References: [1] Naney M. D. et al. (1976) *Proc. LSC 7th*, 155–184. [2] Lindstrom D. J.(1990) *Nucl. Instr. Meth. Phys. Res., A299*, 584–588. [3] Shearer C. K. et al. (1990) *GCA, 54*, 1851–1857. [4] Warner R. D. et al. (1979) *Proc. LPSC 10th*, 1437–1456. [5] Wentworth S. J. et al. (1979) *Proc. LPSC 10th*, 207–233. [6] Lindstrom M. M. et al. (1991) *GCA, 55*, 3089–3103.

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THE TAURUS-LITTROW DARK MANTLE, LIGHT MANTLE, CRATER CLUSTER, AND SCARP. Baerbel K. Lucchitta, U.S. Geological Survey, Flagstaff AZ 86001, USA.

The Taurus-Littrow landing site is on the floor of a grabenlike valley that is radial to the Serenitatis Basin; the valley is gently inclined to the east. It is bordered by steep-sided massifs that rise 2 km above the valley floor and form part of the Serenitatis Basin rim [1,2]. The valley floor is exceptionally dark, and in one place it is overlain by a light-colored mantle apparently derived from the massif to the south. The floor is also peppered by overlapping craters. A scarp, up on the west, transects the valley floor and enters the highlands to the north.

Before the mission, the valley floor was interpreted to be covered by a dark mantle that also covers part of the highlands along the southeastern rim of the Serenitatis Basin [3–5]. The dark unit has an albedo as low as 0.79, which is darker than the outer dark mare ring in the Serenitatis Basin [6]. The dark mantle was generally interpreted to be a young pyroclastic deposit. The reasons for the young age assignment were (1) a dearth of small craters when compared with crater densities on surrounding mare surfaces and (2) the observation that the dark mantle appears to cover young craters and the fresh-looking scarp. Postmission analysis established that the dark material in the landing area is mostly composed of old mare regolith averaging about 14 m in thickness and containing about 5% dark beads [7]. These beads are associated with orange beads in the ejecta of a small crater. The generally accepted postmission interpretation of the dark mantle is that it is a deposit of dark and orange beads erupted from fire fountains soon after the mare basalts were emplaced [7], and that the reworking of the beads into the regolith gave it the low albedo [1,2]. The presence of orange and dark layers on mare and highland material at the base of the regolith is also supported by detailed studies of the Sulpicius Gallus Formation on the west side of the Serenitatis Basin, where many outcrops give clues to the stratigraphic relations [8]. There the dark mantle covers mare and highlands with deposits on the order of 50 m thick. The reason for the paucity of small craters in the dark mantle is now attributed to the unconsolidated, friable nature of the mantle; small craters are eroded much more rapidly by mass wasting and impact gardening than in the adjacent hard-surfaced, younger lavas, which have thin regoliths [9].

The controversy concerning the light mantle mostly centers on whether it is a simple avalanche deposit or whether it was emplaced largely by impact (whereby secondary projectiles may have hit the top of the massif from which the light mantle is derived and dislodged the material). A detailed study of secondary impact craters of Tycho over the entire lunar nearside showed that Tycho secondaries have distinctive characteristics [10]: they are crater clusters with sharp, fresh-looking surface textures; the surface downrange from secondary craters displays a braided pattern with V-shaped grooves and ridges; acute angles of the Vs as well as the trend of many ridges, together with the overall cluster trend, point in the general direction of Tycho. An analysis of the light mantle, the crater cluster on top of the massif, and the crater cluster on the valley floor showed that the Tycho secondary characteristics are present. Thus, the light mantle is not a

true avalanche but an impact-propelled feature, and the crater cluster on the valley floor is composed of Tycho secondaries. The scarp on the valley floor displays the typical characteristics of a mare-type wrinkle ridge. Wrinkle ridges in the Serenitatis region were studied by several authors [11] and were generally considered to be thrust faults. A detailed study of the scarp on the valley floor and its continuation into the adjacent highlands showed that it has characteristics of high-angle normal and high-angle reverse faults [12]. It is likely that this scarp is the surface expression of minor postmare adjustments along high-angle faults that reactivated older faults bordering basin-rim massifs.

References: [1] Wolfe E. W. et al. (1975) *Proc. LSC 6th*, 2463–2482. [2] Wolfe E. W. et al. (1981) *U.S. Geol. Surv. Prof. Paper 1080*, 280 pp. [3] Scott D. H. and Carr M. H. (1972) *U.S. Geol. Surv. Misc. Geol. Inv. Map I-800*, sheet 1. [4] Lucchitta B. K. (1972) *U.S. Geol. Surv. Misc. Geol. Inv. Map I-800*, sheet 2. [5] Lucchitta B. K. (1973) *Proc. LSC 4th*, 149–162. [6] Pohn H. A. and Wildey R. L. (1970) *U.S. Geol. Surv. Prof. Paper 559-E*, 20 pp. [7] Heiken G. H. et al. (1974) *GCA, 38*, 1703–1718. [8] Lucchitta B. K. and Schmitt H. H. (1974) *Proc. LSC 5th*, 223–234. [9] Lucchitta B. K. and Sanchez A.G. (1975) *Proc. LSC 6th*, 2427–2441. [10] Lucchitta B. K. (1977) *Icarus, 30*, 80–96. [11] Muehlberger W. R. (1974) *Proc. LSC 5th*, 101–110. [12] Lucchitta B. K. (1976) *Proc. LSC 7th*, 2761–1782.

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MORPHOLOGY AND COMPOSITION OF CONDENSATES ON APOLLO 17 ORANGE AND BLACK GLASS. David S. McKay[1] and Sue J. Wentworth[2], [1]NASA Johnson Space Center, Houston TX 77058, USA, 2Lockheed, 2400 NASA Road 1, Houston TX 77058, USA.

Background: Lunar soil sample 74220 and core samples 74001/2 consist mainly of orange glass droplets, droplet fragments, and their crystallized equivalents. These samples are now generally accepted to be pyroclastic ejecta from early lunar volcanic eruptions [1,2]. It has been known since early examination of these samples that they contain surface coatings and material rich in volatile condensible phases, including S, Zn, F, Cl, and many volatile metals. Meyer [3] summarizes the voluminous published chemical data and calculates the volatile enrichment ratios for most of the surface condensates.

The volatiles associated with these orange and black glasses (and the Apollo 15 green glasses) may provide important clues in understanding the differentiation and volcanic history of the Moon. In addition, condensible volatiles can be mobilized and concentrated by volcanic processes.

The Problem: While considerable chemical data exist on these samples, the phases that contain the volatile species are not known; no unequivocal condensate mineral has ever been identified in these samples, with the possible exception of sodium chloride salt crystals [4]. No X-ray diffraction or electron diffraction data exist on any of these phases. More positive information on the phases or mineralogy of the condensates would lead to a better understanding of the nature of the volatile gases from which they formed and the temperature, total pressure, and gas fugacity conditions associated with the eruption. This in turn would lead to a better understanding of lunar extrusive volcanism and of the history of the magma from which the pyroclastics came.

Some basic questions still unanswered include

1. What is the composition of the gas phase of the eruption? Was the major driving gas $CO-CO_2$ or was it something else?

2. What is the source of the condensible volatiles found on the droplets? Are they all indigenous lunar volatiles? Are any of them,