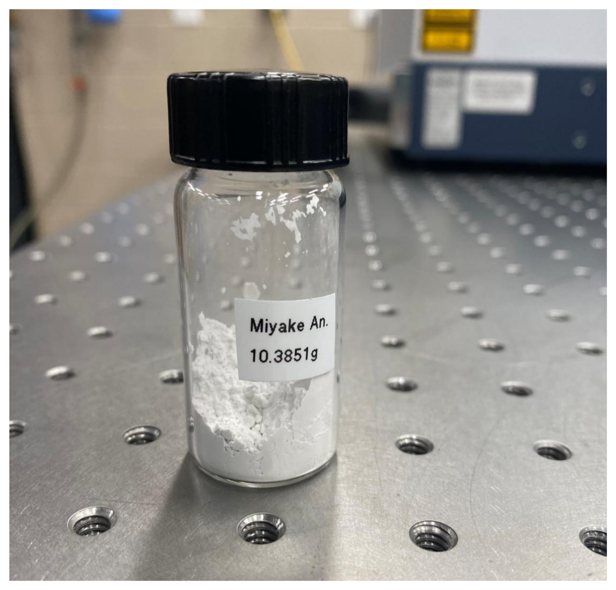
Sri Lankan Mg-Spinel crystals

Crushed using a spinel mortar and pestle

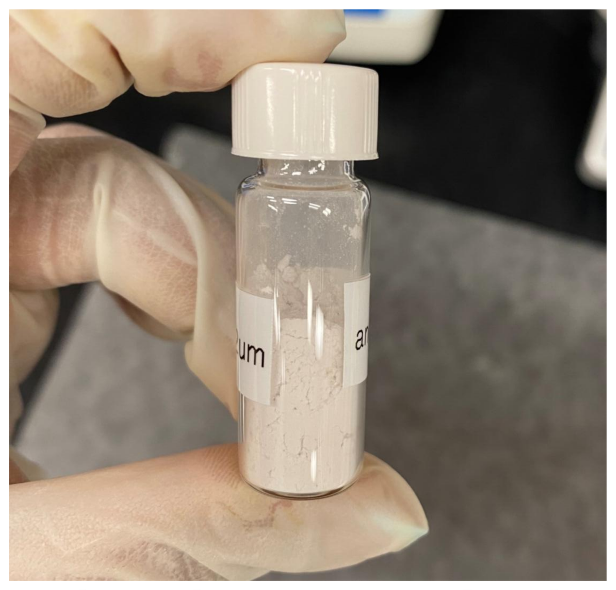
Sieved through 250 μm and 32 μm sieves



Spinel powder (<32 μm)



Miyake Anorthite powder (<32 μm)



Physical Mixtures produced

Table 1: Anorthite and Mg-Spinel Mixtures

Volume % anorthite	Anorthite Mass (g)	Spinel Mass (g)	Total Mass (g)	Real % volume
5	0.085	2.122	2.207	5.053
10	0.169	2.031	2.200	10.010
25	0.440	1.760	2.200	25.002
50	0.943	1.257	2.200	50.010
75	1.523	0.677	2.200	75.005
90	1.916	0.284	2.200	90.013

Methods

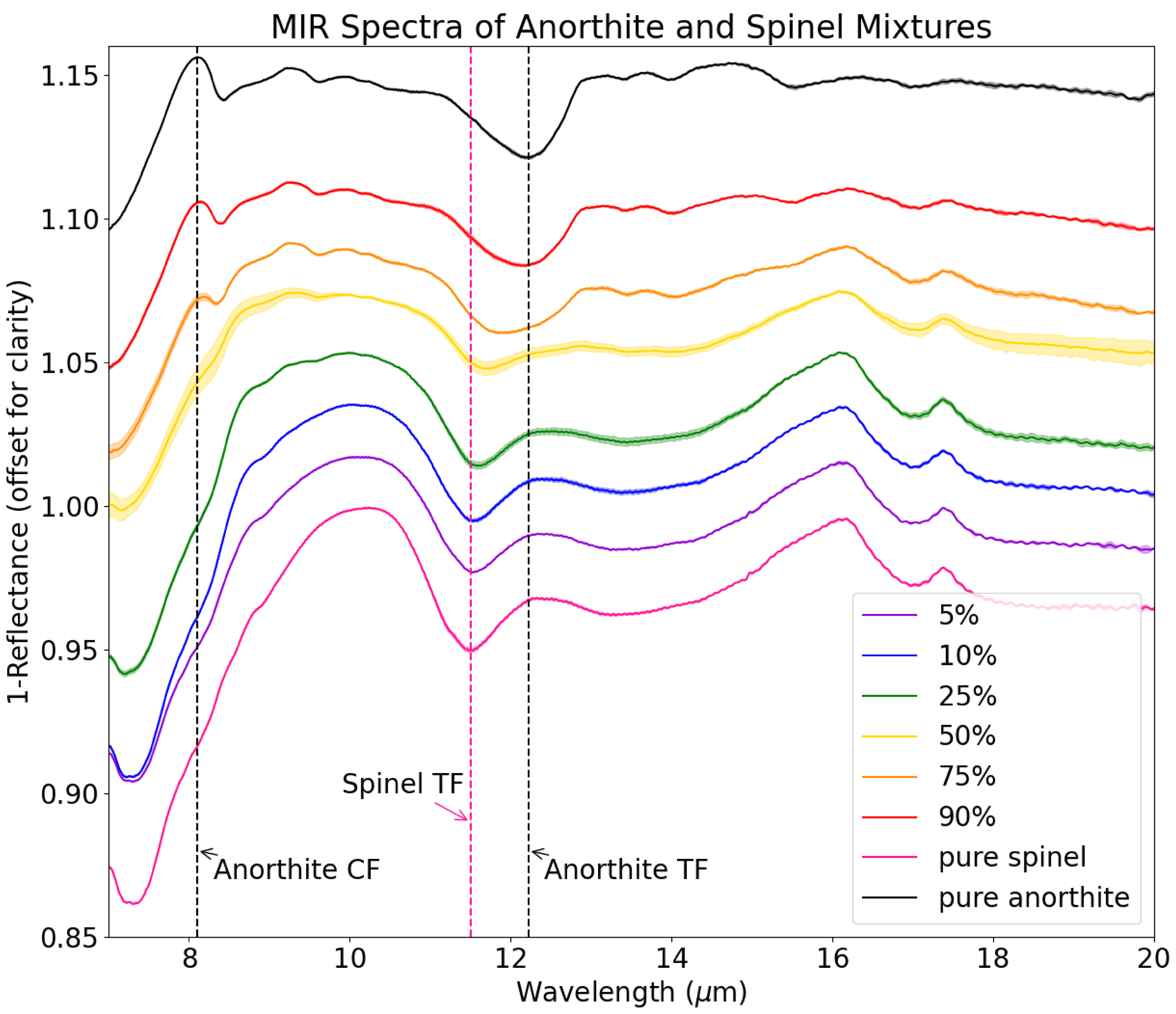
Sample Preparation

Our mineral endmembers include Miyake-jima anorthite, which is a highly calcic (An_{94-96}) plagioclase, and a Mg-spinel sourced from Sri Lanka.

- ❖ Spinel crystals were crushed and sieved to <32μm powder and then combined with Miyake anorthite of the same particle size.
- ❖ Six unique mixtures were prepared based on the volume percentage abundance of anorthite and spinel (Table 1).

Spectral Measurement

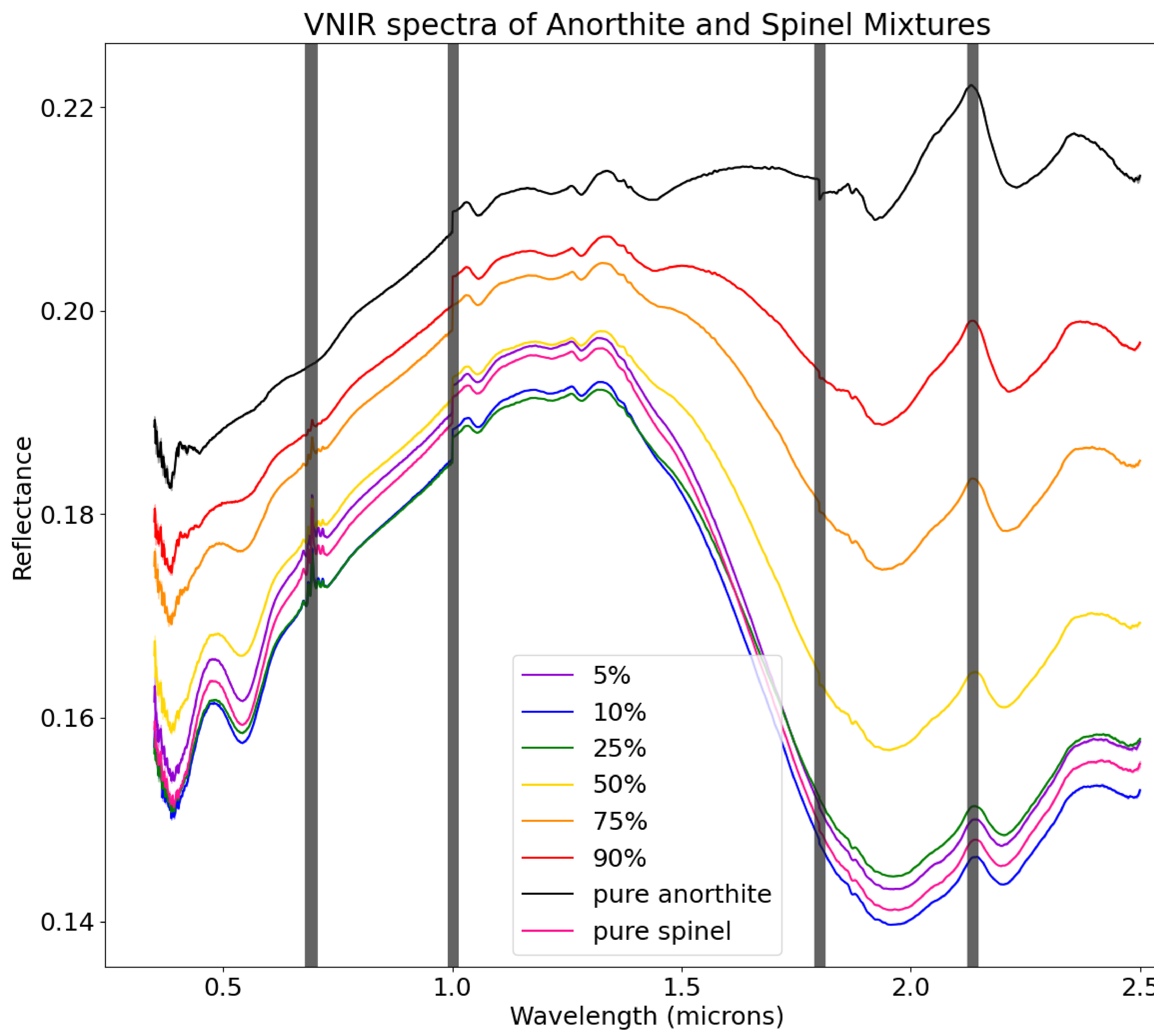
- ❖ A Nicolet iS50 FTIR Spectrometer with coarse gold as the reflectance standard was used to measure the MIR reflectance using the DTGS detector and a KBr beamsplitter.
- ❖ A Malvern Panalytical's ASD LabSpec 4 with a Spectralon reflectance standard was used to measure VNIR spectra mixtures.



Results

In the MIR spectra, we can see that as the abundance of anorthite in the mixture increases, the Christiansen feature (CF) associated with anorthite becomes more prominent. Similarly, as the abundance of spinel decreases, the transparency feature (TF) becomes weaker and visibly shifts.

In the VNIR, the most notable feature is spinel's absorption feature near 2 μm. While the changes in spectra are non-linear with abundance in the VNIR, there is still a notable decrease in absorption band depth with a decrease in spinel abundance. We observe an increase in overall reflectance as the anorthite abundance increases as well.



References

[1] Pieters C. M., et al. (2011) JGR: Planets VOL. 116, E00G08. [2] Sodha G., et al. (2025) Sci Rep 15, 2426. [3] Pieters C. M., et al. (2014) American Mineralogist, VOL. 99. [4] Prissel T. C., et al. (2014) EPSL. VOL 403

Future Work

- ❖ Improve characterization of spectral features using quantitative techniques.
- ❖ Compare spectra with M³ and Diviner observations of Mg-spinel bearing locations to constrain plagioclase and spinel abundances.

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