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The layered structure of lunar maria: Identification of the HF-radar reflector in Mare Serenitatis using optical images

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Comparison of the Lunar Radar Sounder (LRS) data to the Multiband Imager (MI) data is performed to identify the subsurface reflectors in Mare Serenitatis. The LRS is FM-CW radar (4-6 MHz) and the 2 MHz bandwidth leads to the range resolution of 75 m in a vacuum vacuum, whereas the sampling interval in the flight direction is about 75 m when an altitude of the spacecraft with polar orbit is nominal (100 km). Horizontally continuous reflectors were clearly detected by LRS in limited areas that consist of about 9% of the whole maria. The typical depth of the reflectors is estimated to be a few hundred meters. Layered structures of mare basalts are also discernible on some crater walls in the MI data of the visible bands (VIS). The VIS range has 9 wavelengths of 415, 750, 900, 950, and 1000 nm, and their spatial resolution is 20 m/pixel at a nominal altitude. The stratigraphies around Bessel and Bessel-H craters in Mare Serenitatis are examined in this paper. It was revealed that the subsurface reflectors lie on the boundaries between basalt units with different chemical compositions. In addition, model calculations using the simplified radar equation indicate that the subsurface reflectors are not compositional interfaces but layer boundaries with a high-porosity contrast. These results suggest that the detected reflectors in Mare Serenitatis are regolith accumulated during so long hiatus of mare volcanisms enough for chemical composition of magma to change, not instantaneously. Therefore combination of the LRS and MI data has a potential to reveal characteristics of a series of magmatism forming each lithostratigraphic unit in Mare Serenitatis and other maira.

Keywords: radar sounder, lunar maria, layered structure, crater wall