GEOLOGY OF SCALIGER CRATER REGION: IMPLICATIONS FOR MAGMATISM IN THE AUSTRALE NORTH BASIN . N. Panwar[1,2] (nehapanwar20@gmail.com) and N. Srivastava[1], [1]Planetary Sciences Division, Physical Research Laboratory, Ahmedabad, India, [2]Indian Institute of Technology Gandhinagar, India.

Introduction: The Australe North (35.5°S, 96°E) is a pre-Nectarian impact basin first identified using the data from GRAIL [1]. It lies to the north of Mare Australe at the nearside-farside boundary. It is noted that even the largest impact structures can be muted depending on the thermal state of the crust during the early history of the Moon [2]. The Australe North Basin too is not associated with any topographic structure that is typical of an impact basin indicating to its ancient formation. The proposed boundary of this ~880 km basin identified from GRAIL does not coincide with the earlier identified Australe Basin boundary [1, 3]. The Scaliger Crater, centered at (27.1°S, 108.9°E), is a ~87 km diameter complex impact crater lying at the north-eastern flank of the proposed Australe North Basin at its intersection with the peak ring basin Milne (diameter = 264 km) [1] (Figure 1). The Lacus Solitudinis is an arcuate mare to the west of the Scaliger Crater emplaced between the Inner Depression and the outer rim of the proposed Australe North Basin.

In this study, we have carried out a detailed investigation of the geology of one of the oldest basins on the Moon. Specifically, we have studied the compositional diversity of the magmatic units in the region to understand their emplacement mechanisms and role in the geological evolution of the Australe North Basin.

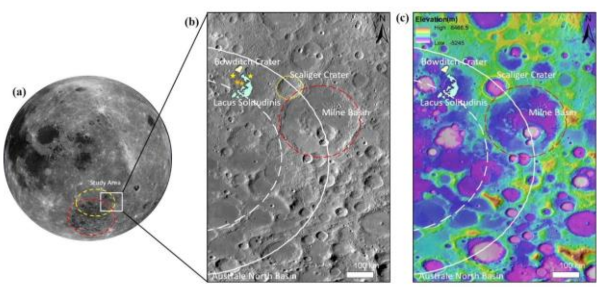

Figure 1(a) A LROC WAC image of the Moon depicting the geological setting of the study area, Scaliger Crater Region enclosed within the white square. The red dashed circle in 1a marks the location of the Mare Australe as per [3]. The yellow dashed circle in 1a marks the Australe North Basin identified using GRAIL [1]. (b, c) A zoomed-in view and topography of the study area and adjoining regions using a LROC WAC image mosaic and a SLDEM2015 topographic map. The solid white line represents the rim of the Australe North Basin, while the dashed white lines denote the associated 600 km depression [1]. The spatial extent of mare inside Lacus Solitudinis (blue) and Bowditch Crater (yellow) [4]. The yellow stars mark the location of the Concentric Craters (CC), and the orange stars denote the Floor Fractured Craters (FFC).

Datasets and Methods: High-resolution datasets from the Wide Angle Camera (WAC) (resolution 100 m/pixel) [5] and the Narrow Angle Cameras (NACs) (resolution 0.5 m/pixel) [6] has been used to study the regional topography of the study area. The Moon Mineralogy Mapper (M^3) hyperspectral data [7] has been used along with the FeO wt% [8] map TiO_2 [9] map to study the compositional diversity in the Scaliger Crater Region. The M^3 data has also been used to prepare an Integrated Band Depth (IBD) based false-color composite (FCC) for the study area using the methodology defined by [10].

$$IBD1\ (1\ \mu m) = \sum_{n=0}^{26} 1 - \frac{R(789 + 20n)}{Rc(789 + 20n)}$$

$$IBD2\ (2\ \mu m) = \sum_{n=0}^{21} 1 - \frac{R(1658 + 40n)}{Rc(1658 + 40n)}$$

The FCC is generated by assigning red to the 1 µm IBD image, green to the 2 µm IBD image, and blue to the 1489 nm reflectance image (Figure 2).

Observations and Results:

Morphology: The topographic profiles have been used to estimate the morphometric parameters such as the crater diameter, crater depth, rim height, floor diameter height of the central peak, basal area of central peak. These observed values have been compared with the values calculated using crater scaling relationships to provide context to Scaliger Crater with respect to other craters of similar size. The Scaliger Crater central peak has a basal area of 58.73 km^2 much lower than the expected 161.23 km^2 calculated from the relation defined by [11].

Compositional Analysis:

The mare basalts show moderate variation in the FeO wt% inside Lacus Solitudinis (~18 wt%) and the Bowditch Crater (~14 wt%). The Lacus Solitudinis basalts have higher TiO_2 (~ 5-7 wt%) than the Bowditch Crater (~3-4 wt%). The cryptomare and mare from Lacus Solitudinis is also compositionally distinct from the Milne Basin cryptomare (Figure 2).

Chronology: At least three resurfacing events have been witnessed inside the Lacus Solitudinis. Crater counting yield ages of 3.8 (+ 0.04, -0.07) Ga, 3.5 (+0.05, -0.08) Ga and 2.3 (+0.09, -0.09) Ga for the Lacus Solitudinis basalts [by fitting curves of diameter ranges, 1.4 km < D < 4 km, 800 m < D < 2 km, and 250 m < D

< 1.2 km, respectively]. The Bowditch Crater basalts correspond to ages 3.5 (+0.09, -0.2) Ga and 1.7 (+0.2, -0.2) Ga [by fitting curve for diameter ranges, 700 m < D < 1.1 km, and 250 m < D < 1 km] (Figure 3).

Discussion: The unique geological setting of the Scaliger Crater has enabled us to decipher the evolutionary history of heavily degraded pre-Nectarian Australe North Basin. The study probes the mineralogical diversity that exists between the various magmatic units associated with the north-eastern edge of the Australe North Basin. The mare and the cryptomare units in the region are mineralogically distinct and are spread through space and time. Interestingly, one of the oldest basin on the Moon far from KREEP has experienced prolonged volcanism inside it extending till ~1.7Ga.

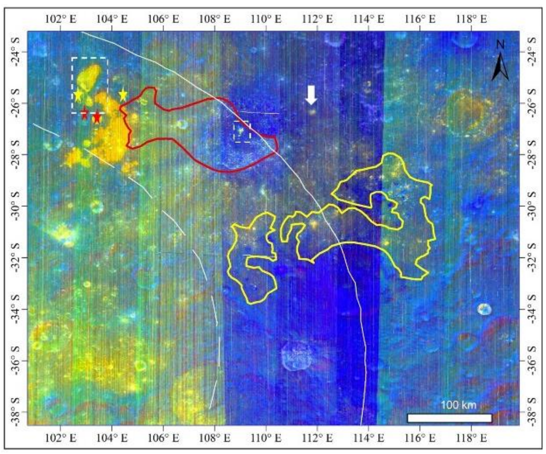

Figure 2: IBD based FCC of the study area showing the cryptomare regions of Lacus Solitudinis (red polygon) and Milne Basin (yellow polygon) [12] covered in this study..

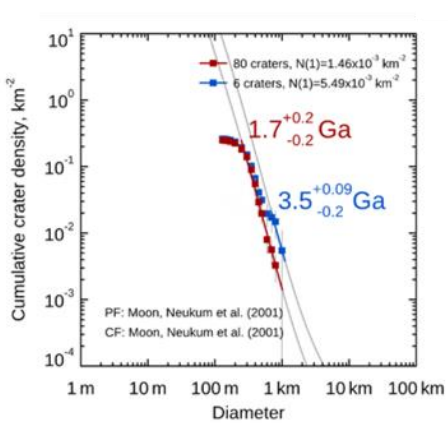

Figure 3: CSFD plot for Bowditch Crater basalts

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