**LUNAR SINUOUS RILLES REVISITED: ANOTHER POSSIBLE ORIGIN;**

*S. W. Ruff, Department of Geology, Arizona State University, Tempe, Arizona 85287*

A long, narrow sinuous rille in southwest Mare Imbrium near the crater Euler (Fig. 1) has been studied in detail by the author. The accepted explanation for this type of feature is an origin by flowing lava (e.g., 1), either in an open channel or a tube which then collapses to form a channel-like feature. Geomorphic and geologic characteristics of this rille are difficult to explain using this model. Based on preliminary observations it is suggested that the rille is a tensional fracture, the product of tectonic activity.

The proximity of the rille to Crater Brayley is used here to establish its name. Brayley Rille occurs in an area dominated by some of the youngest and best preserved volcanic flows on the moon (2). The presence of lobate scarps from multiple events, leveed and braided channels, as well as mare ridges offers an ideal opportunity to observe a sinuous rille in the context of a relatively young and unambiguous set of volcanic landforms (Fig. 2). Additionally, the outstanding Apollo photographic coverage of this area which includes many low sun angle and stereo images allows for a detailed photogeologic investigation.

Brayley Rille with a total length in excess of 360 km is one of the longest sinuous rilles on the moon (3). Its width, which ranges from 140 to 400 m and depth, a few to roughly 30 m, place it in contrast with other sinuous rilles of similar lengths. Hadley Rille for example which is considered to be fairly typical of sinuous rilles (4) is 135 km long, 0.5 to 2 km wide and up to 300 m deep. This then suggests that Brayley Rille is unusually narrow and shallow given its considerable length.

A unique style of branching is another striking feature of this rille (Fig 3). Near Crater Brayley the main channel bifurcates at several points creating narrower and shallower side channels which then rejoin the main channel at points almost 20 km from where they split. In one place a small channel crosses between the main channel and a side channel, joining the two at nearly perpendicular intersections (arrow, Fig 3). At its southerly end, sharply angular sinuosity as well as a flat-floored, steep walled cross section are additional noteworthy characteristics.

Taken separately or together these geomorphic features place this rille in the category of "unusual" but do not necessarily rule out an origin by flowing lava. But, when combined with geologic evidence, a lava origin becomes more difficult to reconcile.

At its northerly end, a few kilometers of the channel occur within one of the flow lobes of the young volcanics (arrow, Fig 2). This appears to be a superpositional relationship suggesting that Brayley Rille is at least as young if not younger than the flow. The rille trends away from the northerly directed volcanic flow lobes and channels at a roughly perpendicular angle.

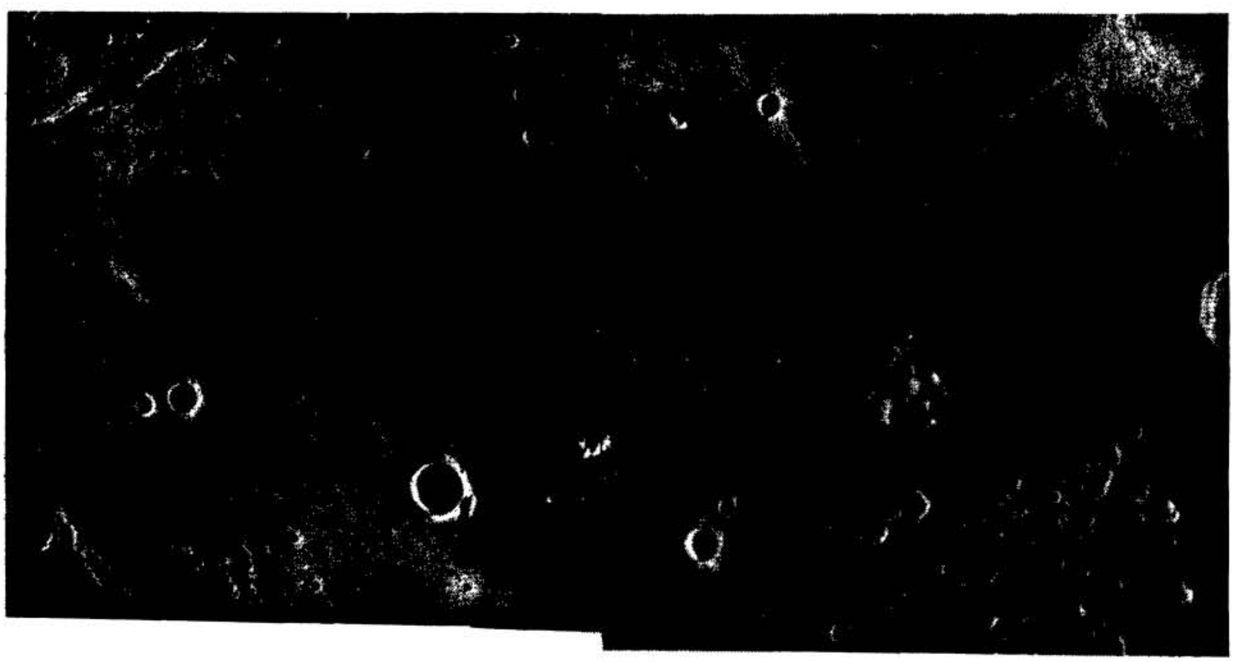

Figure 1. Mosaic of Brayley Rille (refer to text for letter designations). Picture covers area approximately 180 by 300 km; AS17 2925 & 2929

**SINUOUS RILLES REVISITED: Ruff, S.W.**

The regional trend of the channel is coincident with other structural features observed in the area. Roughly 30 km away from Brayley Rille is a prominent scarp formed by normal faulting (A in Fig 1). 150 km east of the scarp lie similarly oriented grabens as well as a rille which shares many of the features of Brayley Rille including its regional trend (B & C in Fig1). One final observation concerns the intersections of the channel with several mare ridges. In all cases these are nearly perpendicular junctions.

It is with these initial observations that an origin for Brayley Rille by tensional tectonic activity emerges. Tensional features such as grabens and cracks have been observed in numerous locales on the moon and attributed to subsidence of mare basins (5,6). The observed tectonic structures in the vicinity of Brayley Rille seem to indicate an extensional stress regime. These stresses are acting upon a layer or layers of basalt that are fairly thin (7). It is proposed then that the rille formed within a relatively thin , areally extensive layer of basalt in response to tensional stresses associated with subsidence of the Imbrium basin.

Also compelling, though not part of the tectonic argument, is the fact that the channel is oriented in a direction significantly different from that of the volcanic flows. If it is accepted that Brayley Rille is younger than the flows, a change in the regional slope must be invoked to explain an origin for the rille by flowing lava. A tectonic origin does not require this.

Although preliminary, the model put forth arises out of a need to reconcile geomorphic and geologic evidence which seems to conflict with an origin by flowing lava. Additional work should attempt to establish terrestrial analogs and if none exist, explain why. Efforts to model the morphology of tension fractures could begin with the observation that simple pavement cracks bear a striking resemblance to the rille. Does there exist a scaling relationship that transcends the obvious size difference of these cracks and the rille? Finally, if Brayley Rille can be attributed to tectonic activity, what other sinuous rilles on the moon share a similar origin?

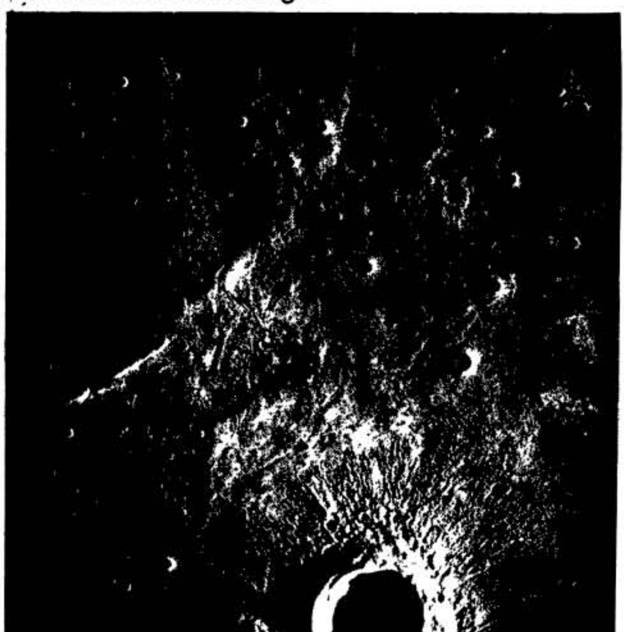

Figure 2. Regional volcanic flow features (see text); AS15 1701 Figure 3. Branching patterns (see text); AS17 23760.

REFERENCES


1) Head, J. W. (1976) *Rev. Geophys. Space Phys.*, **14**, p. 265-300.
2) Schaber, G. G. (1973) *Proc. Lunar Sci. Conf. 4th,* p. 73-92.
3) Young, R.A., Brennan, W.J., Wolfe, R.W., and Nichols, D.J. (1973)*Proc. Lunar Sci. Conf. 4th,* p. 57-71.
4) Spudis, P. D., Swann, G. A., and Greeley, R. (1987) *Proc. Lunar Planet. Soc. Conf. 18th,* p. 243-254.
5) Baldwin, R. B. (1963) *The Measure of the Moon* , University of Chicago Press, Chicago. 488 p.
6) Bryan W. B. (1973) *Proc. Lunar Sci. Conf. 4th,* p. 93-106.
7) Horz, F (1978) *Proc. Lunar Planet. Sci. Conf. 9th,* p. 3311-3331.