Introduction: Chang’e-5 mission (CE-5) is China’s first lunar sample return mission, which will collect ~2 kg of samples by drilling subsurface and grabbing surface samples [1]. Northern Oceanus Procellarum region near Mons Rümker has been selected as the landing region (Rümker region, 41–45°N, 49–69°W).

Northern Oceanus Procellarum locates in the Procellarum-KREEP-Terrain [2]. This region was chosen with some of the youngest lunar mare basalts, which have not yet been sampled [1, 3]. The geological characteristics and scientific significance of the Rümker region were described by [4] in detail, which divided the young mare basalts into Em3 and Em4. Sampling these young mare basalts could profoundly improve our understandings of lunar impact and late thermal history.

In order to properly interpret the laboratory analysis of the returned samples, the geological backgrounds of the landing site need to be well understood. For this reason, we have undertaken a comprehensive study of the young mare basaltic units in the CE-5 landing region.

Results and Discussion:

Geomorphology. The young basalt unit is a smooth mare plain, with a mean elevation of -2184 m and a mean slope of 0.88° (a baseline length of ~180 m). The elevation is controlled by the occurrence of wrinkle ridges and arches, which may reflect the underlaying features [5]. Highland mountains (some are Imbrian Basin rings), and Mairan domes (silica-rich) are embayed by these young basalts. Rima Sharp extends across the area, and four source vents closely associated with the rille are identified.

Rima Sharp is described as the longest sinuous rille on the Moon in the global catalog of [6]. [6] interpreted Rima Sharp originates from north and the main branch length is 566 km. We find evidence that Rima Sharp is composed of two independent sinuous rilles; their channels were combined together by rille capture.

Composition. The young basaltic unit is richer in TiO₂ (6 wt. %, mean), FeO (17 wt. %, mean), and olivine than that of the Imbrian-aged mare basalts in the region. High-Ca pyroxene is the dominant mineral according to the spectra of small fresh craters.

Stratigraphy. The Em4 unit is the youngest unit in the region. It covers all pre-existing units, including Em3, and Imbrian-aged low-Ti mare basalts. It embays pre-existing hills, domes, and crater rims. Large craters can penetrate through the overlying high-Ti young basalts and excavate old low-Ti basalts. On the basis of the crater excavation technique [7], the average thickness of the young basalt unit is estimated to be ~40 m; together with its area, we estimate its total volume to be 1521 km³. This value is within the estimation of [8] (30–60 m), using CSFD measurements. The Em3 unit, however, is underneath Em4 and is also Ti-rich, suggesting that 1521 km³ is the upper limit of Em4 volume. This volume is near the range of volumes that appear typical for lunar basaltic eruptions 10²–10⁴ km³ [9].

Source. A source vent for the young high-Ti basalts is unclear. We are investigating three possible scenarios: 1) eruption occurred through a dike(s), with the source vent buried by later erupting parts of the flow unit; 2) eruption occurred through Rima Sharp, which has several apparent source-vent-like features at both ends of the rille; 3) The young flow unit is composed of more than one flow, sourced from different vents. We are currently utilizing these data to model rille vent features [10] and compare these predictions to the nature and structure of the rille and associated parts of the flow unit.


Figure: Kaguya MI color composite map of young mare units (Em3, Em4) in the CE-5 landing region.