EXPLORATION STRATEGIES AND LANDING SITES AT THE LUNAR SOUTH POLE. P. J. Stooke[1], [1] Departments of Geography and Physics and Astronomy, University of Western Ontario, London, Ontario, Canada N6A 5C2. (pjstooke@uwo.ca; http://publish.uwo.ca/~pjstooke/).

Introduction: Previous landing site studies for the lunar south pole have emphasized sites with maximum duration of sunlight for solar powered lander operation (Euromoon 2000 [1]; Lunacorp Icebreaker mission, [2]). Using this plus two other site selection criteria, access to South Pole/Aitken basin ejecta and convenient rover access to perpetually shaded regions with possible volatile materials, I identify several candidate landing sites for future missions.

South Pole rationale: The lunar south pole is interesting for its proximity to the South Pole/Aitken (SPA) basin, the potential for volatile materials including water in perpetually shaded areas, and (arising from the latter) the potential for future human settlement. SPA is the largest, oldest preserved lunar basin. Its ejecta and rim contain material from the lower crust and possibly upper mantle, and would provide an important early date and compositionally unique samples. Near-polar crater floors are never illuminated by the sun, offering potential volatile traps of great interest, both scientifically and as future resources for lunar outposts or bases. Conversely an area informally known as the 'peak of eternal light' (a ridge between the rims of several craters) receives sunlight nearly all the time, though no single spot is permanently illuminated [3].

Landing Sites: Landing in an area of nearly continual sunlight helps thermal control and power generation. Thus the 'peak of eternal light' is considered the landing target region. Within this, specific target landing points are identified (top half of figure, next page). To best sample SPA rim material, sites are chosen on the ejecta blankets of Shackleton and de Gerlache craters (which cover the whole 'peak'), but adjacent to small craters which will have excavated fresher material from under the local weathered regolith. This is comparable to Cone crater at the Apollo 14 site, excavating Fra Mauro material from beneath the weathered regolith. Also, sites generally facing Earth, not hidden behind local ridges, are chosen to maximize communication periods. Seven such sites are shown on the figure. Sites 2, 5 and 7 are essentially those considered for Euromoon 2000 [1].

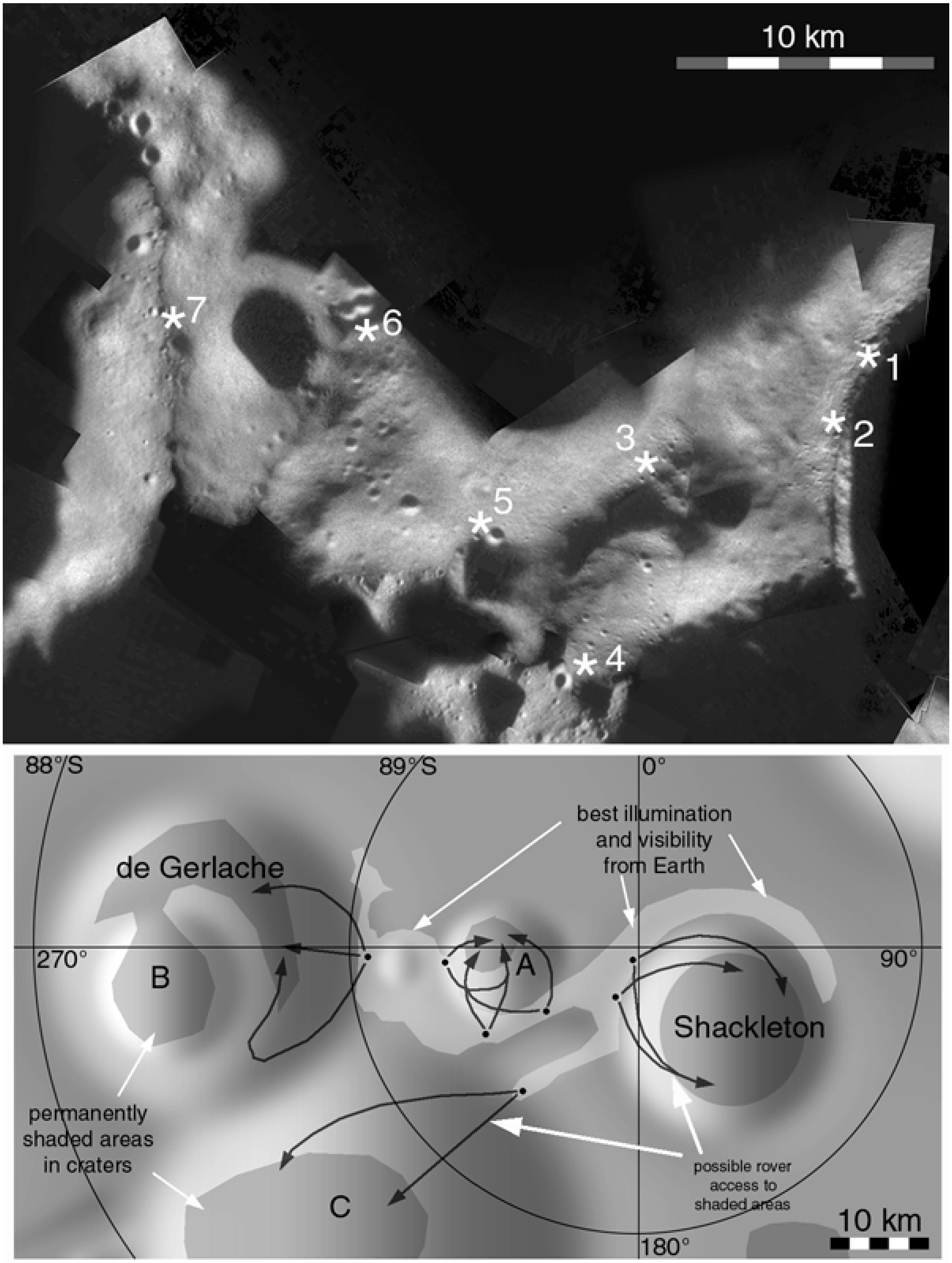
Access to volatiles: From any of these seven landing sites a rover might have access to nearby permanently shaded areas. The map (lower half of figure) shows the south polar region with four craters (Shackleton, de Gerlache, and two labelled A and C) whose rims define the 'peak'. Another crater (B) lies inside de Gerlache. A light overprint shows the area of maximum illumination. A dark overprint shows areas likely to be in continuous darkness, hence possible volatile traps. These are considered individually in terms of their accessibility by rover. Potential rover routes into these areas are shown as dark arrows. They have been chosen to provide the shortest reasonable routes (between about 8 and 20 km), with reasonable slopes (*e.g.* mostly diagonal traverses of crater walls) and direct line of site communications with Earth or the lander, or both. Note that knowledge of topography is extremely limited in this area because of the effects of shadowing in both Clementine images and Earth-based radar [3], especially inside craters, so a detailed analysis of route safety and communications is not yet possible.

Sites 1 and 2 are on the rim of Shackleton. Both allow rover access to the interior of Shackleton, but its young age may mean its walls are too steep for safe driving and its volatile content may be low. Sites 3, 5 and 6 offer short and easy drives into crater A, but its small size may limit its volatile reservoir potential. Site 4 offers long (20 km) drives into crater C, which appears to be older than Shackleton (more superposed craters) and so may have accumulated more volatiles and have shallower interior slopes. Communication could only be via the lander remaining at site 4 (or relays deployed along the way) as the 'peak' will hide Earth for much of the route. Site 7 offers several routes into de Gerlache crater, including a short direct route if the walls are shallow enough and longer diagonal routes.

Summary: All proposed landing sites offer access to SPA material and volatiles. Sites 4 and 7 are probably the best for access to volatiles because of the size of the dark areas and the shallower slopes on the rover route. I note that Earth is never more than 5° above the nominal horizon here, and then only for about half of each month, but some geosynchronous Earth satellites will be above the horizon most of the time. Communication via relays on such satellites should be investigated for polar exploration.

References:

[1] Kminek G. and Foing B. H. (1998) *LPS XXIX*, Abstract #1834. [2] Lunacorp, Inc. website: http://www.lunacorp.com/moon_probes.htm. [3] Margot, J. L. *et al*., 1998. LPS XXIX, Abstract #1845.



Top: mosaic of Clementine HIRES images of the lunar south pole (P. Stooke). Points 1 to 7 are landing sites propsed in the text. Bottom: map of the region showing potential rover access to permanently shaded areas.