STRATIGRAPHY AND COMPOSITION OF NECTARIS BASIN DEPOSITS Paul D. Spudis[1] and M. C. Smith[1,2] 1. Lunar and Planetary Institute, Houston TX 77058 (spudis@lpi.usra.edu) 2. [1]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37916

Introduction. The Nectaris basin is a critical stratigraphic marker on the lunar near side [1]. In addition to its role as a major subdividing event in lunar history [1,2], it is also one of the largest multi-ringed basins, excavating many kilometers of its highland crustal target [3]. Moreover, the stratigraphic position of Nectaris, being roughly mid-way in relative age between the oldest (South Pole-Aitken) and youngest (Orientale) impact basins [1], suggests that knowledge of its formational processes, deposit compositions and absolute age can enlighten us on the topics of lunar crustal composition, multi-basin formational mechanics, and the possible occurrence of an impact "cataclysm" at 3.9 Ga [4].

We have initiated new study of the geology of the Nectaris basin, with emphasis on new geological mapping of its deposits [5] to isolate and identify Nectaris basin units and stratigraphy and distinguish them from abundant overlying, younger Imbrium basin units on the central and southern near side. This work is an outgrowth of the recent recognition that Imbrium ejecta is more widespread and influential across the near side than had been previously recognized [e.g., 6]. We have re-mapped the geology of the Nectaris basin using new LROC WAC images and global topographic data [5]. We have used this new mapping to isolate units that are unambiguously related to the Nectaris basin and to estimate their extent and position around the basin. This information is then used to determine the chemical composition of Nectaris basin materials, to compare these ejecta with ejecta from other lunar basins and typical highlands compositions, and to reconstruct the likely composition and structure of the Nectaris basin crustal target.

Geological Units. The distribution of units around the Nectaris basin are described in detail in a companion abstract [5]. In brief, basin units are best exposed near the main (Altai) rim of Nectaris, both as basin massifs and the Altai scarp, the near-rim highlands and the laterally expansive Janssen Fm. (continuous ejecta) south and southeast of the basin [1,3]. These units have long been recognized as the predominant remaining exposures of Nectaris basin deposits [1]. We have found from new mapping that in addition to these units, basin terra south west and west of the Altai ring are also likely to be related to the Nectaris basin. The newly recognized Nectaris deposits result in a total exposure of ~50,000 km^2 around the basin rim. This material displays of a variety of morphologies, including radially textured, undulating, plains-like and irregular. We specifically exclude from a Nectaris basin category any of the extensive knobby materials seen in the northeastern rim area and beyond [7]; it is likely that these units are distant facies of Imbrium basin ejecta, as recently recognized in studies of the Apollo 17 Montes Taurus highlands [6].

Composition of Nectaris basin ejecta. We have used the new geological mapping to create stencils to isolate and characterize the chemical composition of basin ejecta, with the aims of better understanding the nature and origin of Nectaris basin target materials as well as describing the likely compositional characteristics of Nectaris basin ejecta. Results of these determinations are presented in Table 1. Typical non-KRREPy highlands composition is that of a feldspathic norite (Table 1, [8]). This corresponds reasonably closely to the average composition of the Nectaris basin Janssen Fm., the radially textured, distal continuous ejecta blanket of the basin. Inner basin massif and near-rim deposits appear to be slightly more mafic than this composition (Table 1). It is possible that some of these exposures have been contaminated by material from the Imbrium basin. However, we have attempted to distinguish between mappable Imbrium deposits, which are well exposed northwest of the basin center, and highland units that can be confidently ascribed to Nectaris. The deposits mapped here as "Nectaris basin material" have clear texture and geometrical properties indicative of a Nectaris basin origin. Thus, we conclude that the difference in composition between near-rim and distal basin deposits is real and reflects derivation from different crustal levels or lateral regions.

We have made special effort to identify and map deposits of possible impact melt from the Nectaris basin and to estimate its likely composition. If melt deposits can be identified and isolated for compositional analysis, we can use this information to evaluate: 1) whether we possess candidate samples of Nectaris basin melt in the Apollo collections or as lunar meteorites; and 2) to identify sites on the Moon for future missions to obtain geologically controlled samples of basin melt. Several portions of the inner rings of Nectaris are similar in appearance to the inner Rook ring of the Orientale basin [1,3]; although it is not certain that these are exposures of Nectaris basin impact melt, they occur where such exposures would be expected. The compositions of these deposits appear to be slightly different than the inner basin deposits elsewhere, being generally lower in Fe and slightly higher in Th (Table 1). The lower Fe may be related to the inclusion of isolated inner ring massifs, some of which are composed of pure anorthosite, as reported previously [3]. The Nectaris basin melt sheet appears to be similar in composition to the other deposits of the basin ejecta, i.e., that of feldspathic "highland basalt," slightly lower in Th.

One final way to visualize the composition of these ejecta deposits is to plot their composition in the pseudo-ternary Ti-(Fe-Ti)-"Al" space [9,10]. This method uses the high-resolution Clementine Fe and Ti mapping techniques [11,12] so that small areas can be mapped and characterized. Results show that most of the Nectaris basin ejecta plots in classes 9 and 14 (Fig. 2), which corresponds to feldspathic compositions both similar and slightly less mafic than the Apollo 16 landing site soils (Fig. 2). These results suggest that Nectaris basin ejecta is more feldspathic and less mafic than either Imbrium and Serenitatis basin ejecta. We will continue to refine our estimates of basin ejecta compositions using the new geological mapping.

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Table 1. Composition of Nectaris Basin Geological Units

Basin units	FeO (wt.% ± 1σ)	TiO_2 (wt.% ± 1σ)	Th (ppm ± 1σ)	Comments
Massifs and near-rim deposits	8.1 ± 3.6	1.22 ± 3.5	1.29 ± 0.31	Inner basin ring massifs and rim crest ejecta
Possible melt sheet remnants	5.6 ± 2.4	1.1 ± 2.8	1.5 ± 0.24	Similar to Maunder Fm. of Orientale
Janssen Fm. and other rim exterior ejecta	6.1 ± 1.9	0.77 ± 2.59	0.89 ± 0.26	Continuous ejecta
Nectarian age basin terra	7.4 ± 2.7	0.90 ± 2.12	1.48 ± 0.62	Mixture of Nectaris + Imbrium (?)
All Nectaris basin terra	7.7 ± 3.7	0.91 ± 2.58	1.24 ± 0.57	All of above
"average" terra	6.6	0.6	0.9	From [8]

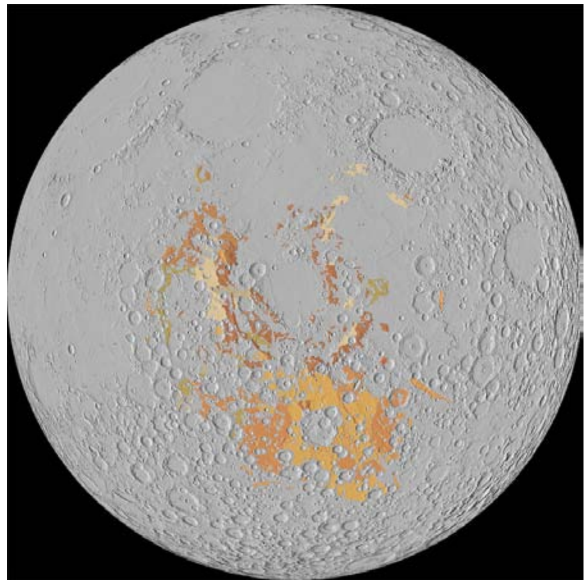

Fig. 1 Exposed Nectaris basin geological units based on new mapping in progress [5]. Orthographic projection centered on -16°, 34°

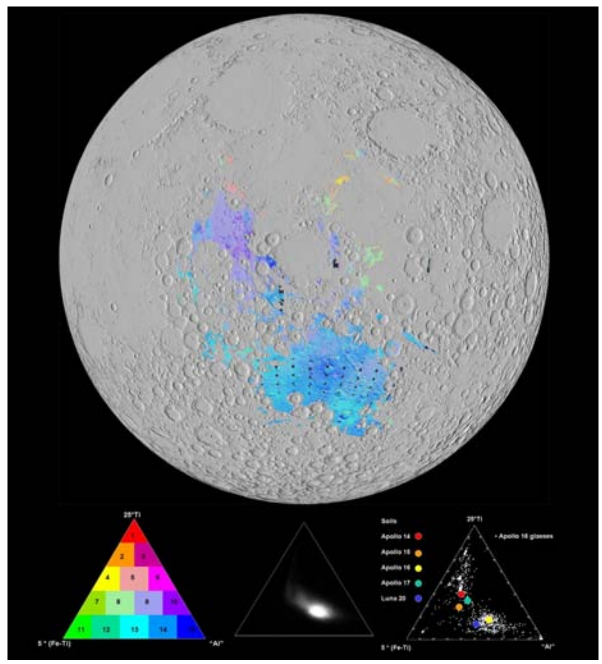

Fig. 2 Compositional map of basin ejecta units, plotted in Ti-(Fe-Ti)-"Al" pseudo-ternary space [9,10]. Color key shows arbitrary compositional fields; scatterplot of pixels shows where basin deposits fall in this compositional space, plot at right shows compositions of impact glasses in highlands soils (dots) and the average composition of landing site soils (color dots). Nectaris ejecta is slightly more feldspathic than the average Apollo 16 soil composition (right; yellow dot). After [10].