7.4), 5 mM NaCl, 2 mM $MgCl_2$, 1 mM EGTA, 1 mM dithiothreitol (DTT), and protease inhibitors (leupeptin, pepstatin, and aprotinin) for 5 min at 4°C. After being washed twice in the same buffer, cells were incubated for 30 min at 23°C in the different incubation conditions. A high-speed supernatant was prepared from *Xenopus* eggs resuspended in 20 mM Hepes (pH 7.5), 70 mM KCl, 1 mM DTT, and 250 mM sucrose and centrifuged at 13,000*g* and then at 190,000*g*. The addition of ATP corresponded to 1 mM ATP, 10 mM creatine phosphate, and creatine phosphokinase (4 U/ml).

14. For indirect immunofluorescence analysis, cells were fixed for 10 min with 2% paraformaldehyde and 0.1% glutaraldehyde and permeabilized with 0.1% Triton X-100 for 5 min. A monoclonal antibody (mAb) to MYC (9E10) was applied for 30 min followed by a 30-min incubation with fluorescein isothiocyanate–conjugated donkey anti-mouse immunoglobulin G (Jackson). Cover slips were mounted in Moviol (Hoechst, Frankfurt, Germany). Photographs corresponding to the different conditions were taken with the same setting parameters.
15. Cells were treated first with 1 μg of deoxyribonuclease I before being lysed in Laemmli sample buffer containing 8 M urea. Proteins were resolved by 10% SDS-PAGE and transferred to nitrocellulose membrane. Membranes were incubated with mAb 9E10 and an mAb to hnRNP C (4F4), followed by an incubation with anti-mouse coupled to horseradish peroxidase, and finally developed with the chemiluminescence protein immunoblotting reagents (POD, Boehringer Mannheim, Germany). Quantitation of protein immunoblots was performed with the Bioprint acquisition system and Bioprofil program (Vilbert Lourmat).
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TECHNICAL COMMENTS

The Possibility of Ice on the Moon

N. J. S. Stacy *et al.* (*1*) have dealt a blow to the hypothesis that ice deposits may exist in permanently shadowed regions at the lunar poles. Their ground-based radar observations detected several areas with high backscatter cross sections and circular polarization ratios consistent with ice, but in locations that are at least occasionally illuminated by sunlight. These features are associated with walls and rims of small craters; the most likely explanation for their occurrence is high surface roughness at the scale of the radar wavelength. Mercury has regions with similarly anomalous radar properties located near its poles, in permanently shadowed floors of large craters (*2*). These anomalies have been interpreted as resulting from ices accumulated by cometary and meteoritic bombardment (*3*). The results of Stacy *et al.* imply an alternative explanation: They may be a result of a difference in texture rather than composition. Such a difference could be caused by their thermal environment.

The sunlit and permanently shadowed regions of Mercury are, respectively, the hottest and coldest surfaces in the solar system that have silicate composition and are subject to meteoroid bombardment. Their responses to impacts should differ accordingly. Hot target material will yield a higher proportion of impact melt, while cold material should have a greater tendency toward brittle fracture, producing fragments that are more angular. Thus, one may expect mature regoliths developed at such different temperatures to have different radar scattering properties, with the colder surface having higher roughness and radar albedo. It is not clear whether this effect would suffice to account for the magnitude of the radar anomalies observed on Mercury, but this hypothesis could be experimentally tested by hypervelocity impacts into silicate targets at extreme temperatures.

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We would like to clarify our understanding of events associated with the 1992 Arecibo observations of the lunar south pole (*1*) and the Clementine bistatic radar experiment (*2*). The Clementine team was fully aware of the Arecibo observations before conducting the bistatic radar experiment. Although interpretation of the Arecibo observations was inconclusive, it had been suggested that areas showing high circular polarization ratios (CPRs), observed below the sun line inside the crater containing the south pole, could be underlain by ice (*3*). Surface roughness was an alternative explanation for the observed high CPR. The Clementine bistatic radar experiment was designed to resolve this ambiguity. Observations over a range of bistatic (phase) angle, β, can distinguish diffuse scattering caused by wavelength-scale roughness from the highly directional coherent backscatter opposition effect (CBOE), indicative of low-loss targets (for example, ice). This measurement cannot be made from ground-based telescopes. The rationale for bistatic observations is well documented (*4*).

Clementine observed a CPR peak around β = 0 near the south pole, consistent with the presence of ice at the surface. This peak was not observed anywhere else on the lunar surface and was isolated to an area within 60 km of the south pole. The radar footprint was fairly broad, and included areas outside of permanent shadow; thus, only a tiny fraction of this area could be underlain by ice. The method used (*2*) to estimate the area of putative ice deposits is similar to that applied to the polar deposits on Mercury (*5*). An upper limit on the area of ice deposits of 80 to 135 km^2 was estimated, assuming contributions to the scattered signal from the total observed area of 45,000 km^2. If the estimate is made strictly from the surface area that can contribute to the observed CPR peak (that is, the area over which the range of β = ±1°), the area of possible ice deposits is reduced to 7 to 10 km^2. Given uncertainties in the properties of the putative ice deposits, this estimate can be reconciled with areas showing high CPR in the Arecibo images. We should have been clearer in our presentation in order to avoid misleading interpretation. The high spatial resolution of the Arecibo images show that any possible ice is small and patchy, as we suggested (*2*). Stacy *et al.* suggest that Clementine and Arecibo measurements are in disagreement (*1*), but meaningful comparisons can be made only for regions observed at similar incidence and β, normalized to the same area.

A result reported by us (*2*) for a specific area (80° to 82° south latitude), angle of incidence 84°, β ± 1 degree, CPR 0.36 ± 0.01, is in agreement (3 σ) with the Arecibo near south pole (CPR 0.43 ± ?) values, given that no error was stated (*1*). This correct Clementine near south pole CPR value was not used by Stacy *et al.* (*1*).

The Arecibo and Clementine north pole values reported (*1, 2*) show disagreement. Because Arecibo cannot measure CPR as a function of β, direct comparisons between the data sets must be done carefully. The Clementine north and south pole values internally agree (3 σ), as do the reported Arecibo measurements, although no error is reported (*1*) except for β ± 1° at the south pole. The Clementine values used (*1*) were not compared in a consistent manner. The actual Clementine β = 0 areas are an order of magnitude smaller than the reported (*1*) Arecibo areas, and in two cases the Clementine median CPR (over 82° to 90° angle of incidence) was compared instead of the appropriate values of β, incidence angle, and area (*1*). The Arecibo and Clementine data are fundamentally different measurements with different error sources, one made with a spacecraft transmitter near the moon with rapidly changing geometry (incidence angle, β, illuminated surface area) and one ground-based over a range of incidence angles at β = 0. Given these inconsistencies and differences in data analysis, the conclusion that the Clementine and Arecibo data sets do not agree is probably incorrect.

Surface roughness was postulated to be responsible for areas of local high CPR observed from Arecibo, because these areas are associated with impact craters (*1*). But the interiors of impact craters near the poles are also the areas most likely to be permanently shadowed. Ice, if present, must be associated with impact craters. A majority of the high CPR patches observed from Arecibo within 60 km of the lunar south pole are likely to be in permanent shadow. One of the areas with highest CPR found from Arecibo is in the deepest part of the south pole crater observable from Earth. From the combination of Clementine and Arecibo observations, it can be shown that this part of the crater is in permanent shadow. Ice can occur wherever it is thermodynamically stable, on a crater wall or on the floor. We suggest that the lower part of the south pole crater wall is a principal source of the CPR peak observed by Clementine. There is no a priori geological reason for the south pole crater to be any rougher than its neighbors. Roughness will produce diffuse scattering and a general CPR enhancement over a range of β at many surface locations. Clementine observed a CPR and SS peak *centered* at β = 0 localized to the south pole. A comparison of the Clementine data with physically based computations of coherent backscattering suggests that the peak measured by Clementine is consistent with CBOE produced by grazing incidence scattering in an area where the scatterers only cover a fraction of the surface (*6*). Perhaps the strongest evidence in this regard is the lack of a CPR peak in the Clementine bistatic measurements of regions not in permanent shadow. These terrains contain geological units comparable to the south polar region, being rugged highlands, including several 20-km diameter craters. Only the south polar pass (orbit 234) shows the CPR enhancement at β = 0. This strongly suggests a controlling factor related to shadowing. Surface roughness does not so qualify.

On Mercury, radar bright features are observed well off the pole, but they are not assumed to be produced by the same scattering mechanism as the polar deposits (*5*). This situation illustrates the difficulty in correctly interpreting combined space- and ground-based data sets. Ground-based radar observations of Venus revealed radar "bright" regions (for example, Maxwell Montes) that were initially attributed to roughness (*7, 8*). Low-resolution space-based observations by Pioneer Venus suggested that some of these areas were bright as a result of intrinsic chemical differences, not roughness (*9*); finally, high-resolution bistatic observations by Magellan showed this to be the case (*10*). The main weakness in the Clementine result is that the CPR peak was only observed on one orbit, albeit the only orbit with correct geometry for detecting CBOE at the south pole. The existence of ice will await confirmation by another independent spacecraft (Lunar Prospector). If confirmed, we believe that it will have been discovered by Clementine.

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Response: Contrary to their earlier analysis (*1*), Nozette *et al.* now state that the magnitude and polarization of the enhanced radar echo observed by Clementine at the lunar south pole can be reproduced by a target of 7 to 10 km^2 cross section with the radar-scattering characteristics of pure water ice. We would not necessarily disagree with this interpretation of their data if their measurements were made at close to normal incidence, but we point out that, because the observation was made at an incidence angle of 85°, a geometrical correction must be applied (*2*). The resulting surface area is about 400 km^2, which is (barely) consistent with the Arecibo results (*3*), but cannot be attributed to ice, because the observed areas of anomalous backscatter in the Arecibo images are not correlated with regions of permanent shadow, but with regions that would be expected, on geological grounds, to possess high surface roughness.

We obtained the Clementine CPR of 0.29 (−5.4db) for β = 0 for the near south pole Clementine orbit (235) from figure 3A of the report by Nozette *et al.* (*1*). The Arecibo value is 0.43 [table 1 of (*3*)]. Because almost all systematic measurement errors in the Arecibo data will cancel out when deriving polarization ratios, we conclude that the two CPR values differ significantly.

It is inappropriate to compare the lunar measurements with those of Maxwell Montes on Venus, where the early interpretations from ground-based observations—that the enhanced radar backscatter from Maxwell is a result of high surface roughness at wavelength scale—have not been overturned, although subsequent studies have confirmed the presence of a second, perhaps more exotic, scattering component (*4*).

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