GEOCHEMICAL STUDIES OF THE LOMONOSOV-FLEMING REGION OF THE LUNAR FARSIDE. T. A. Giguere[1,2], B. Ray Hawke[1], D. T. Blewett[1,3], G. Jeffrey Taylor[1], P. G. Lucey[1], and P. D. Spudis[4]. [1]Hawai`i Inst. of Geophys. and Planetology, University of Hawai`i, 2525 Correa Rd., Honolulu, HI 96822 USA, email: giguere@kahana.pgd.hawaii.edu. [2]Intergraph Corporation, 2828 Pa`a St. Ste. 2150, Honolulu, HI 96819 USA. [3]Inovative Technical Solutions, Inc. 2800 Woodlawn Dr., #192/120, Honolulu, HI 96822 USA. [4]Lunar and Planetary Institute, Houston, TX 77058.

Introduction: The Lomonosov-Fleming basin on the lunar farside has been suspected of being a cryptomare for over twenty years [1]. Cryptomaria are ancient mare basalts deposits that are hidden or obscured by superposed higher albedo material [2, 3, 4]. As such, they represent a record of the earliest mare volcanism, and may be a significant volumetric contribution to the lunar crust. Previous remote sensing and geologic studies have provided evidence for the distribution of ancient mare deposits. Schultz and Spudis [1] studied the distribution of dark-haloed impact craters in the lunar highlands, most of which appear to have excavated dark mare basalt from beneath a higher albedo surface layer. They suggested that basaltic volcanism predated the last major basin-forming impacts and that early mare volcanism may have been widespread. Hawke and Bell [5, 6] used near-IR spectra to demonstrate that many dark-haloed impact craters excavated ancient mare units buried by basin and crater ejecta. Studies of the Apollo orbital geochemical data sets [7, 8, 9, 10] have shown that mafic geochemical anomalies on the east limb and farside of the Moon are commonly associated with light plains deposits that exhibit dark-haloed craters. The ages of these plains units indicated that the extrusion of mare basalt was a major process well before 4.0 b.y. In recent years, both Earth-based and spacecraft remote sensing data have been used to characterize selected lunar cryptomaria [3, 4, 11, 12, 13]. Still, many issues remain unresolved. We have been using maps of FeO and TiO_2 abundances produced from Galileo and Clementine multispectral images coupled with the nearside geologic map in a GIS dataset to investigate the nature and origin of ancient buried mare basalts on the lunar nearside [14, 15]. We are now extending this work to the farside of the Moon. The purposes of this study include the following: 1) to study the composition of surface units in and around the Lomonosov-Fleming (L-F) basin region, 2) to determine the composition of the buried mare unit, 3) to investigate the processes responsible for cryptomare formation.

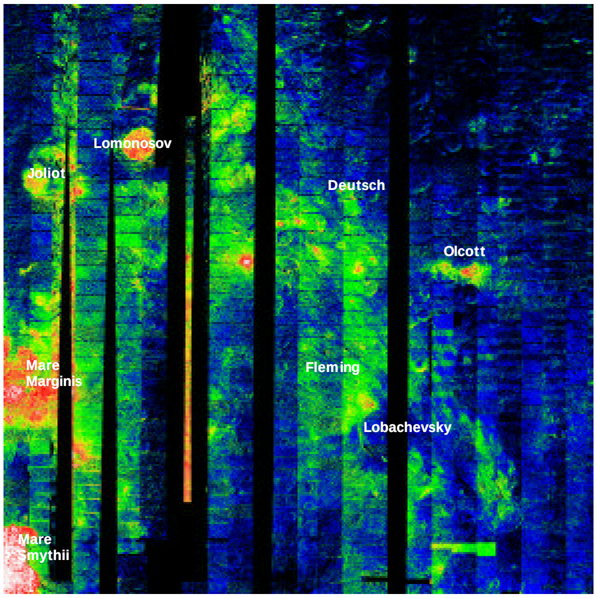
Method: Clementine UVVIS images were utilized in this study. The techniques described by Lucey *et al.* [16, 17] and Blewett *et al.* [18] were applied to calibrated Clementine images in order to produce FeO and TiO_2 abundance maps for the Lomonosov-Fleming region. These maps have a spatial resolution of 125 m and were the primary data sets used in this investigation.

Lomonosov-Fleming Basin from Apollo 12 frame H-8296. Craters Lomonosov (L), Fleming (F), Richardson (R), and Szilard (S) are marked. From Wilhelms [19].

Lomonosov-Fleming Region: This 620 km, pre-Nectarian basin is located on the farside of the Moon with the center at 19º N., 105º E. The basin is named for the Nectarian-aged crater Fleming (130 km, 15º N., 109.5º E.) and the lower Imbrian-aged crater Lomonosov (93 km, 27.5º N., 98º E.) which is mare filled. Possible overlying basin deposits include those of Imbrium, Crisium, and Humboldtianum. There are no underlying basins detected. The basin was detected by mapping mounds, ridges, and scarpes in the area. No interior ring is observed but the basin does contain Nectarian and Imbrian age light plains [2, 19, 20].

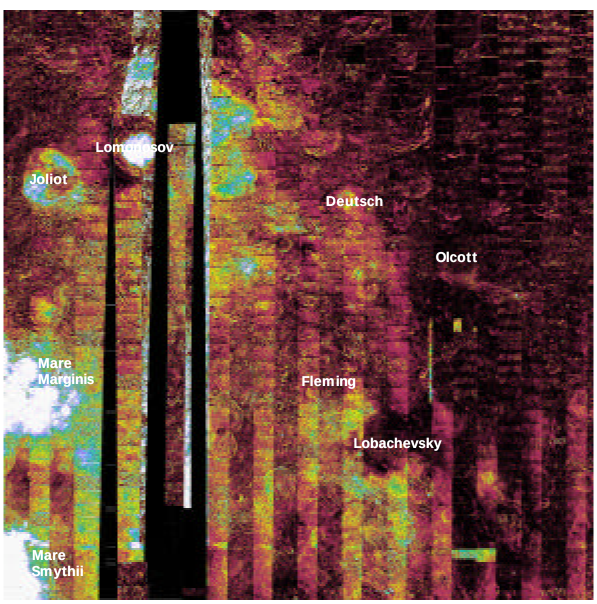
Characterization of FeO. An examination of Clementine images obtained for the L-F region reveals numerous dark-haloed impact craters (DHC's) in the interior. Many of these craters were previously mapped by Schultz and Spudis [1]. These dark-haloed craters are associated with point sources of elevated

FeO which are 4-6 wt. % higher than their surroundings.



FeO image of the Lomonosov-Fleming Region. FeO wt. %: 0-7 black, 7-10 blue, 10-12 green, 12-14 yellow, 14-16 orange, 16-18 red, 18+ white.

The craters have peak values for FeO in the 19-20 wt. % range and the dark halos have FeO values in the 13-17 wt. % range. The light plains deposits in the basin have elevated FeO values of 10-12 wt. %. For comparison, the surrounding highlands have FeO values around 4.5-6.5 wt. %.



TiO_2 image of the Lomonosov-Fleming Region. TiO_2 wt. %: 0.0-0.5 black, 0.5-0.8 brown, 0.8-1.1 yellow, 1.1-1.4 green, 1.4-1.7 blue, 1.7-2.0 purple, 2.0+ white.

Characterization of TiO_2. The dark-haloed craters also have slightly elevated TiO_2 values. These craters have peak TiO_2 values of 2.5-3.5 wt. % and average dark halo values of 1.1-1.7 wt. %. The light plains in the basin exhibit only slightly elevated TiO_2 values (0.4-0.9 wt. %). The surrounding highlands have lower TiO_2 values of 0.4-0.6 wt. %.

Crater Deutsch. Located in the northeast corner of the basin, this 66 km crater has a smooth light plains interior and contains at least five dark-haloed craters. Both the FeO and TiO_2 values are high for each of the dark-haloed craters indicating that the impacts exposed mafic material.

Conclusions: The evidence confirms that the Lomonosov-Fleming basin is the site of a major cryptomare. The FeO values in the dark-haloed craters approach the values of surface mare. The TiO_2 values of some of the DHC's are as high as 3.5 wt. %. These values are higher than any other cryptomare on the Moon.

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