OPTICAL MATURITY STUDY OF STUART'S CRATER CANDIDATE IMPACT. D. T. Blewett[1] and B. R. Hawke[2]; [1]NovaSol, 1100 Alakea St., 23rd Floor, Honolulu, HI 96813 USA, dave.blewett@nova-sol.com; [2]Hawaii Institute of Geophysics & Planetology, University of Hawaii, 1680 East-West Rd., Honolulu, HI 96822 USA, hawke@higp.hawaii.edu.

Introduction: Optical maturity (OMAT) images are an important a tool for investigating features on the lunar surface whose origins are related to maturity and albedo. An interesting case is "Stuart's crater", whose formation may have been photographed by an amateur astronomer half a century ago [1]. Buratti and Johnson [1] used a Clementine ratio image to identify a particular feature as a candidate impact for the flash photographed by L. H. Stuart in 1953. Other workers [see 2] have cast doubt on the interpretation of [1]. We employ Clementine optical maturity [3, 4] and compositional images to carry out further study of the candidate Stuart's crater and the geology of the area where the flash occurred.

Stuart's Flash: Knowledge of the absolute ages of lunar craters is of great importance for understanding the Moon's stratigraphy and geologic history, as well as the flux of impactors that has affected the Earth. Study of returned lunar samples has provided dates for a small number of craters, both large and small. Large craters include Autolycus (2100 Myr), Aristillus (1300 Myr), Copernicus (810 Myr), and Tycho (109 Myr), see summary in [4, 5]. Another large crater, Giordano Bruno, is probably older than 800 years [6]. Smaller craters dated with returned samples include North Ray Crater (50 Myr) and South Ray Crater (2 Myr) at the Apollo 16 site, and Cone Crater at Apollo 14 (25 Myr) [5].

In 1953 an amateur astronomer, L. H. Stuart, photographed a flash on the Moon which he interpreted to be the result of a meteoroid strike. If the flash recorded by Stuart was indeed caused by a crater-forming event and the crater can be located, it would provide an interesting opportunity to examine a "zero age" crater and to study the onset of the optical maturation process. The flash on Stuart's photographic plate was estimated by [1] to be at 4.8° N, 357.1° E, with an uncertainty of about 35 km. This is in the central nearside, roughly between the craters Pallas and Schröter, near the northern and western shores of Sinus Medii (Fig. 1).

Sinus Medii consists of Upper Imbrian age mare basalt [7]. The spectral properties of these basalts put them in the "mIG" spectral class of [8], referring to "medium" TiO_2 content (~2-5 wt.%), "Intermediate" albedo, and "Gentle" 1-μm absorption band. Extensive dark mantle deposits of pyroclastic origin exist north and west of the area of the flash [9]. The highland terrain in the vicinity is dominated by the Fra Mauro Formation, which is believed to be ejecta emplaced during the Imbrium basin-forming event. Pre-Imbrian material is exposed on the walls of Pallas, Pallas E, and Murchison craters [7].

Candidate Impact Crater: Buratti and Johnson [1] studied the area of Stuart's flash with Clementine images. They used a UV/Vis (415-nm/750-nm) ratio image to search for small craters with high ratio values. A high UV/Vis ratio indicates relatively "blue" color and a shallow spectral slope. Space weathering causes a steepening ("reddening") of the spectral slope, so younger craters are generally bluer. The crater identified by [1] indeed has a high UV/Vis ratio and stands out conspicuously in the ratio image (Fig. 2). Interestingly, while this feature has the highest UV/Vis ratio in the vicinity, it does not have the highest OMAT value (Fig. 3), indicating that it may not be the freshest (higher OMAT corresponds to fresher material). The spectral ratio is controlled by both composition and maturity [e.g., 3, 10]. The two craters indicated by the short arrows in Fig. 3 are in mare basalt with ~15 wt.% FeO; the candidate feature is in highland material of ~11 wt.% FeO. The OMAT image therefore indicates that the candidate impact crater of [1] is not unusually fresh compared to other small craters in the vicinity. Instead, it may happen to have a high UV/Vis ratio partly for compositional reasons.

References:

[1] B. Buratti and L. Johnson, *Icarus*, *161*, 192-197, 2003. [2] J. K. Beatty, *Sky & Telescope*, June 2003 issue, p. 24. [3] P. Lucey et al. *J. Geophys. Res.*, *105*, 20,377-20,386, 2000. [4] J. Grier et al., *J. Geophys. Res.*, *106*, no. E12, 32,847-32,862, 2001. [5] D. Stöffler and G. Ryder, *Space Sci. Rev.*, *96*, 9-54, 2001. [6] C. Pieters et al. *Science*, *266*, 1844-1848, 1994. [7] D. Wilhelms, U.S.G.S. Professional Paper 1348, 1987; D. Wilhelms, U.S.G.S. Map I-548, 1968. [8] C. Pieters, *PLPSC 9th*, 2825-2849, 1978. [9] L. Gaddis et al., *Icarus*, *61*, 461-489, 1985. [10] P. Lucey et al., *J. Geophys. Res.*, *103*, no. E2, 3679-3699, 1998.

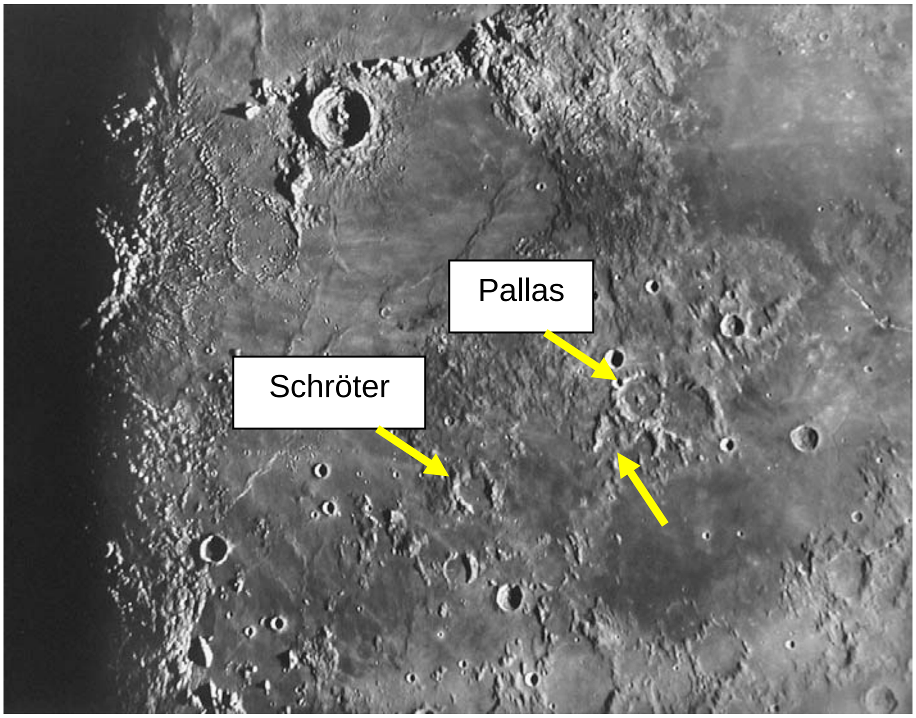

Figure 1: Consolidated Lunar Atlas plate D15 (image C3904), available at web site: http://www.lpi.usra.edu/research/cla/ . North is toward the top, Pallas crater is 46 km in diameter. Stuart's flash reportedly occurred between Pallas and Schröter. The feature identified by [1] is located near the tip of the unlabelled arrow.

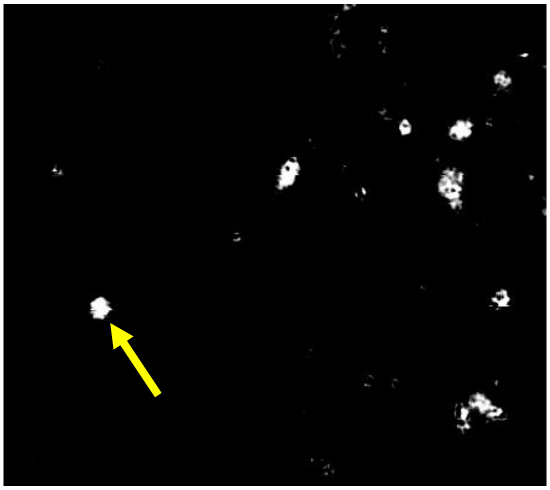

Figure 2: Clementine 415/750 ratio image (100 m/pixel) displayed so that values >0.61 are white, lower values are black. The image is a close-up of the area of the candidate impact, and is ~45 km wide. The candidate impact crater of [1] (arrow) has the highest ratio value in the area.

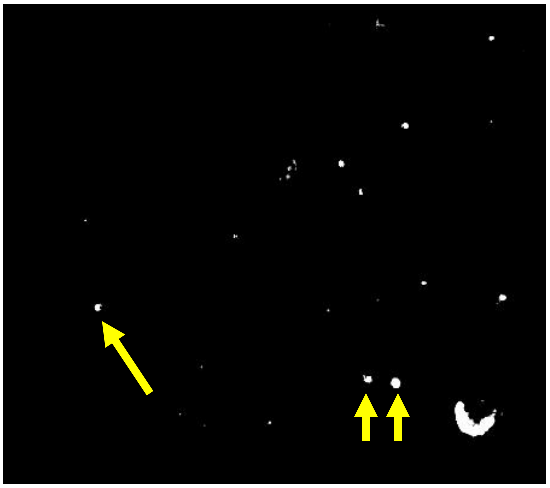

Figure 3: Clementine OMAT image (100 m/pixel) displayed so that values >0.21 are white, lower values are black. The image covers the same area as Fig. 2. Several features not prominent in the ratio image stand out in OMAT, for example, the two craters indicated by the short arrows. The candidate crater (long arrow) has OMAT values comparable to these and several other similar-sized features, indicating that it may not be unusually fresh compared to other features in the region.