Planetary Science from NASA's WB-57 Canberra High Altitude Research Aircraft During the Great American Eclipse of 2017

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Abstract Text:

The Great American Eclipse of 2017 provided an excellent opportunity for heliophysics research on the solar corona and dynamics that encompassed a large number of research groups and projects, including projects flown in the air and in space. Two NASA WB-57F Canberra high altitude research aircraft were launched from NASA's Johnson Space Center, Ellington Field into the eclipse path. At an altitude of 50,000ft, and outfitted with visible and near-infrared cameras, these aircraft provided increased duration of observations during eclipse totality, and much sharper images than possible on the ground.

Although the primary mission goal was to study heliophysics, planetary science was also conducted to observe the planet Mercury and to search for Vulcanoids.

Mercury is extremely challenging to study from Earth. The 2017 eclipse provided a rare opportunity to observe Mercury under ideal astronomical conditions. Only a handful of near-IR thermal data of Mercury exist, but IR images provide critical surface property (composition, albedo, porosity)

information, essential to interpreting lower resolution IR spectra. Critically, no thermal image of Mercury currently exists. By observing the nightside surface during the 2017 Great American Eclipse, we aimed to measure the diurnal temperature as a function of local time (longitude) and attempted to deduce the surface thermal inertia integrated down to a few–cm depth below the surface.

Vulcanoids are a hypothesized family of asteroids left over from the formation of the solar system, in the dynamically stable orbits between the Sun and Mercury at 15–45 R_s (4–12° solar elongation). Close proximity to the Sun, plus their small theoretical sizes, make Vulcanoid searches rare and difficult. The 2017 eclipse was a rare opportunity to search for Vulcanoids. If discovered, these unique, highly refractory and primordial bodies would have a significant impact on our understanding of solar system formation. Only a handful of deep searches have been conducted. Our observations will only be the second time ever a search for Vulcanoids will have been conducted in the NIR.

We present the first results of planetary science from airborne observations during the 2017 Great American Total Solar Eclipse using two of NASA's WB-57F research aircraft, each equipped with two 8.7–8.9" telescopes feeding high-sensitivity visible (green-line) and near-IR (3–5 μm) cameras operating at high cadence (30 Hz) with ~3″/pixel platescale and 1.2–1.6° fields of view. The aircraft flew along the eclipse path, separated by ~90 km, to observe a summed ~120 min of partial and total eclipse (including ~8 min of solar observations in totality) in both visible and NIR, enabling an attempt at the first thermal imaging of Mercury and a new search for Vulcanoids with improved sensitivity limits.