COMPARISON OF UNSAMPLED LUNAR BASALTS

H. Hiesinger, R. Jaumann, G. Neukum. German Aerospace Research Establishment (DLR), Institute for Planetary Exploration, Berlin/Germany

Introduction: Comparison of spectral characteristics of the Apollo landing sites with spectra of unsampled regions allows the identification and classification of materials similar to the materials exposed at the landing sites. Assuming a strong correlation between geochemistry and spectral behavior it is possible to expand our knowledge of the chemistry of the landing sites to unsampled lunar regions.

Samples collected at the Apollo landing sites provide ground truth for numerous spectral and compositional investigations of the moon's surface. However, the spectral characteristics of not all lunar surface units can be reproduced by the landing site characteristics. This leads to the question where on the moon and to which extent lunar materials can be described by the landing site samples. For this purpose we are restricted to remote sensing techniques (e.g. spectroscopy) to obtain further compositional information on unsampled surface units. In 1992 the Galileo spacecraft provided multispectral imaging data of the northern nearside in the VIS-NIR range of the electromagnetic spectrum. The spatial resolution is about 1.3 km/pixel. The data which have been corrected for radiometric, photometric and geometric effects have been mosaicked and map-projected. The data have been normalized to Apollo 16 and the spectral reflectance has been calculated. From these data the spectral characteristics of the Apollo 11, Apollo 15, Apollo16, and Apollo 17 landing sites have been extracted and then applied to the whole data set in order to identify areas which match the landing site characteristics within a given tolerance. Once landing site regions are identified spectrally, unsampled regions with equivalent spectral characteristics can be mapped and classified. Even when it is not possible to derive compositional information for the unsampled lunar regions directly from the available spectral data, we can investigate the spectral differences between sampled and unsampled regions and thus constrain the composition of unsampled materials.

We found spectral characteristics similar to Apollo 11 in Mare Fecunditatis, and in the shelf region of Mare Serenitatis. Oceanus Procellarum, Mare Imbrium, and Mare Vaporum also exhibit areas with Apollo 11-like spectral characteristics. In Mare Tranquillitatis, particularly, the mare basalts of the southern border are similar to the Apollo 11 basalts. Here, large areas, which clearly extend the sampled regions, are covered by this type of basalt. Apollo 15-like basalts have been identified in the northern regions of Mare Imbrium, inside Sinus Iridum and

crater Plato. Northwestern parts of Mare Crisium also contain large amounts of Apollo 15-like material. The bright ray crossing Mare Serenitatis exhibits the same spectral characteristics as do the Apollo 15 landing site spectra. Bright rays north of crater Copernicus also exhibit Apollo 15-like spectral characteristics. In both cases we are not able to define whether there are physical effects (e.g. grain size) or chemical effects that cause the rays to be classified as Apollo 15-like material. More detailed spectral information (e.g. higher spectral resolution) may resolve this problem. Inside Mare Serenitatis the northern parts can mainly be described by the Apollo 15 spectrum. In the passage between Mare Tranquillitatis and Mare Fecunditatis there is exposed material that is spectrally similar to the Apollo 15 landing site. The northern parts of Mare Tranquillitatis near crater Maraldi are typically filled with Apollo 15-like basalts. Apollo 17-like spectral characteristics can be found west of crater Posidonius, in the northwestern portions of Mare Crisium and the southern parts of Mare Tranquillitatis, especially in the vicinity of crater Torricelli. The central regions of Sinus Medii are filled with Apollo 17-like lavas which are surrounded by Apollo 15-like basalts. Mare Marginis and Mare Smythii contain Apollo 17-like and Apollo 15-like basalts whereas numerous other mare regions like Mare Nectaris, Mare Frigoris, Mare Humboldtianum and large parts of Oceanus Procellarum cannot be characterized by any of the Apollo 11, Apollo 15, or Apollo 17 spectra. In Lacus Somniorium there exists a sharp boundary between Apollo 15-like basalts and still unclassified basalts. The spectral characteristics of pyroclastic deposits like the dark mantling material in the south-west of Mare Serenitatis and the south of the Apeninne Bench are poorly reproduced by the given landing site spectra.

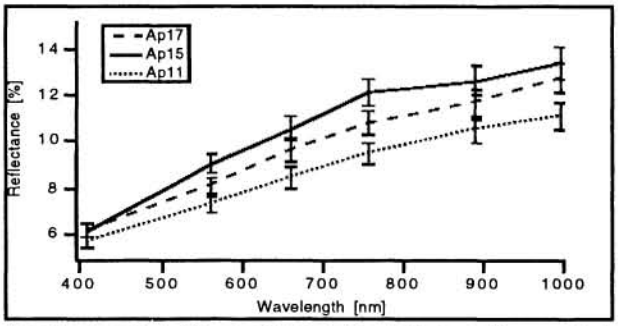

Fig.1: Apollo landing site spectra used as reference for spectral classification of the lunar surface. Error bars indicate the allowed variance permitted for a spectrum to be classified as „being similar to" one of the three reference spectra