LETTERS TO THE EDITOR

ASTRONOMY

Structure of the Crater Alphonsus

THE photographs of the Crater Alphonsus obtained by *Ranger* IX show several features which may have structural significance from the point of view of the history of the lunar crust.

An examination of the northern side of Alphonsus (Fig. 1) indicates a horizontal offset along the central spine. The southern side, being irregular in outline, is more difficult to interpret. The general impression of the overall outline is, however, that the eastern (astronautical) side is displaced toward the south with respect to the western side.

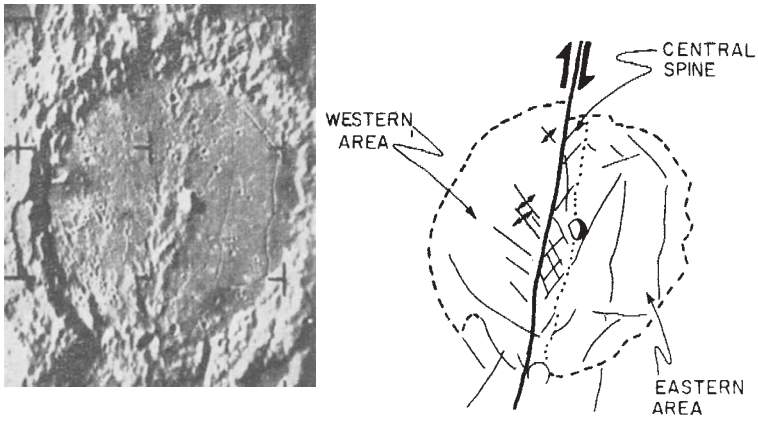

Fig. 1. *Ranger* IX photograph No. 0537 and schematic line drawing. The central spine area separates the western area from the eastern area. The dextral strike-slip fault is indicated by the offset of the northern 'shore' and by the orientation of the folds and lineaments. The central spine and central peak are probably volcanic

The presence of strike-slip faults on the Moon has been a matter of controversy for some time. Fielder[1,2] has described several of them on the basis of outlines, while MacDonald[3] and Baldwin[4] believe that there are no large-scale strike-slip faults. The presence of a strike-slip fault on the floor of Alphonsus is suggested not only by the offset of the northern 'shore', but also by the analysis of the lineament, as will be shown here.

Three areas can be defined on the floor of Alphonsus; the area west of the central spine, the area of the central spine with the central peak, and the area east of the central spine. The movement seems to have occurred on the border between the central spine and the western area, aligned with a lineament that goes from one of the sides of Ptolomaeus to Arzachel.

Three sets of lineaments are present on the floor of the crater: set *A* with azimuth approximately north-east–south-west, set *B* with azimuth approximately north-west–south-east, and set *C* approximately north–south. Few other lineaments of different azimuths are present, and they may be explained by distortions produced by the crater rim. The regularity of some of the lineaments along their extent, especially the rilles, is an indication of an extreme areal homogeneity in the material which constitutes the floor of the crater. Some of the lineaments in the western area, with azimuth of approximately north-west–south-east, appear under careful examination to be folds rather than depressions. Folds have not previously been noticed on the lunar surface.

Although the horizontal displacement could be apparent, rather than real, due to vertical motion of the inclined sides of the crater, the lack of a difference in elevation between the east and west rims and the character of the lineament is more consistent with an offset due to a dextral strike-slip fault. In particular, the fractures and folds oblique to the fault are characteristic of the dragging produced by strike-slip faults on overlying formations[5,6]. This can be easily verified by applying a couple with one's hands to a sheet of paper. The folds, oriented approximately north-west–south-east, match the proposed dextral movement of the strike-slip fault.

Rather than one single fault, it seems likely that a fault zone is present, extending the whole width of the central spine of Alphonsus.

It is possible that the central spine was formed by igneous eruptions which were localized by, and occurred along, the fault zone; and that the central peak could be similar to the famous *aiguille* of Pelée Mountain in Martinique, that is, a peak caused by the slow extrusion of a very viscous magma. The similarity between photographs of Pelée Mountain[7] and the central spine of Alphonsus is striking. The rest of the crater floor could be covered by ignimbritic material, which often accompanies Peléan volcanism. The lineaments on the central spine area indicate that the movement continued during and after the eruptions.

Regardless of the origin of the material forming the central spine and floor of the crater, it would seem from both the general outline of the crater and the presence of the folds that Alphonsus is a crater deformed by a strike-slip fault of dextral type.

I thank the National Aeronautics and Space Administration and the Jet Propulsion Laboratory for providing the *Ranger* photograph, and Dr. J. W. Salisbury for his advice.

LUCIANO B. RONCA

Lunar-Planetary Research Branch,
Air Force Cambridge Research Laboratories,
Bedford, Massachusetts.

[1] Fielder, G., *Geophys. J. Roy. Astro. Soc.*, **8**, 187 (1963).
[2] Fielder, G., *Quart. J. Geol. Soc., London*, **120**, 275 (1964).
[3] MacDonald, G. J. F., *Planetary and Space Science*, **2**, 249 (1960).
[4] Baldwin, R. B., *The Measure of the Moon*, 315 (University of Chicago Press, Chicago, 1963).
[5] Goguel, J., *Tectonics*, 158 (Freeman and Co., San Francisco, 1962).
[6] De Sitter, L. U., *Structural Geology*, 172 (McGraw-Hill, New York, 1956).
[7] Rittman, A., *Les Volcans et leur Activité*, 62 (Masson et Cie, Paris, 1963).

GEOPHYSICS

Explosive Phase Transitions in the Earth's Mantle

THE Earth's crust and mantle deform viscoelastically. There has, therefore, been some question as to whether stress relaxation rates in the upper mantle and lower crust might not exceed any realistic rates of stress accumulation. If this is so, earthquakes could not be generated by rebound of elastic strain; that is, by either the type I or type II source of Honda[1]. It might, therefore, be worth-