INTEGRATION OF LUNAR POLAR DATASETS. Stewart Nozette[1], Paul D. Spudis[2], Mark Robinson[3], Ben Bussey[4], Chris Lichtenberg[5] Robert Bonner[6] 1. Lawrence Livermore National Laboratory, Livermore, CA 2. Lunar and Planetary Institute, Houston TX 3. Northwestern University, Evanston IL 4 .ESTEC, European Space Agency, Noordwijk The Netherlands 5. Naval Research Laboratory, Washington D.C. 6 Protasis Inc., Alexandria VA. (nozette@atech.pxinet.com)

Introduction We continue our studies of the environment and the deposits of the poles of the Moon [1,2,3]. In this paper, we describe our integration of Clementine, Lunar Prospector, and groundbased radar data to provide additional insight into the nature of the lunar polar ice deposits.

New analysis of Clementine bistatic radar data We registered Clementine UV-Visible and High Resolution image data on the solar illumination conditions at the south pole of the Moon over two lunar days with Clementine bistatic radar [1], Arecibo groundbased radar [4], and Lunar Prospector Neutron Spectrometer data ([5]; Figure 1). Such an integration of diverse data yields insight into the nature and distribution of shadowed terrain, anomalously illuminated massifs, and putative polar ice deposits. From these data, a high degree of correlation is seen between the decreasing epithermal neutron flux and the shadowed terrain at the south pole (Figure 1). These areas correlate with the high β=0 Circular Polarization Ratio (CPR) areas sampled by Clementine bistatic radar during lunar orbit 234 (Figure 2), which in turn are coincident with areas of high CPR observed by Arecibo Observatory on the shadowed wall of Shackleton crater and in shadowed regions around it and the pole [4]. Detailed examination of the illuminated areas sampled by Clementine and Arecibo, including those high CPR zones interpreted by [4] as due to roughness, do not display statistically significant CPR enhancements observed in the Clementine bistatic data. Observation of the north pole shows that the decreasing epithermal neutron flux is correlated with areas of shadow located on the north facing wall and floor of Perry crater, and many potentially shadowed small crater walls and floors. Clementine and Arecibo were unable to observe these areas as they are in radar shadow when viewed from Earth.

Our analysis of the patterns and strength of the CPR enhancement from Clementine bistatic data suggests that approximately 2.4-18.3 km^2 of relatively clean ice is present near the surface and on the wall of Shackleton crater and in at least one of the neighboring dark areas. These regions cannot be resolved in the neutron spectrometer data from the nominal mapping mission, but could contribute to the observed polar epithermal flux deficit. Improved spatial resolution of neutron flux, obtained during the lower orbit, extended mission of Lunar Prospector, may allow us to evaluate the degree of correlation with specific features and shadowed terrain but is unlikely to resolve the observed enhanced CPR areas. Further insight into the nature of these deposits will likely require higher resolution orbital measurements, including imaging of the extent of shadow regions for extended times and dual polarization imaging radar from an orbiting spacecraft [2].

References: [1] Nozette S. et el. (1996) *Science* **274**, 1495. [2] Spudis P. D. et al. (1999) *Aerospace America*, Feb. issue. [3] Shoemaker E. M. (1996) *Science* **266**, 1851. [4] Stacy N. J. S. et al. (1997) *Science* **276**, 1527. [5] Feldman W. C. et al. (1998) *Science* **281**, 1496.

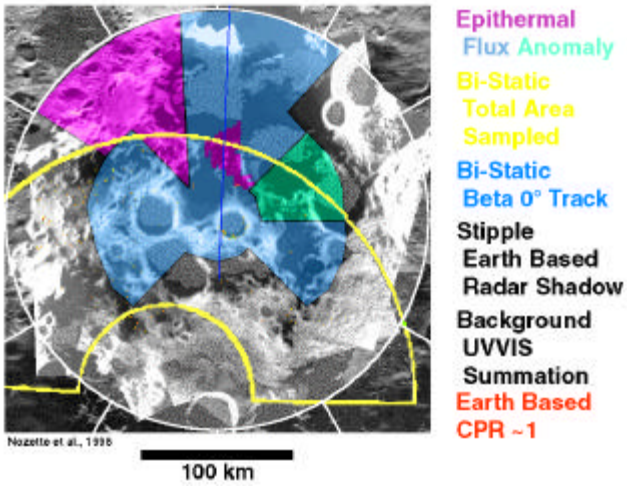

Figure 1. Composite showing Clementine uvvis image mosaic (light gray) over Arecibo radar image of lunar south pole. Yellow outline is calculated footprint of Clementine bistatic radar measurements. Blue line is the groundtrack for beta=0 points (i.e., zero phase) for the bistatic experiment, for which we claim CBOE enhancements. Bright speckled points within the dark areas are high backscatter points seen in the Arecibo depolarixed backscatter image. Note that not only did the Clementine bistatic experiment directly sample the "dark" areas of the pole (e.g., within and north of Shackleton), but abundant high Arecibo backscatter points are associated with this darkness.

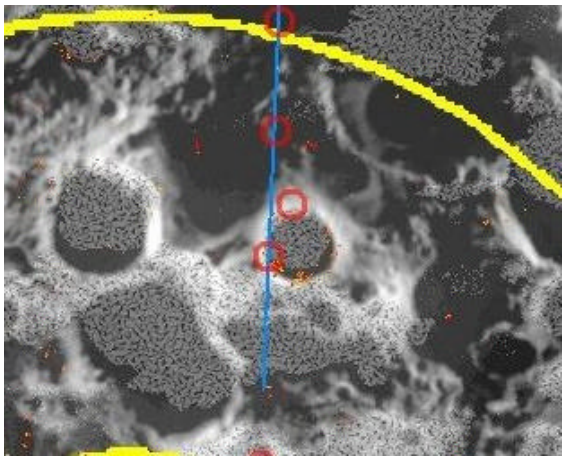

Figure 2. Close-up of Clementine bistatic radar beta=0 groundtrack. Red circles are newly studied data bins. Note speckled deposits in shadow and rim of Shackleton. These areas may be mostly ice deposits.