Malapert Mountain: A Recommended Site for a South Polar Outpost

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The Moon’s poles have emerged as scientifically and strategically valuable areas for a new lunar program as proposed by President George W. Bush in 2004. The Clementine missions showed that there are large areas of permanently-shaded terrain at both poles, but the southern one is more concentrated and well-defined. Consequently most interest has been focused on the south polar region, and specifically on the crater Shackleton because it is thought to be in continual sunlight, and is close to the hydrogen-bearing shaded areas. However, Malapert Mountain appears to have several advantages over Shackleton.

It was shown by D. Schrunk and B. Sharpe that Malapert Mountain is sunlit 90% or more of the lunar year, whereas Lunar Orbiter 4 pictures show that the rim of Shackleton is only partly illuminated at any one time. Furthermore, the illuminated area varies over the lunar year, and no one site is continually sunlit.

Malapert Mountain is old, pre-Nectarian terrain, probably with a thick regolith saturated with implanted hydrogen and helium. It offers a broad and smooth landing area, demonstrably in continuous microwave visibility of Earth (for tracking and communications). It is close to permanently-shaded areas to the south, which should be easily reached by a vehicle driven down the south flank of Malapert Mountain.

Malapert Mountain, in summary, deserves careful study in light of mission safety, scientific importance, and evaluation of lunar resources.
Malapert Mountain as a Lunar Outpost

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Clementine Mosaic of the Moon’s South Pole

Arrow points to Shackleton Crater; rim thought to be continually sunlit, recommended as a lunar outpost site
Relief Map of Lunar South Pole

From Clementine Atlas of the Moon (Busse and Spudis, 2004). Zero meridian (top) points north, toward Earth.
Earth-based radar shows area of Moon in continual microwave and earthshine visibility.
Lunar Orbiter 4 View of South Pole

Location of Shackleton Crater
Lunar Orbiter 4 Picture of Shackleton

Most of rim sunlit, but not all (note dark segment on south rim)
Lunar Orbiter 4 Picture of Shackleton and Malapert Mountain

- Malapert Mountain
- Completely sunlit
- Shackleton Crater
- Shackleton rim almost all dark
Lunar Orbiter 4 picture of Shackleton and Malapert Mountain

Malapert

Shackleton

Shackleton rim almost all shaded

Malapert Mountain in full sunlight on earth side and top.
Lunar Orbiter 4 Picture of Shackleton Crater

Rim of Shackleton almost entirely shaded; note decreasing visibility of Amundsen Crater

Amundsen Crater
Apollo Picture of Euler (29 km diameter)

Topography probably similar to Shackleton; note rough flanks and narrow rim
Lunar Orbiter 4 Close-up of Malapert Mountain

MM about 50 km left to right

Top of MM relatively smooth; note only one crater

North face and top continually sunlit on all available Lunar Orbiter photos

Slopes probably smooth, similar to Apennines at Apollo 15 landing site
Surveyor VII View of North Flank of Tycho Crater

Note thin regolith, rough terrain, probably similar to flank of Shackleton Crater.
Small Crater Populations, Surveyor I and VI Sites

Similar slopes and intercepts imply steady-state small crater population, similar on all mare sites.
Surface Particle Size Distribution, Surveyor I and III Sites

Similar slopes and intercepts imply similar regolith properties at all mare sites; steady state feature
Particle Size Distribution, Returned Lunar Soil Samples

Similar slopes of regolith returned samples shows similarity of mature regolith at mare and highland sites. Implies similar regolith on Malapert Mountain.

Diagram explains regolith at Tycho: immature, thin
Epithermal Neutron Counts, Lunar Prospector Orbits

Low neutron counts indicate high hydrogen content; note sharp drops over both poles.

Epithermal Neutron Count Maps, North Pole (left) and South Pole (right)

South pole map shows closeness of Malapert Mountain to high-hydrogen areas; compare with Clementine mosaic showing shaded areas.
Advantages of Malapert Mountain as an Outpost Site

Long-term continuous sunlight on top and north side
Large relatively smooth area for landing and surface operations
Probable thick, workable regolith
Close to shaded areas, high hydrogen content
Dynamic accessibility; zero longitude; LOR mode with no plane changes; anytime return
Uninterrupted microwave visibility from Earth