GEOLOGIC AND REMOTE SENSING STUDIES OF THE ALPHONSUS CRATER REGION, Cassandra R. Coombs, Bernard Ray Hawke, Paul G. Lucey, Planetary Geosciences Division, Hawaii Institute of Geophysics, Honolulu, HI, 96822, and James W. Head, Dept. Geological Sciences, Brown University, Providence, RI, 02912.

INTRODUCTION

Alphonsus crater, located on the central lunar nearside (13°S, 4°W), has long been a center of interest and controversy among lunar scientists. This pre-Imbrian crater is 118 km in diameter. The fractured floor of Alphonsus contains eleven dark-halo craters that are interpreted to be of endogenic origin.[1,2,3,4,5,6,7,8,9,10,11] To date, most studies associated with Alphonsus have centered around the nature of these dark halo deposits. There are however, several other unresolved problems associated with Alphonsus. These include: (1) the nature and origin of the light plains on the crater floor, (2) the composition of the localized dark mantle deposits associated with the endogenic craters on the crater floor, (3) the origin of the N-S trending ridge on the crater floor, and (4) the processes responsible for the crater floor uplift, and (5) the effects of Imbrium ejecta on Alphonsus.

In an attempt to address the above questions, we have conducted a variety of remote sensing and geologic investigations of the region. This paper presents the preliminary results of this effort.

METHOD

A variety of spacecraft and earth-based photography as well as topographic data was used for geologic studies of the region. Also, near-infrared reflectance spectra (0.6 - 2.5 µm) of a number of geologic units within Alphonsus crater were collected and examined. The geologic features from which spectra were collected include: (1) the central peak, (2) the light plains mantling the floor, (3) the very fresh small impact crater on the floor, and (4) three localized pyroclastic units surrounding the endogenic craters. Additional spectra in the 0.3 - 1.1 µm region have recently been collected for many features in and around Alphonsus. These spectra are currently being reduced and analyzed. In addition radar data (3.8 cm) collected by Zisk[12] was also analyzed during the course of this study.

RESULTS AND DISCUSSION

Alphonsus crater, located just east of Mare Nubium in the western portion of the central lunar highlands, has undergone a fairly complex history of formation. The slightly elongate main crater is pre-Imbrian in age, or greater than 3.85 b.y. old, and contains a central peak. The Imbrium basin impact appears to have had an effect on Alphonsus as evidenced by the presence of Imbrium sculpture on the main crater rim. The Imbrium event may also have been responsible for the emplacement of the smooth plains deposits on the floor of Alphonsus.

Following the Imbrium event, the crater Arzachel (diameter=97 km) formed south of Alphonsus. Associated with the formation of this crater was the deposition of an ejecta blanket on the southern portion of the Alphonsus floor. Tectonic reshuffling then ocurred to form the numerous linear rilles, or graben, that are located about the perimeter of the Alphonsus crater floor. Eleven previously identified endogenic dark-halo craters within the crater are associated with these linear rilles.[2,9,10,13] Studies by Head and Wilson[9,10] and Hawke et al.[13] have suggested that these deposits are basaltic in composition and most likely were emplaced as a result of individual vulcanian-type eruptions that ocurred along the floor-fractures. In these types of eruptions gas is trapped and builds up beneath a cap-rock or plug-rock at the mouth of the magma conduit. Once sufficient pressure has built up, explosive decompression occurs and pyroclastic material is deposited about the mouth of the vent. Generally, these vulcanian-type eruptions produce small pyroclastic mantling deposits, that is, the material remains within a few kilometers of the vent, unlike the larger regional pyroclastic deposits whose strombolian-type eruptions which deposited material over thousands of square kilometers. During the course of this research, a small dark-haloed impact crater was identified in the southern portion of Alphonsus crater floor, bringing the total number of Alphonsus dark-haloed craters now known to 12. Multispectral images (0.40/0.56 μm, 0.56 μm, 0.95/0.56 μm) exist for the Alphonsus region. The localized pyroclastic deposits (east and west DHC clusters) in the floor of Alphonsus exhibit low 0.40/0.56 μm (red) values and relatively high 0.95/0.56 μm ratios. The "red" Alphonsus pyroclastics have 0.40/0.56 μm values similar to the mare basalt deposits in nearby Mare Nubium.

Near-infrared reflectance spectra collected for these localized pyroclastic deposits have revealed that the Alphonsus pyroclastics are rich in olivine and pyroxene.[13] The spectra for these deposits have moderately deep (5 - 7 %) and relatively broad asymmetrical absorption bands in the !.0 μm region. The olivine was emplaced with the juvenile material. Lesser amounts of fragmented basaltic plug-rock and highlands-rich wall rock are thought to be present in these deposits. These deposits belong to the Group 3 spectral class as identified by Hawke *et al.*[13], along with other similar deposits on the floor of J. Herschel and in the Cruger region.

Spectra collected of the Alphonsus central peak indicate that this feature is composed of anorthosite. This anorthosite is thought to have been derived from an anorthosite layer located at depth below the Alphonsus target site. Other highland features in the Alphonsus region exhibit a more orthopyroxene-rich composition. The spectra for these features suggests that they are noritic. PThe walls and central peak of Arzachel crater, located directly south of Alphonsus, are composed of noritic anorthosite. Since the Arzachel central peak was derived from almost as great a depth (~10 km) as that of Alphonsus, the pure anorthosite layer may not be present beneath Arzachel crater. Alternatively, anorthosite may exist just below the layer sampled by the Arzachel peak.

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