KUIPER CRATER ON MERCURY – AN OPPORTUNITY TO STUDY RECENT SURFACE WEATHERING TRENDS WITH MESSENGER. Piero D'Incecco[1], Jörn Helbert[1], James W. Head[2], Mario D'Amore[1], Alessandro Maturilli[1], Noam R. Izenberg[3], Gregory M. Holsclaw[4], Deborah L. Domingue[5], William E. McClintock[4], and Sean C. Solomon[6]. (1) DLR, Berlin, Germany, Piero.DIncecco@dlr.de. (2) Department of Geological Sciences, Brown University, Providence, RI 02912, USA. (3) The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA. (4) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80303, USA. (5) Planetary Science Institute, Tucson, AZ 85719, USA. (6) Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015, USA.

Introduction: The ~55-60-km-diameter, unusually fresh impact crater Kuiper (centered at 11°S, 228.5°E) displays one of the highest albedos of any area on the surface of Mercury in Mariner 10 measurements [1] and is thus an excellent candidate for an end member for the study of "space weathering" effects on Mercury. Indeed, Kuiper has been designated as the type area for the youngest geological era on Mercury [2].

We have mapped the geology of Kuiper crater and the distribution of impact melt. We also searched for post-Kuiper craters to see material that is even fresher than Kuiper. The mapping gives us the context for the study of surface composition with MESSENGER's Mercury Atmospheric and Surface Composition Spectrometer (MASCS).

Craters as probes for space weathering effects: One of the most fundamental questions about Mercury is the nature of its crustal materials and how this information permits us to understand the geological and thermal history of Mercury. It is well known on all planetary bodies that surface alteration of rocks and minerals disguises this fundamental information. For airless bodies, a series of processes known as space weathering tend to alter fresh surface materials over time.

Of particular interest in terms of understanding space weathering is the surface of Mercury, where close proximity to the Sun enhances many candidate space weathering effects [e.g., 3-13], and elevated surface temperatures introduce effects on minerals that are unknown, poorly documented, or currently under study [e.g., 14,15]. Thus, there are two issues:

(1) what is the nature of space weathering on Mercury, and

(2) how do these effects change surface materials with time, and what are the rates of these changes?

It is well known that impact craters on planetary surfaces excavate fresh bedrock material from depth and redistribute it across the surface, mixing the primary ejecta with local material upon impact. On the Moon, the progression of craters from very fresh and bright to more degraded morphology and lower-albedo deposits has been used since the advent of imaging and mapping to construct a geological time scale [16] (Copernican, brightest and freshest with well-preserved bright rays; Eratosthenian, less bright deposits, rays largely similar to background albedo, but morphologically distinct, and so on, backward in time).

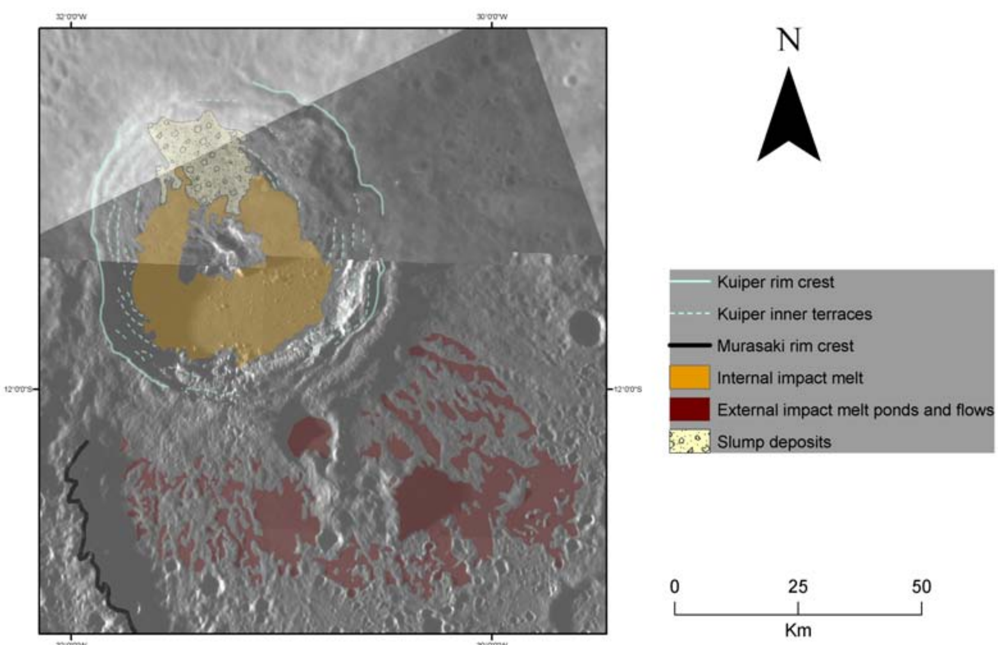

Figure 1. Geological map of Kuiper crater and its distribution of impact melt.

Geological mapping: The purpose of this study is to characterize Kuiper crater geologically so as to provide a temporal and process baseline for the assessment of space weathering processes and their rates. The impact melt distribution for Kuiper crater shows a number of interesting differences from comparable craters on the Moon. The impact melt deposits show a much larger ratio of the maximum distance of impact melt from rim crest (*D*) to the crater radius (*R*). The *D/R* ratio is larger than what has been observed [17, 18] on the Moon. In comparison with same sized craters on the Moon [17], Kuiper shows a major influence of impact melt flows in place of impact melt ponds and veneers.

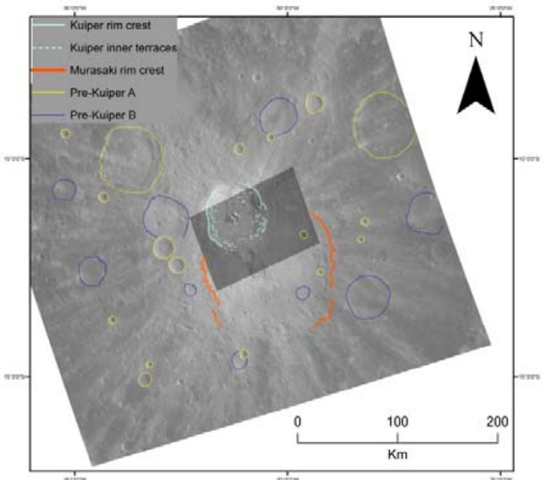

Figure 2. Distribution of two populations of pre-Kuiper craters (with A younger than B).

The distribution of the ejecta blanket deposit and secondary crater chains is not symmetrical about Kuiper. The first occurrence may be primarily linked to the effect of preexisting topography after the Murasaki crater formation event. In addition the influence of an oblique impact should be also taken in consideration. Secondary craters may be partially buried to the southeast of Kuiper crater, where impact melt deposits are more abundant. This possibility may have an influence on the observed distribution of secondaries around the crater itself.

All primary craters in the Kuiper region look to be stratigraphically younger than Murasaki but older than Kuiper crater itself. Moreover, there is no evidence for any clearly visible post-Kuiper crater.

MASCS data: A first look at the MASCS observations covering Kuiper crater is shown in Figure 3. Presented here is the ratio of reflectance at 585-605 nm wavelengths to that at 700-750 nm, a ratio that allows correction for photometric effects [19], as evident from the good agreement between different tracks.

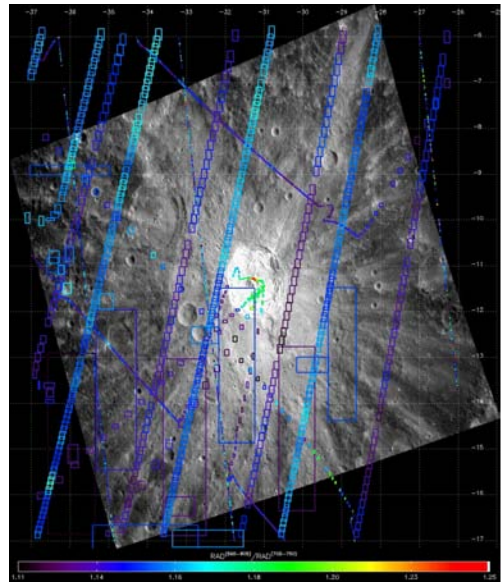

Figure 3. Kuiper crater. Colored MASCS footprints show the ratio of reflectance at 585-605 nm to that at 700-750 nm wavelengths; background is Mercury Dual Imaging System wide-angle camera image EW0223443634I.

Young material on the floor of Kuiper is spectrally distinct from the surrounding plains material. The central peak, which probes material from depth, is spectrally distinct from both the surrounding material and the crater floor material.

Outlook: The combination of geological mapping of Kuiper crater with ongoing laboratory work [20, 21] offers an opportunity to study space weathering effects for this crater with very red ejecta. Many processes, including extreme heating, micrometeoroid bombardment, radiation, and solar wind interaction, influence space weathering on Mercury. All of these effects operate on different timescales. Analysis of the Kuiper deposits might allow these processes and their timescales to be explored.

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