The surficial nature of lunar swirls as revealed by the Mini-RF instrument

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Lunar swirls are optically bright, sinuous albedo features found on the Moon. Lunar swirls appear to overlay the lunar surface, apparently representing diffuse brightening of unmodified terrains. Lunar swirls are associated with regions of anomalously high crustal magnetic fields, but their exact formation mechanism is unknown. The Mini-RF synthetic aperture radar on LRO acquired a comprehensive set of radar images of these enigmatic features, including the first radar observations of swirls on the lunar farside. A few general remarks can be made about the nature of the lunar swirls from this data set. First, the average radar properties of lunar swirls are identical to nearby non-swirl regions, in both total radar backscatter and circular polarization ratio (CPR). This implies that average decimeter-scale roughness and composition within the high-albedo portions of the swirls do not differ appreciably from the surroundings, and thus that the swirls are a very thin surface manifestation (< 10 cm) not observable with S-Band radar. Secondly, bright swirl material appears to be stratigraphically younger than an impact melt flow at Gerasimovich D newly discovered in Mini-RF images. This observation indicates that the swirls are capable of forming over timescales less than the age of the crater, perhaps less than 1 Ga. This data set also provides information about the origin of the lunar swirls. In at least one case, the presence of an enhanced crustal magnetic field appears to be responsible for the preservation of a high-albedo ejecta blanket around an otherwise degraded crater, Descartes C. The degree of degradation of Descartes C suggests it should not be optically bright, yet it is. This implies that the enhanced albedo is related to its location within a magnetic anomaly, and hence supports swirl origin hypotheses that invoke interaction between the solar wind and the magnetic anomaly.