TOWARD A CLASSIFICATION OF LUNAR SINUOUS RILLES. G.A. Swann, Dept. of Geology, Northern Arizona University, Flagstaff, AZ 86011

Since the time of the Apollo program, lunar sinuous rilles have generally been considered to be lava channels or collapsed lava tubes (1,2,3,4,5). Thus they are considered for the purposes of this study, but with an eye for rille characteristics that might prove otherwise. So far, there is no evidence to refute this generally accepted origin.

Over 250 sinuous rilles have been noted on the Moon (5), and although they all have several things in common, there is also a wide diversity in sizes and shapes. All have a certain degree of anfractuosity, hence the name "sinuous," virtually all appear to "originate" in a source depression and to "dwindle" in the direction away from this source; in all cases where reasonably accurate elevations can be measured, the "source" depression is at a higher elevation than the distal end of the rille. All occur in, or along the margins of, mare basins (7).

Sinuous rilles vary greatly in size, from a few kilometers in length and a few tens of meters in depth and width, to rilles like Hadley, which is about 135 km long, 1.5 km wide, and 300 m deep. Many rilles, such as Sebelius, originate in highlands and extend into mare; others, such as Chopin, originate and terminate in mare. A few, such as an unnamed rille between Montes Jura and Montes Alpes, originate and terminate in highlands. These generally appear to have a small outpouring of dark (basaltic?) material associated with them in the highlands.

"Source" depressions may be round, irregular, elongate, large, or small. Some rilles, such as Mozart, terminate in a depression. Others, such as Brayley, have what appear to be feeder tributaries, and also branches, or closed distributaries. Rilles such as Hadley and Mozart have straight reaches and sharp, angular bends, which suggests structural control (5,8). Aristarchus IV, and a small unnamed rille between Aristarcus V and VI have reaches that are obviously deflected along structures. A long segment of Chopin is deflected along highlands topography; the rest of the rille, however, has curved reaches and looping bends, even goosenecks, reminiscent of a mature stream. Rilles in highlands material, such as Sebelius commonly have lobate walls. Others, such as Schroters Valley and the Alpine Valley, are confined to meandering within a large, flat-floored valley. These are interpreted as lava channels that overtopped to flood the valley floors with lava.

Assuming sinuous rilles to be lava channels, the argument continues whether they are primarily channels caused by thermal and/or mechanical erosion of country rock (8,9,10), or constructional features caused by deposition of lava by over-banking from the rille (2,3). Carr (9) makes a good case for rilles in highlands material being formed by erosion because of the lack of basalt deposits along the sides of the rille to form its walls. Although highland rocks are generally more refractory than basalts, they are deeply brecciated, and the relatively steep gradients of rilles emanating from highland sources would be conducive to mechanical erosion.

A question remains as to how effective an erosion agent basaltic lava would be in basalt country rock with little or no regolith and a very low gradient along the course of the rille. The porphyritic nature of many mare basalt samples returned by Apollo indicate that they were not superheated when they reached the surface, and since the liquidus and solidus temperatures of the presumed pre-rille basalts and the basaltic lava forming the rille are

probably about the same, it is also questionable how effective thermal erosion would be. Until more is known concerning the liquidus and solidus temperatures and the rheology of lunar lavas, the eruption rates, and the actual gradients of nearly horizontal surfaces, I seriously question the results of theoretical modeling of erosion to explain rille formation by thermal erosion. Additional, and more definitive, studies of the role of erosion by terrestrial basaltic lavas are also needed.

A classification with its genetic implications based on the above observed characteristics of sinous rilles, may help to characterize different sinuous rilles so that the details of their formation may be better understood. The next step in this study is the development of such a classification.

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