New Geological Map of the Orientale Basin

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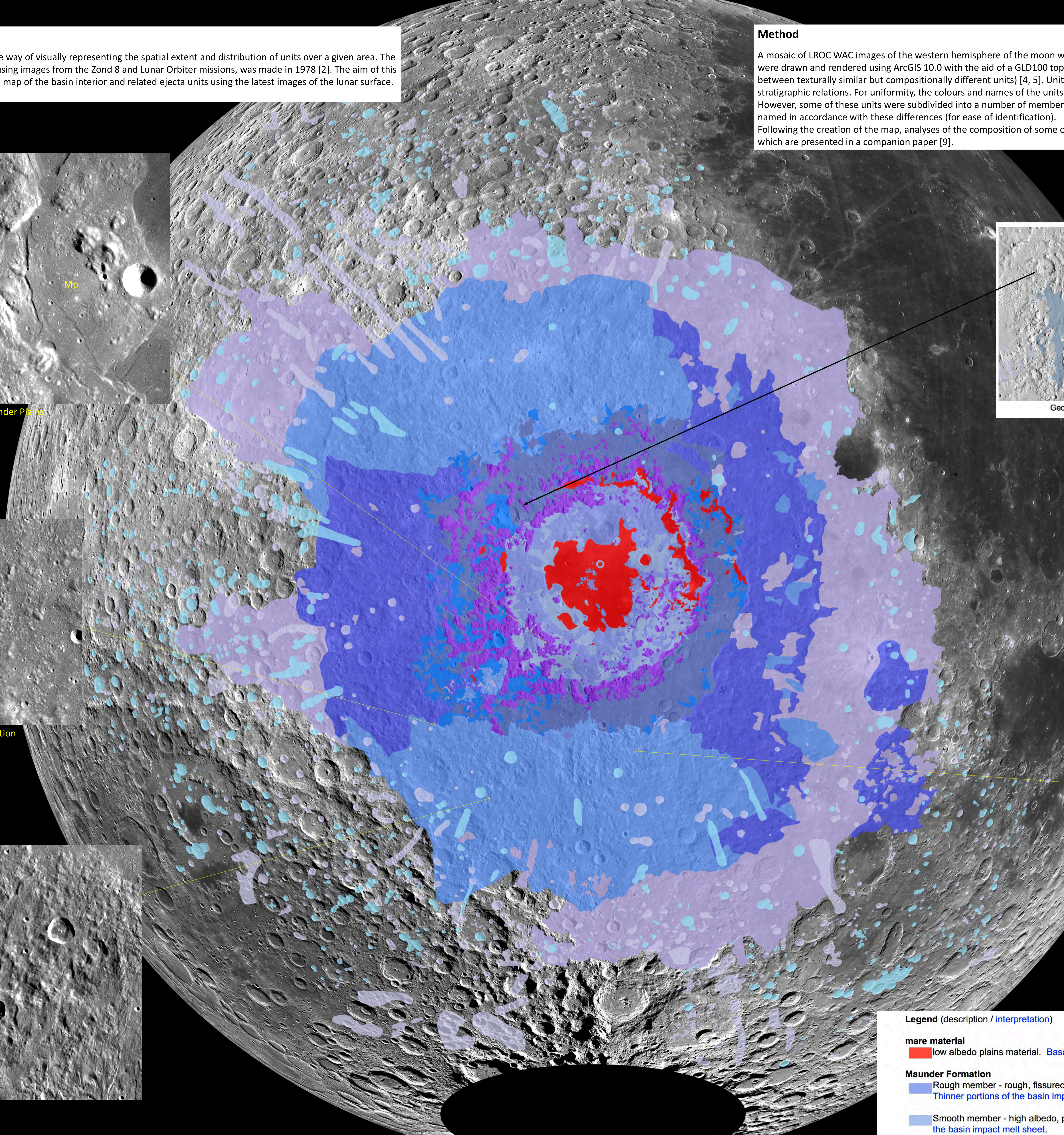
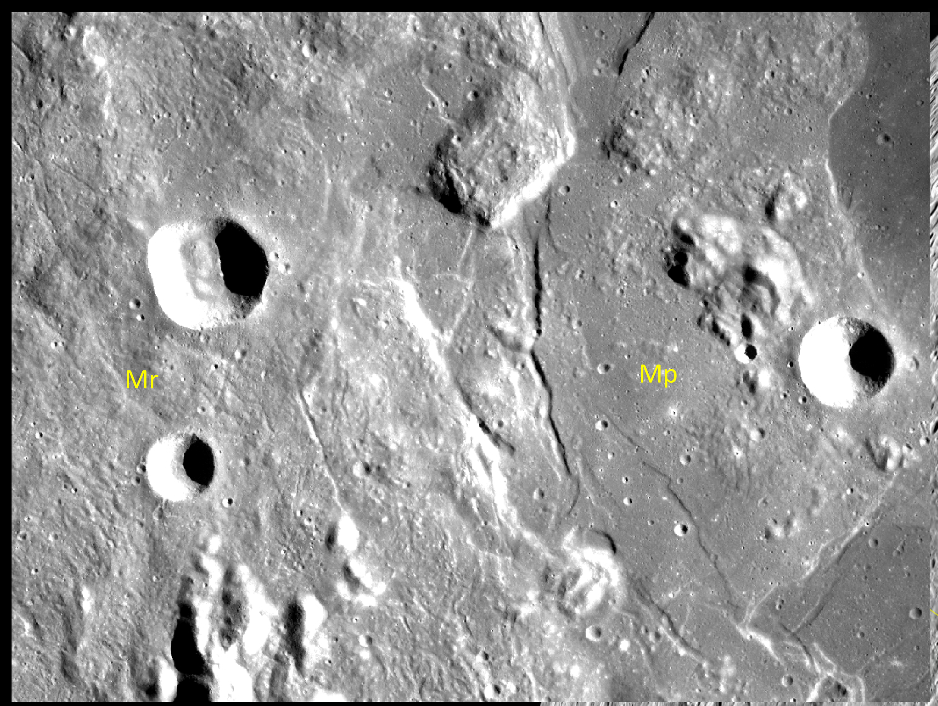
Introduction

Geological maps are the most effective way of visually representing the spatial extent and distribution of units over a given area. The previous map of the Orientale Basin, using images from the Zond 8 and Lunar Orbiter missions, was made in 1978 [2]. The aim of this project was to create a new geological map of the basin interior and related ejecta units using the latest images of the lunar surface.

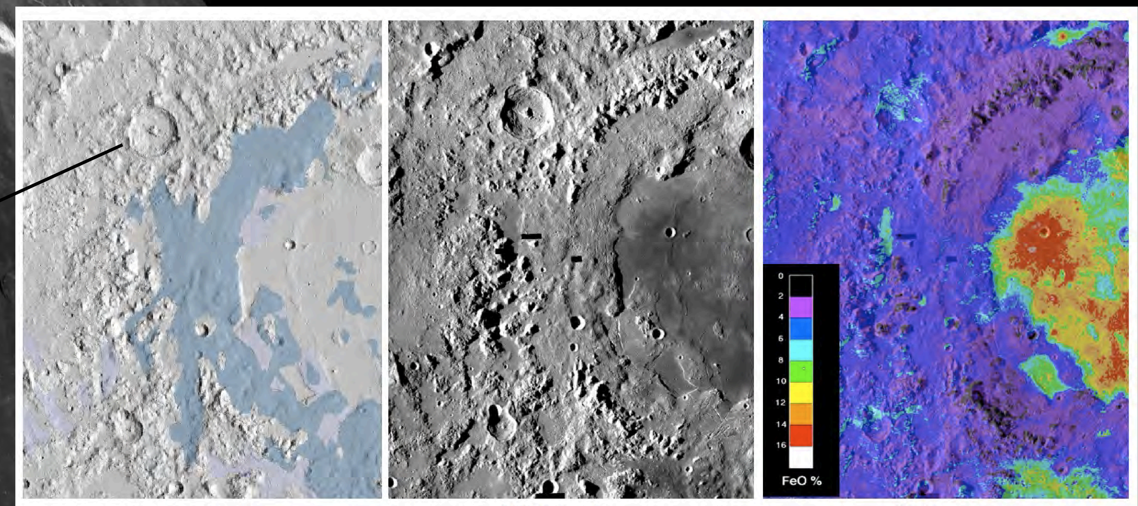
Method

A mosaic of LROC WAC images of the western hemisphere of the moon was used as a base map and centred on the Orientale Basin. The units were drawn and rendered using ArcGIS 10.0 with the aid of a GLD100 topographic map and Clementine FeO and TiO_2 images (to distinguish between texturally similar but compositionally different units) [4, 5]. Units were defined by surface texture, composition, structure, position and stratigraphic relations. For uniformity, the colours and names of the units were based on those used for the previous map by Scott et al [2]. However, some of these units were subdivided into a number of members based on differences in their defining characteristics and have been named in accordance with these differences (for ease of identification).
Following the creation of the map, analyses of the composition of some of the units (particularly the melt sheet) were carried out; the results of which are presented in a companion paper [9].





Mr – Maunder Rough Mp – Maunder Plains



Geology WAC image FeO map

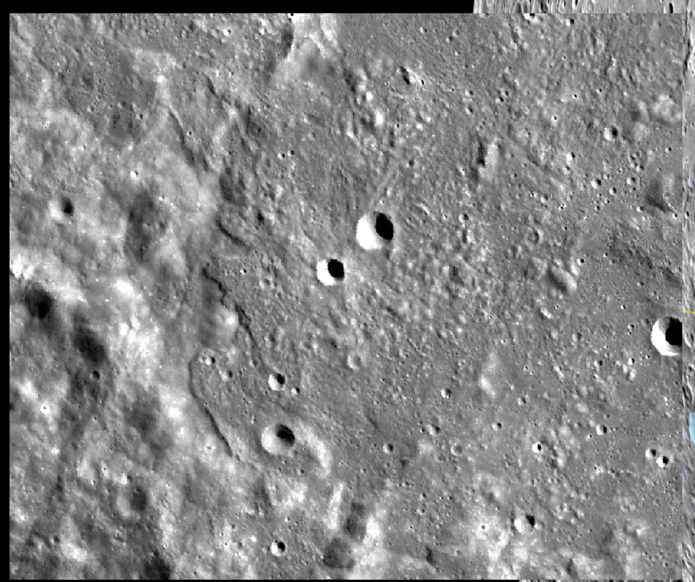
Basin impact melt sheet

Widely Exposed inside Inner Rook ring

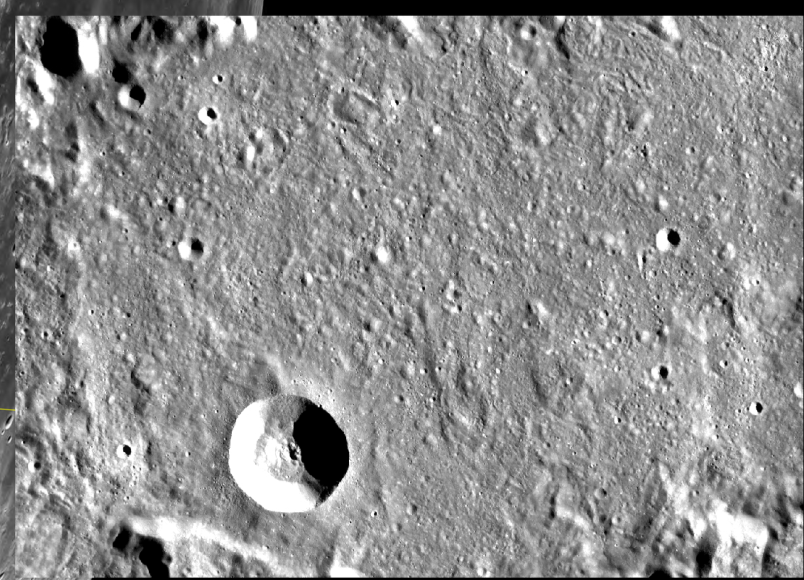
Has uniform composition with 4.4 ± 2.0 wt.% FeO

Small superposed craters show no change in composition with depth

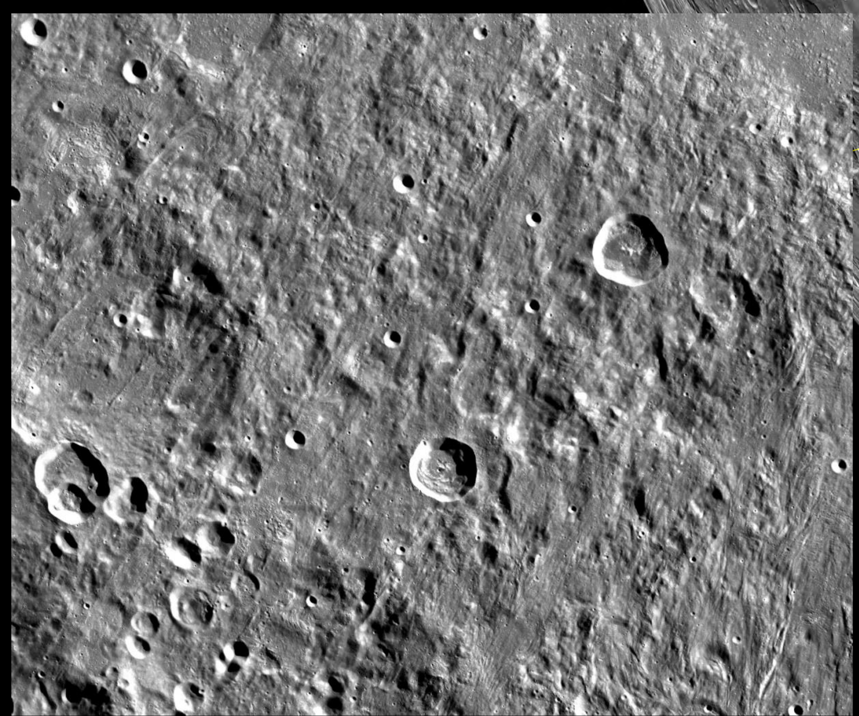
No evidence for differentiation of melt sheet



Flow lobes within Montes Rook formation



Typical texture of the Montes Rook formation



Radial ejecta pattern

Legend (description / interpretation)

mare material
low albedo plains material. Basaltic lava flows with TiO_2 ~ 2.5 wt.%

Maunder Formation
Rough member - rough, fissured and cracked material. Appears to drape underlying rough terrain. Thinner portions of the basin impact melt sheet.

Smooth member - high albedo, plains-like materials confined inside the Rook rings. Thicker segments of the basin impact melt sheet.

Montes Rook Formation
Knobby member - knobby to hummocky, rough materials; display flow lobes in some regions. Basin ejecta, possibly with a significant melt component.

Smooth member - transitional to knobby member, plains-like materials. Basin ejecta with larger fractions of impact melt.

Massif member - rugged, equant to massive massifs arranged in concentric circular patterns. Basement crust uplifted by basin formation. Pure anorthosite in some regions.

Hevelius Formation
Smooth member - featureless flat terrain within exterior deposits. May contain ejected basin impact melt.

Radial member - exterior deposits with lineated surface texture radial to basin center. Ejecta, primarily clastic.

Transverse member - exterior deposits with lineations concentric with basin rings. Likely clastic basin ejecta modified by surficial flow subsequent to deposition.

Secondary crater member - Large (up to ~20 km) impact craters forming clusters, chains and isolated features at large radial distances from the basin. Created by the impact of ejected blocks and clouds of debris from basin.

Covered crater member - high albedo plains on secondaries at large radial distances (> 2x basin dia.). Mixture of primary and secondary basin ejecta emplaced by debris surge following ballistic ejecta curtain.

Results/Discussion

-Orientale basin has been mapped in more detail, identifying previously unmapped areas of mare material and melt ponds.

-Some formations have been split into a number of constituent members based mainly on textural differences within the formation.

-Flow lobes have been identified in the Montes Rook Formation. They are situated again Massifs and the Cordillera Ring and, in some areas, breaching the boundaries of the inner basin. This implies that some portion of the impact melt material is contained within this formation [8].

-The Hevelius Formation displays bilateral symmetry, indicating an oblique impact from the east [1].

-Maunder Plains member is impact melt material that has locally ponded in contrast with the rough member that is melt material that has been draped pre-existing material [3].

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References

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