MARE AND CRYPTOMARE DEPOSITS IN THE SCHICKARD REGION OF THE MOON: NEW MEASUREMENTS USING CLEMENTINE FEO DATA. I. Antonenko[1] and R.A. Yingst[2], [1]PIT, 197 Fairview Ave., Toronto ON M6P 3A6, Canada, irene.antonenko@utoronto.ca, [2]Natural and Applied Sciences, University of Wisconsin-Green Bay, Green Bay, WI 54311, yingsta@uwgb.edu.

Introduction: An understanding of maria and cryptomaria (hidden or obscured volcanic deposits [1]) is important for the study of lunar volcanism [2]. Thickness, and therefore volume, of both mare and cryptomare deposits have been studied using the depth of excavation of craters [eg. 3, 4]. Previous work [5] has also shown that iron abundance algorithms [6] can be used in the identification of mafic materials.

In this study, we use FeO Clementine data [6] to identify FeO-rich areas and FeO-excavating craters. We apply this information to the study of mare and cryptomare deposits in the Schickard area of the Moon.

Method: Clementine data was processed as in [5, 6,] to obtain FeO abundance (Figure 1). Areas with strong mafic signatures and craters that tap into mafic material were identified. Areas in shade, which have very high phase angle and result in erroneous FeO values [6] were disregarded. Fresh craters that could be identified as either a) tapping mafic material (FeO craters) or b) not tapping mafic material (non-FeO craters) were measured. Over 2000 craters were so classified.

Large concentrations of FeO craters, along with high FeO values in general, were used to identify mafic units and map their extent. Boundaries were refined using non-FeO craters, whose sizes overlapped those of FeO craters in an adjacent unit [4]. Mafic deposits so identified are illustrated in Figure 2.

Crater sizes were converted to depths of excavation, giving thickness estimates. FeO craters provide minimum estimates. Non-FeO craters, if present within the unit boundary, yield maximum thickness estimates.

Areas for all units were estimated and multiplied by the thickness to give volume estimates (Table I).

Results: The results of this study are summarized in Figure 2 and Table I. Additional deposit characteristics are discussed in more detail below.

M1: Mare patch M1 was previously mapped [7], but was found to be more extensive in this study. Albedo is very low and FeO values are high throughout the extended unit. For this reason, the extra section recognized here is considered to be an unidentified part of the mare, as opposed to a cryptomare unit having a different age and provenance. Deposit thickness is estimated to be on the order of 100 meters, with some thicker sections, consistent with previous estimates [3].

M3 & M4: These unmapped patches have very low albedo and high FeO values, and so are considered to be unidentified maria, rather than obscured deposits.

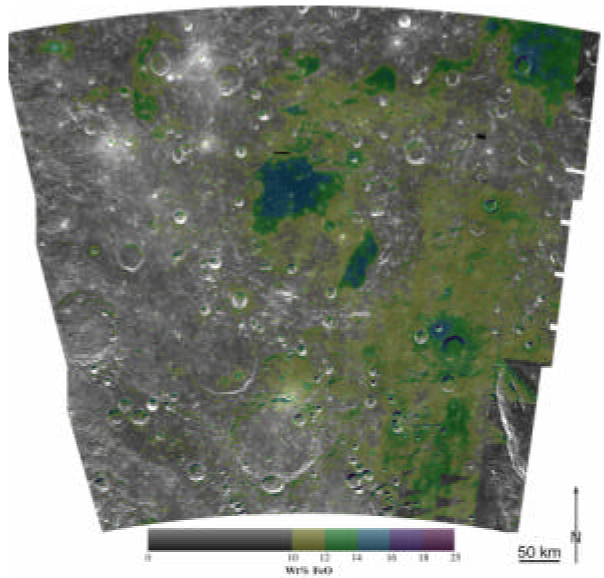

Figure 1. Clementine mosaic of the study area, showing the 750 nm band overlain by FeO data [6].

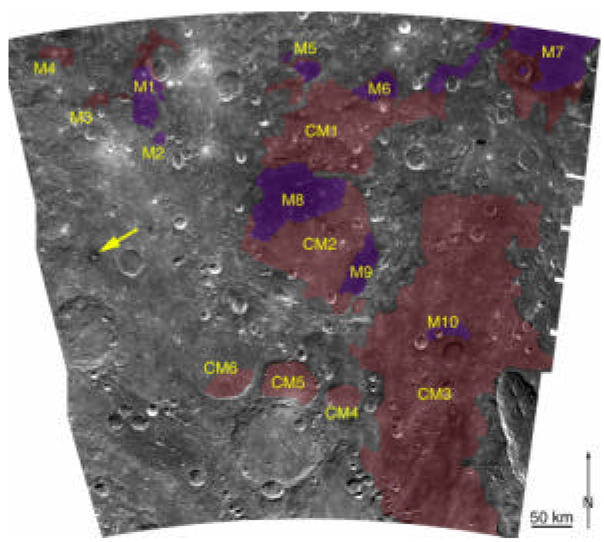

Figure 2. Map of known mare deposits (purple) [7] and additional FeO-rich deposits identified by this study (pink), overlain on a mosaic of Clementine 750 nm band data. Yellow annotations indicate the locations of deposits discussed in the text.

M5: This unit has been mapped as two separate patches [7]. However, low albedo and strong FeO values between and around the patches suggest one extended mare unit at this location.

Table I: Characteristics of maria and cryptomaria in the Schickard region of the Moon.

Deposit	FeO Crater Diameter (km)	Non-FeO Crater Diameter (km)	Thickness (m)	Area (km^2)	Volume (km^3)	Comments
M1	0.7-1.9	1.3-3.0	100	3500	350	More extensive than mapped
M2	0.8-2.3	-	200-100	200	200	Only 3 FeO craters
M3	0.9-1.1	-	100	450	450	Unidentified mare patch
M4	0.9-1.8	-	150	750	112.5	Unidentified mare patch
M5	0.7-3.7	1.8-3.1	300-150	1750	262.5	Thins to the north
M6	0.9-3.1	-	250	1400	350	Patch confined to crater
M7	0.6-5.1	2.1-7.4	200	12,000	2400	More extensive than mapped
M8	0.7-5.4	-	300	7000	2100	Thicker than previous estimates
M9	0.8-2.3	-	200	1800	360	Thicker than previous estimates
M10	0.7-1.8	-	150	720	108	Few craters
CM1	0.5-5.1	0.6-13.0	150	14,500	2175	Found between mare patches
CM2	0.5-13	-	150	12,000	1800	Very variable thickness
CM3	0.5-12.7	0.6-12.0	100	60,500	6050	Very variable thickness
CM4	1.0-3.1	2.3-5.7	100	1000	100	Confined to crater Phocylides C
CM5	1.0-6.3	6.5	100	2750	275	Confined to crater Nasmyth
CM6	1.5-4.0	1.4-2.3	200	1500	300	South part of Wargentin crater
			TOTALS	120,000	17,393	

M7: A low albedo and strong FeO signature in surrounding areas suggest this mare is more extensive than mapped [7]. Crater diameters indicate a thickness of up to 400 meters, but closer to 200 meters in most places. This is consistent with previous estimates [3].

M8 & M9: FeO craters in these maria suggest thicknesses of 300 and 200 meters respectively, which is considerably thicker than previous estimates [3].

CM1: Craters in this large cryptomare unit suggest a variable thickness of 50-750 meters, but ~ 150 meters in most of the unit. The overlying layer is 40-80 meter thick, consistent with ejecta from Orientale [4, 8].

CM2: The cryptomare in Schickard crater contains some large FeO craters, suggesting a thickness of up to 1 km in places. In other areas, highland kipukas protrude to the surface. However, thickness is ~ 150 meters throughout most of the deposit. The overlying layer is very thin, < 40 meters. This is too thin to correspond to Orientale basin ejecta at this location [4, 8].

CM3: Numerous FeO and non-FeO craters in this large cryptomare suggest a very variable thickness; up to 1 km in places, but ~ 100 meters in most of the deposit. The overlying layer is thin, <40 m, which is consistent with Orientale ejecta at this distance [5, 9].

CM4 &CM5: These cryptomare patches are < 500 meters thick, likely ~ 100 meters. The overlying layer is <80 meters, consistent with Orientale ejecta [4, 8].

CM6: Craters here suggest that a mafic unit is buried > 100 meters deep. Such a thick covering is consistent with Orientale ejecta [4, 8].

Most FeO craters are associated with an identified mafic unit, but some isolated FeO craters are not, occurring in areas with very low FeO values. These may represent a) very small mare or cryptomare patches, b) tapping into sub-surface dikes, or c) the presence of impact melt in the crater area. For very fresh craters, FeO algorithms may not distinguish FeO material from impact melts [6]. Thus, these isolated craters are considered suspect. One exception is the dark-haloed crater Inghirami W (6.8 km), yellow arrow in Figure 2. Inghirami W excavates material from a depth of < 570 meters. Surrounding craters are all smaller (2.1-2.5 km in diameter), suggesting the covering layer is at least 200 meters thick, consistent Orientale ejecta [4, 8].

Conclusions: New volume and area estimates for mare and cryptomare units in the Schickard region are obtained from Clementine FeO data. Some agreement and some differences were found between our results and those of previous studies, which were based solely on the analysis of panchromatic photographs [3,7]. These variations demonstrate a need for the concurrent usage of both photogeologic and multispectral data sets in studies of the lunar surface. Old lunar maps should be revisited now that multispectral data is available.

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