ANALYSIS OF SCARPS ON THE RIM OF MARE SERENITATIS;

B. K. Lucchitta, U.S. Geological Survey, Branch of Astrogeologic Studies, 601 E. Cedar Avenue, Flagstaff, Arizona 86001

Two prominent scarps that transgress from mare into highlands were singled out for detailed study. They are the Lee-Lincoln scarp in the Taurus-Littrow area on the east side of the Serenitatis basin, and a scarp about 150 km northwest of the crater Sulpicius Gallus on the west side of the basin. The Lee-Lincoln scarp can be traced for about 40 km from the Apollo 17 landing valley across the highlands to the north. The West-Serenitatis scarp branches west-northwestward from a major system of wrinkle ridges and crosses the rim highlands for about 17 km. The geologic setting of the scarps differs: the Lee-Lincoln scarp lies on the rim of the Serenitatis basin and crosses a minor mare bay; the West-Serenitatis scarp lies partly within the basin and appears to belong to the major mare ridge system. Several features are common to both scarps: 1. They cross mare terrain and offset the surface by 80 m (Lee-Lincoln scarp, up on the west) and 100 m (West-Serenitatis scarp, up on the south). 2. On the mare, the scarps are topped by irregular, sharp wrinkle ridges. The West-Serenitatis scarp in places descends as steps, where each step is topped by a wrinkle-ridge arch that has boulder fields across its crest. 3. The surface above the scarps slopes towards the scarp, the surface below is more level. 4. Both scarps continue into the highlands, where their morphology changes: they become single scarps with a smooth welt on the upthrown side, and they do not have wrinkle ridges. There the scarp height measures 10 m to 30 m; the reduced height is probably caused by mass wasting against the scarp. 5. In the highlands, both scarps are segmented. The gaps show less distinct scarplets in parallel or imbricate arrangement. The Lee-Lincoln scarp has straight segments arranged in imbricate form. The West-Serenitatis scarp is more sinuous, but the segments are aligned. 6. Both scarps follow older structural trends, including older massif-bounding faults. 7. Both scarps are faults, as the material offset by the scarp is the same on both sides, but different in different stratigraphic units. 8. Observations of the fault trace show that the fault planes are irregular in strike as well as in dip, and measurements along the fault trace must be evaluated with caution, as they suggest both normal and reverse faulting. A seemingly reliable measurement, where the Lee-Lincoln scarp enters the highlands to the north, suggests normal faulting.

The following conclusions partly confirm the work of other authors, but do not support previously proposed models in all details: 1. The scarps are faults with roots that involve the material underneath the mare fill. The decollement model of

SCARPS, MARE SERENITATIS

Lucchitta, B. K.

thrusting along discontinuities in the mare (1) is not applicable here. 2. If the faults are the result of stresses created by some isostatic adjustment to mascons (2, 3, 4) these stresses have to be transmitted into the basin rim areas. 3. The lack of wrinkle ridges in the highlands suggests that wrinkle ridges are not of deep-seated volcanic origin (5). It is plausible that they are structures responding to the material properties of the mare basalts (1, 2, 3, 4, 6). However, formation of mare ridges by autointrusion remains a possibility (7). 4. A winding, near vertical fault plane agrees best with most of the observational data. 5. Wrinkle ridges topping the scarps suggest arching as a result of thrusting, on the other hand, the downward increase in slope on the upper-level mare surface towards the faults, and measurements on the outcrop trace where the faults enter the highlands suggest normal faulting. 6. Even though most authors prefer a compressional stress regime (1, 3, 4, 6) a tensional regime (7, 8) is supported by some of the evidence described here, and cannot be ruled out.

REFERENCES

(1) Howard, K. A., and Muehlberger, W. R., 1973, NASA SP-330, p. 31-22 to 31-25.
(2) Baldwin, R. B., 1968, Science 162, p. 1407-1408.
(3) Bryan, W. B., 1973, Proc. Lunar Sci. Conf. 4th, p. 93-106.
(4) Maxwell, T. A., El-Baz, Farouk, and Ward, S. H., 1974, Geol. Soc. Am. Bull., v. 86, p. 1273-1278.
(5) Young, R. A., Brennan, W. J., Wolfe, R. W., and Nichols, D. J., 1973, NASA SP-330, p. 31-1 to 31-11.
(6) Muehlberger, W. R., 1974, Proc. Lunar Sci. Conf. 5th, p. 101-110.
(7) Hodges, C. A., 1973, NASA SP-330, p. 31-12 to 31-21.
(8) Scott, D. H., Diaz, J. M., and Watkins, J. A., 1975, Proc. Lunar Sci. Conf. 6th, p. 2531-2540.