GEOLOGIC MAPPING OF THE LUNAR SOUTH POLE QUADRANGLE (LQ-30). S.C. Mest[1,2], D.C. Berman[1], and N.E. Petro[2], [1]Planetary Science Institute, 1700 E. Ft. Lowell, Suite 106, Tucson, AZ 85719-2395 (mest@psi.edu); [2]Planetary Geodynamics Laboratory, Code 698, NASA GSFC, Greenbelt, MD 20771.

Introduction: In this study we use recent image, spectral and topographic data to map the geology of the lunar South Pole quadrangle (LQ-30) at 1:2.5M scale [1-7]. The overall objective of this research is to constrain the geologic evolution of LQ-30 (60°-90°S, 0°-±180°) with specific emphasis on evaluation of a) the regional effects of impact basin formation, and b) the spatial distribution of ejecta, in particular resulting from formation of the South Pole-Aitken (SPA) basin and other large basins. Key scientific objectives include: 1) Determining the geologic history of LQ-30 and examining the spatial and temporal variability of geologic processes within the map area. 2) Constraining the distribution of impact-generated materials, and determining the timing and effects of major basin-forming impacts on crustal structure and stratigraphy in the map area. And 3) assessing the distribution of potential resources (e.g., H, Fe, Th) and their relationships with surface materials.

Methodology: This project utilizes ArcGIS (v. 9.3) to compile image, topographic and spectral datasets to produce a geologic map of LQ-30. The study uses the Clementine UVVIS 750-nm mosaic (100 m/pixel) as its primary base to characterize geologic units from surface textures and albedo, identify contacts and structures, and map impact craters (D>1 km). Additional datasets are being used to complement the UVVIS base and include mosaics (Lunar Orbiter, Clementine NIR), images (LROC, Clementine UVVIS and HIRES, and Lunar Orbiter), Clementine color ratio data, and LOLA topography.

Regional Geology: LQ-30 exhibits ~16 km of relief. The near side consists predominantly of cratered highlands, is more heavily cratered and displays higher elevations than the far side. This difference is due to the overwhelming presence of SPA, which encompasses nearly all of the far side map area.

SPA is the largest (D=2600 km, ~18 km deep) and oldest (pre-Nectarian) impact basin identified on the Moon [8-10]. Models suggest that SPA formed by an oblique impact that excavated material from the upper crust [11,12] to the lower crust or upper mantle [13,14]. Galileo and Clementine multispectral data show enrichment in mafic materials [15-19] and LP-GRS data show enhancements in both Fe and Th [20-23] within the basin relative to the surrounding highlands. The materials exposed within SPA, such as in central peaks or in crater walls, could be used to estimate the composition of the lower crust/upper mantle.

Mapping Results: LQ-30 hosts all or part of 46 impact features greater than 100 km in diameter that would have significantly affected the structure of the crust and redistributed large amounts of material across the surface [7]. Impact craters display morphologies ranging from simple to complex [7-9,24] and most contain floor deposits distinct from surrounding materials. Most of these deposits likely consist of impact melt; however, some deposits, especially on the floors of the larger craters and basins (e.g., Antoniadi), exhibit low albedo and smooth surfaces and may contain mare. Higher albedo deposits tend to contain a higher density of superposed impact craters.

Antoniadi Crater. Antoniadi crater (D=150 km; 69.5°S, 172°W) is unique for several reasons. First, Antoniadi is the only lunar crater that contains both a peak ring and a central peak, placing it morphologically between impact craters and multi-ring basins [8,9]. Second, it contains the lowest elevations on the Moon (-8.5 km), which may provide access to lower crustal/upper mantle materials via its central peak and peak ring. Its floor deposits consist of dark smooth material near the center of the crater, and brighter more rugged material between the peak ring and crater wall [7,25]. Recent mapping shows that the dark material embays the rugged material, as well as the peak ring and central peak. The rugged material likely includes impact melt. Superposition relationships indicate the dark material was emplaced after the rugged material and may consist of mare [7].

Crater size-frequency distributions for small craters (D<10 km) superposed on Antoniadi's ejecta blanket suggest an Upper Imbrian age, whereas craters greater than 10 km in diameter suggest a Lower Imbrian/Nectarian age [7,25]. It is important to note that Antoniadi's ejecta blanket also contains a significant number of secondary craters that are likely included in the counts and will affect age determination.

Schrödinger Basin. Schrödinger basin (76 ºS, 134 ºE) is one of the least modified lunar impact basins of its size, is believed to be Imbrian in age [6-8,26], and is likely one of the last major basin-forming impact events on the Moon, slightly older than the Orientale impact, which emplaced secondary craters on Schrödinger's floor [26]. The basin exhibits an outer ring (D=312 km) that defines its rim and an inner peak ring (D=160 km) represented by a discontinuous ring of mountains. LOLA topography shows the basin is ~8 km deep with elevations of ~2.5 km (max) along the western rim and -5.5 km (min) on the floor [6,7].

Arcuate to linear fractures are prominent on the basin floor and occur concentric and radial to the basin rim. Most fractures bisect plains-forming units, but some bisect the peak ring. These features are a few kilometers wide, and tens to a few hundred kilometers long and appear similar to other floor-fractured craters on the Moon and Mars [27].

Mapping has identified nine distinct units in the Schrödinger Assemblage organized into three groups - Basin Materials, the Plains Formation, and the Volcanic Formation [6,7].

Basin Materials: The oldest materials exposed in Schrödinger are *Schrödinger peak ring material* and *Schrödinger basin rim material* [6,7]. The peak ring material forms an incomplete ring of mountains around the center of Schrödinger. The basin rim material forms the topographic rim crest and interior wall of Schrödinger. These materials are interpreted to consist of pre-Schrödinger crustal materials uplifted following the impact event [6,7,12,28].

Plains Formation: The floor of Schrödinger is covered with plains-forming materials that display a variety of surface textures and albedos. *Schrödinger rugged plains material* is the oldest plains material on the basin floor. Most exposures are found outside of the peak ring and form heavily cratered and knobby plateaus and massifs of moderately high albedo [6]. *Schrödinger hummocky plains material* occupies much of the floor along the northern and western walls within Schrödinger, and in the south where the peak ring is the most discontinuous. Hummocky plains display moderately cratered, low albedo surfaces with gently rolling topography [6]. The rugged and hummocky plains materials are interpreted to consist of impact melt [6,7].

Schrödinger smooth plains material, found just inside the peak ring, embays the rugged plains, peak ring and basin wall materials. The smooth plains display moderate to high albedo and contain few craters [6]. *Schrödinger mottled plains material*, found primarily in the center of Schrödinger, displays a smooth surface that is lower in albedo and less cratered than the smooth plains. The smooth plains and mottled plains materials are interpreted to be volcanic (mare) in nature, possibly erupted via floor fractures [6,7].

Schrödinger knobby plains material forms two high-albedo deposits along the southern basin wall. These deposits exhibit lobate edges, and clusters of rounded and elongated knobs. Knobby plains material is interpreted to be (a) impact ejecta, (b) basin wall materials emplaced by landslides, and/or (c) more rugged exposures of the rugged plains [6,7].

Volcanic Formation: Volcanic materials are concentrated inside Schrödinger's peak ring. *Schrödinger dark plains material* displays a smooth, featureless, low albedo surface. Clementine UVVIS color ratio data show these deposits are more mafic relative to other Schrödinger plains [6]. Within one exposure, a long (10s of kilometers) sinuous rille emerges from the mottled plains and terminates within the dark plains. Dark plains material is interpreted to be composed of fluid basaltic lavas [5-7].

A small (D=5 km) well-preserved ovoidal cone is found in the eastern part of Schrödinger, just inside the peak ring. The cone displays ~500 m of relief above the surrounding plains and is ~400 m deep from its floor to its rim [6]. The cone has been characterized as a "maar" crater [26] and a "dark-halo crater" (DHC) [29], and has been identified as the source of pyroclastic eruptions [26,29]. *Schrödinger dark material* forms a small deposit that surrounds and forms the flank of the DHC. This deposit exhibits a relatively smooth, lightly cratered surface with lower albedo than the surrounding plains [6]. Schrödinger dark material displays an unusually strong mafic band (950/750 nm versus 750 nm) in Clementine UVVIS data, but also displays similarities to lunar highland soils [29]. Based on the unit's relationship with the DHC and its spectral signature, Schrödinger dark material is interpreted to consist partly of mafic materials emplaced via pyroclastic eruptions originating from the DHC [6,7]. The deposit's spectral signature suggests contamination by feldspathic highland-type materials either by superposed crater materials and/or vertical mixing [29].

Mare Deposits. Mare deposits are found on the floors of some impact craters, but are also found on the floor of Australe basin along the eastern limb near the northern edge of the map area (~62°S, 90°E). These deposits are dark and smooth in appearance, but some are brighter and more rugged suggesting they are older and have been modified since their emplacement by (1) mantling by ejecta, (2) mixing by subsequent impacts, and/or (3) gardening and regolith development [7,8].

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