AN ACTIVE ZONE IN OCEANUS PROCELLARUM? POSSIBLE FISSURES DEFINED BY RAY CRATERS AND MOONQUAKE ZONES; Barbara M. Middlehurst, The Lunar Science Institute, Houston, Texas, 77058.

Major ray craters are located almost exclusively on the earth-facing side of the Moon. Their distribution is not random most of them being situated on one of two lines that are nearly great circle arcs (from Tycho to Aristarchus and from Tycho to Thales.) By comparison with earth-based impact patterns impact origin for these craters would be better supported if the craters were randomly placed (multiple impact origin) or distributed in ellipse patterns similar to those produced by meteorite shower impacts on the earth.

The ray crater arc from Tycho to Aristarchus crosses Oceanus Procellarum and thus is situated in mare type material over most of its length. It is also well defined by other data: lunar transient event sites (Clavius, Tycho, Bullialdus, Kunowsky, Kepler, and Aristarchus), all the ray craters having at one time or another been reported as showing such phenomena; and moonquake epicenters. The great-circle arc from Tycho to Thales crosses highland areas as well as mare areas. Rays, transients, and epicenters each define this arc also.

The associated hypocenters of the moonquakes, where the activity actually takes place are reported to be at depths of about 800-1100 km. No such correlations of deep-focus phenomena and surface features are known on the earth, and the possibility of conduits leading from depth to the surface in direct communication does not appear likely. Such conduits on earth are known only for short distances and are almost invariably associated with the presence of water which is conspicuously absent on the Moon.

The parallelism between the arrangement of lunar surface sites along a great circle and the arrangement of moonquake sites along an almost coplanar and similar arc at about halfway to the center of the Moon is striking. The second line of rays and ray craters is a great-circle arc that traverses the craters Tycho, Menelaus, and Thales. This arc crosses a highland area. No moonquake epicenters or transients are known to be located in the eastern highlands, but the Alphonsus chain with several transient sights is located just west of the great circle. Epicenters near Tycho and near the edge of Serenitatis lie close to this great circle as well as other sites of transients. A third arc from Copernicus to Proclus can be traced in a similar way. The

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existence of specific small-scale sites, craters at the surface and moonquake sites at depth, that are significant in the context may imply the existence of conduits to the surface from some intermediate depth. Kimberlite pipes are terrestrial geological features in which deep mantle and crustal types of material are mixed and which often show evidence of much gasification.[1,2] These pipes may therefore have some relevance in the present context.

The possibility that ray craters were formed along fissures from slightly subsurface pockets of fluidized material in a cooling Moon is examined. Fluidization is a process in which gas passes through a bed of fine-grained solid particles which then begins to show properties of a fluid; mixing and chemical reaction are also promoted.[2,3,4] According to Gooley et al.[5] rock sample 76535 shows evidence of high pressure. Thus, at least one lunar rock may have reached the surface from depth. Mills[6,7] has shown that a variety of lunar crater forms can be reproduced in the laboratory by fluidization of soil. As cooling proceeded a surface lineament such as that indicated by the line of ray craters from Tycho to Aristarchus might propagate downwards along with the downward migration of the inner lunar crustal edge. Nafi Toksöz has shown that it is probable that the Moon is still cooling and that the deep interior is now hotter than the surface. Latham et al.[8] and Chapman, Middlehurst and Frisillo[9] have found that the presence of a low-viscosity layer at the depth of the moonquake zone is probable. The assumption of a cooling but once hot (surface about 800-900°K) Moon also fits the model of the origin of the Moon now adopted by Appleby and Middlehurst.[10]

References

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