**DIFFERENCES IN THE MEGA-REGOLITH DEPTH ACROSS THE MOON'S SOUTHERN HIGHLANDS.** Thomas. W. Thompson[1], Bruce A. Campbell[2], Rebecca R. Ghent[3], and B. Ray Hawke[4]
[1]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, 91109, CA, USA, Ph: 818-354-3881, Fax: 818-393-5285, Thomas.W.Thompson@jpl.nasa.gov; [2]Center for Earth and Planetary Studies, Smithsonian Inst., MRC 315, Washington, D.C 20013, [3]Dept. of Geology, University of Toronto, Toronto, ON, Canada, M5S 3B1 [4]Hawaii Inst. of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822.

**Introduction.** The occurrences of small (1-16 km diameter) radar-bright craters are not uniform across the southeastern nearside lunar highlands. The region north of a line between Tycho and Janssen (~48° S), a region associated with Imbrian-aged near-side basin deposits, has more radar-bright craters than the highlands south of this line, a region closer to the far-side South Pole Aitken Basin. This difference in the abundance of small radar-bright craters is consistent with mega-regolith depths of 1.5 km to the north and 2.5 km to the south [1]. We attribute the difference in thickness to a blanket of South Pole Aitken basin ejecta across the southern-most regions of the lunar nearside highlands.

**Radar Data.** Dual-polarization radar image data at 70-cm wavelength were collected for the southern highlands in 2002-2006 by transmitting from the Arecibo (1000 foot) telescope and receiving the echoes at the Green Bank (300 foot) radio telescope [2]. The image data are focused to maintain the optimum achievable spatial resolution of a few hundred meters over the illuminated area. Fig. 1 shows same-sense (SC, depolarized) radar echoes for the southern highlands. These SC echoes are dominated by diffuse scattering associated with meter-sized blocks/rocks on the surface or in the upper 10-50 m of the subsurface. Thus, high 70-cm SC returns associated with craters indicate an abundance of meter-sized rugged ejecta blocks.

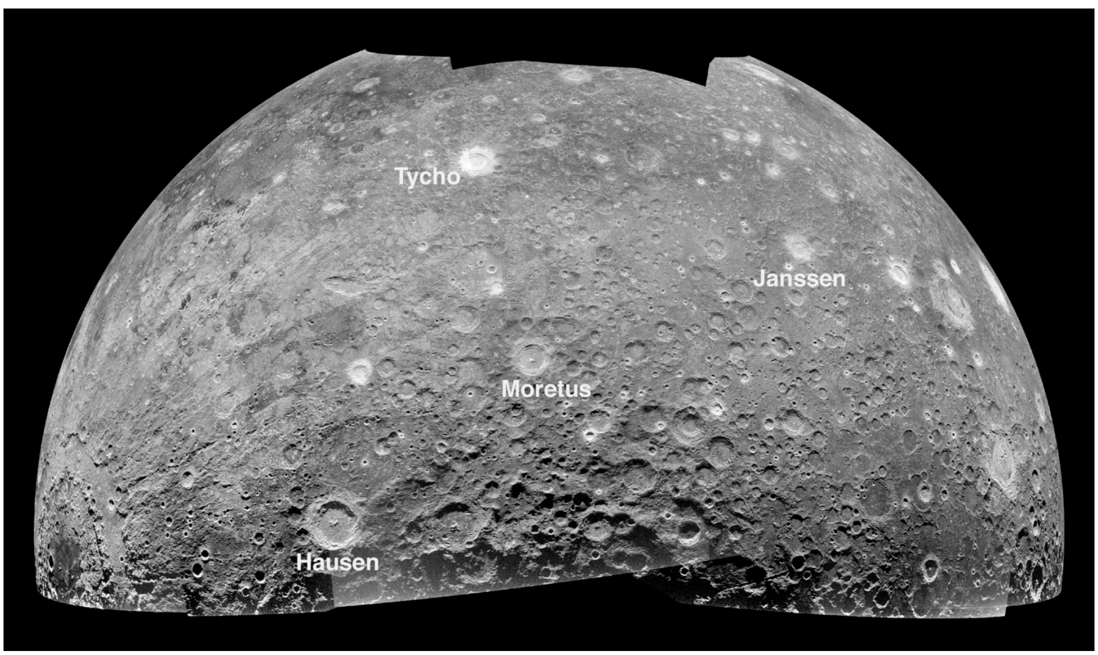
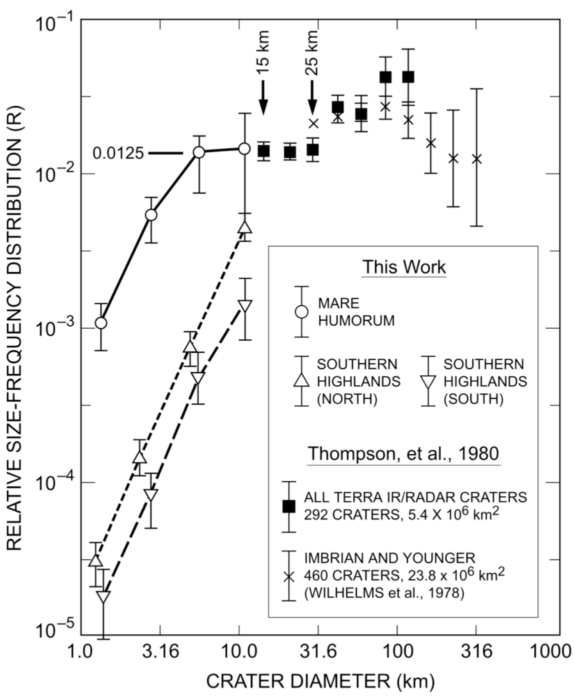



**Fig. 1.** 70-cm same-sense (SC, depolarized) radar echoes for the southern lunar highlands (orthographic projection centered on the south pole). Bright radar echoes due to blocky ejecta surround Eratosthenian- and Copernican-period craters. There are few small (1-16 km) radar bright craters in the area of the southeastern highlands below a line from Tycho to Janssen, while above this line in an area of younger basin ejecta there are significantly more radar-bright craters.

**Observations**. The Moon's southern highlands are a complex, overlapping sequence of ejecta deposited by the major basins, going back to the South-Pole-Aitken event. The line defined approximately by Tycho and Janssen craters at about 48º S marks the transition between units mapped as younger Imbrian-aged basin materials to the north and older pre-Nectarian and Nectarian deposits to the south [3]. Our radar data on the abundances of small lunar craters with radar-bright ejecta offers new insights into differences in mega-regolith depths between these two general areas. To the north of the Tycho-Janssen line, there are more craters, 1-16 km in diameter, with radar-bright ejecta than are present in the highlands extending southward toward the pole. This change in crater density approximately follows the shift from Imbrian-aged deposits to older basin deposits to the south, with the South Pole Aitken Basin being a major contributor in the south. The density of small radar-bright craters across the entire southern highlands is significantly less than in the maria (represented here by Mare Humorum) as shown in Fig. 2.




**Fig, 2** Relative size-frequency distributions of 1-16 km diameter, radar bright craters for Mare Humorum and southern highland terra. Also shown are previous global mare and terra 3.8- and 70-cm radar enhancements for size ranges of 16 to 100 km from Thompson et al. [4] and Imbrium and younger craters from Wilhelms, et al. [5]

**Interpretation.** The 70-cm radar characteristics of small (1-16 km diameter) craters depend upon the abundance of meter-sized blocks excavated by the impact. These craters excavate ejecta to depths of ~1/10 of their diameter (i.e., depths from 100 m to 1.6 km), which coincides with estimated depths of the mega-regolith. The availability of blocks in turn depends upon the target material. Mare targets are characterized by competent lavas overlain by relatively thin (a few meters thick) regolith. This provides a ready source of meter-sized blocks that produce the radar enhancements. In addition, for small craters in the maria, meter-sized competent blocks in the ejecta should survive to ages commensurate with a few meters of meteoritic gardening (approximately Eratosthenian-period age) as the radar-bright ejecta disappear when gardening depths reach several meters (about late Nectarian age) [4]. In contrast, highland targets are such that these 1-16 km diameter craters in the megaregolith will have ejecta derived from mixtures of already-comminuted material.

The occurrence of 1-16 km diameter, radar-bright craters in the northern and southern highlands differ from one another as shown in the relative crater frequencies plotted in Fig. 2. The relative crater frequency of radar bright craters in Mare Humorum with 4–16-km diameters is 0.0125. When the northern and southern radar-bright crater frequencies are extrapolated back to 0.0125, the crater diameters are 15 km and 25 km, respectively. Assuming that these craters excavate to a depth of 1/10 of their diameters, this implies mega-regolith depths of 1.5 km to the north and 2.5 km to the south. This is consistent with the hypothesis that southern portions of the lunar highlands have an additional contribution from South Pole Aitken Basin ejecta that increases the depth of the mega-regolith by about a kilometer.

**References:** [1] Thompson et al., accepted for publication in *Geology*, [2] Campbell, B.A., et al., *IEEE Trans. Geosci. Rem. Sensing, submitted*, 2007; [3] Wilhelms, D., Geologic History of the Moon, *USGS #1348*, 1987; [4] Thompson, T.W., et al. *Proc. Highlands Crust Conference*, 1980; [5] Wilhelms, D.E., *Proc. Lunar Planet. Sci. Conf.* $9^{th}$