THE COMPOSITION OF THE CRUST IN THE ORIENTALE REGION OF THE MOON: A PRE-GALILEO VIEW. B. Ray Hawke[1], P.D. Spudis[2], P.G. Lucey[1], and J.F. Bell[1], [1]Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii, Honolulu, HI 96822, [2]U.S.G.S., Flagstaff, AZ 86001.

In December, 1990, the Galileo spacecraft will encounter the Moon and provide a wealth of new spectral data and imagery for the western limb region that can be used to address a variety of important lunar issues. In order to prepare for this encounter, we are in the process of collecting new spectral data for the Orientale region. In November, 1989, we obtained a large number of UV/VIS spectra (0.4-0.8 µm) for the western limb and this data are currently being reduced and analyzed. Other observing runs are planned in the near future. The Orientale basin has been the subject of extensive geologic and remote sensing studies in recent years and much has been learned[e.g., 11,12]. The purpose of this paper is to review recent remote sensing studies of Orientale and summarize our current understanding of the composition of the crust in this region.

The Orientale impact occurred in rugged highlands on the southwestern limb of the Moon and was the last of the major basin-forming events. Valuable insight concerning lateral and vertical changes in the composition of the lunar crust can be provided by studies of material exposed by lunar impact basins. These impacts have excavated material from a variety of depths and deposited this ejecta in a systematic manner. Hawke et al.[1] presented the results of orbital geochemistry and chemical mixing model studies of the Orientale basin region. It was concluded that the Orientale ejecta north of the basin are dominated by anorthositic material and that only very minor amounts of low-K Fra Mauro basalt are present. In addition, no deposits rich in mafic material of possible mantle origin were identified. Unfortunately, Apollo orbital geochemistry data is available only for terrain north of Orientale.

In order to investigate the composition of materials exposed on the interior of Orientale basin, Spudis et al.[11] collected near-infrared reflectance spectra for units within the Cordillera ring. Twelve near-infrared spectra (0.6-2.5 µm) were obtained at the Mauna Kea Observatory 2.2-m telescope using the Planetary Geosciences Division indium antimonide spectrometer. These included spectra obtained for two fresh surfaces on the inner Rook ring, two fresh craters in the outer Rook Mts. (Eichstadt K, 13-km in diameter and an unnamed 15-km crater), and two fresh 11-km craters (Eichstadt G and H) which are located between the outer Rook ring and the Cordillera ring and expose material from within the knobby facies of the Montes Rook Formation[2] [domical facies of Head[3]. In addition, spectra were collected for portions of the Maunder Formation[2] which is restricted to the central part of Orientale basin within the Montes Rook ring as well as for portions of Lacus Veris and Lacus Autumni. Extinction corrections were made using the techniques described by McCord and Clark[4]. Analyses of absorption bands and continuum slopes were made using the methods presented by McCord et al.[5].

Analyses of the spectra obtained for the mare units on the interior of Orientale (Lacus Veris and Lacus Autumni) indicated that these surfaces are contaminated by variable amounts of local highland debris. This is not surprising in light of the limited areal extent of the mare units and the proximity of highland terrain. However, the presence of a highlands component complicates comparisons with spectra of common nearside mare deposits. However, the evidence currently available suggests that the mare basalts within the Orientale basin are similar in composition to nearside mare basalts.

One spectrum was presented by Spudis et al.[11] for a portion of the Maunder Formation that is restricted to the central part of the Orientale basin within the Montes Rook ring; it has been interpreted to consist largely of Orientale basin impact melt[2,3]. The spectrum exhibits characteristics typical of mature highlands material and is almost identical to spectra obtained for mature units in the vicinity of the Apollo 16 landing site. A similar composition is implied. These results are consistent with those of recent orbital geochemical studies of the Orientale and Apollo 16 regions[6,7,8].

Special attention was paid to the spectra collected for five fresh craters on the Orientale interior. Eichstadt G and H should be dominated by the material which comprises the knobby facies of the Montes Rook Formation. Eichstadt K and an unnamed crater in the outer Rook Mts. should expose the major components of the third Orientale ring. The spectra for knobby facies and the outer Rook Mts., while differing in detail, exhibit many common spectral characteristics. All represent highlands rocks with abundant Fe-bearing plagioclase feldspar and Ca-poor pyroxene. A mixture of noritic anorthosite and anorthositic norite is indicated. There is no evidence for the presence of an ultra-mafic component.

The spectra for fresh surfaces (a steep massif and a small crater on a massif) in the inner Rook ring are very distinct from other spectra of Orientale-related features[11]. Only extremely weak pyroxene bands are present and no well-defined plagioclase bands are seen. Hawke et al.[12] and Spudis et al.[11] suggested that this portion of the inner Rook Mts. was dominated by plagioclase feldspar, some of which may have been subjected to high shock pressure[9,10]. An anorthosite composition is indicated. There is no evidence for the presence of mantle material in the inner Rook ring[11,12].

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