PREFLOW STRUCTURE AND TOPOGRAPHY CONTROLLING MARE BASALT FLOWS. Jeffrey J. Gillis. Paul D. Spudis[2], 1. Washington University, St. Louis MO, 63130, 2. Lunar & Planetary Institute, Houston, TX, Gillis@levee.wustl.edu.

Introduction: Basalt fed lava channels and tubes are the two accepted mechanisms for the origin of sinuous rilles by most investigators [1]. Although there is general agreement on the mode of their origin, there is disagreement between the genetic process dominant in rille formation. As an example, the formation of Hadley Rille had been attributed to purely constructional [2], mostly constructional [3], and purely erosional processes [4,5,6]. We observed aspects of each of these models among rilles and channels within the Orientale and Australe basins. The excellent exposure of these channels, provide evidence for the early stages construction of major volcanic features (e.g., Hadley Rille or Schröter's Valley), and insight into the early processes of mare basin-filling.

Orientale Rille: A small rille (11.5 km long, 150-450 m wide) emerges from a graben structure within the Maunder Formation, on the southern side of Orientale basin, and flows northward into the basin (Fig. 1a). It has been suggested [7] that the rille drained impact melt into the basin center. However, we conclude from our observations that the graben channeled volcanic eruptions that occurred within the Maunder Formation and transported lava toward the center of the basin, forming the rille at the Maunder-Mare interface.

Local adjustment of brecciated debris and cooling of the Orientale melt sheet produced tensile stresses, which resulted in the development of fractures and grabens [8,9]. At the head of one of these grabens, a series of small basalt flows are visible in the Lunar Orbiter and Clementine color-composite images (Figs. 1a & 1b). The lobate flows display low-albedo and a mafic, 1 μm band absorption signature in the Clementine data. The graben confined the discharge and periodically caused the basalt to spill over the walls (Fig. 1c). Multiple sites along the graben are roofed over. This suggests that the graben was either a lava tube or a graben that was utilized by flowing lava and subsequently roofed over (as happened at Hadley Rille; [10]). The total extent of the rille with graben included is approximately 60 km.

Australe Channeled Lava Flow: The source vent and channeled lava flows with the Australe basin are located at 85° E, 61° S. Similar mare basalt flows of this type have not been described previously. Basalt eruptions occurred through a centralized vent, 2.5 km dia., located atop an area of elevated topography, within highlands material (Fig. 2a). The irregular kidney-shaped vent is similar to the one in Sulpicius Gallus. As lava move away from the vent, it was channeled into a north and south trending flow (Fig. 2b). Neither flow has apparently incised into the surrounding highlands surface. After traveling 20 km, the southern channelized lava flow ponded in an area of low topography at the base of the slope. A volume of 66 km^3 of basalt collected within this pond and was possibly deposited in one eruption. An older deposit (57 km^3) is mapped adjacent to the younger unit (Fig 2b). It is unresolved whether both basalt deposits were supplied from the same vent. The northern flow extended approximately 27 km before apparently terminating. It is inconclusive whether this flow actually fed basalt to the lava pond north of the vent. Although the eruption was through a confined vent, there are no detectable pyroclastic deposits seen in the Clementine single filter or color-composite image. A steepen continuum slope produced by pyroclastic material would appear an intense red in the multispectral image. This example illustrates that basalt ponds, and possibly even maria, might be reservoirs for basaltic magma erupted outside their existing boundaries.

Discussion and Conclusions: Both volcanic features discussed above are primarily constructional features. The Orientale rille provides direct evidence for sinuous rille development along and controlled by preexisting structural patterns within the Maunder Formation. Offered as a comparison, Hadley Rille is simply a more evolved version of the Orientale rille; larger volume mare basalt eruptions on the Apennine Bench became confined within preexisting depressions and created a more highly developed rille. In both scenarios, substantial thermal and mechanical erosion by lava did not occur. Grabens with similar width and depth dimensions as the rilles themselves, are evidence that lava erosion was a minor component in rille formation. The lack of lava erosion is approximated by the minor incision by the rille across the shelf of Mare Orientale.

The Australe channeled flows are also constructional because they follow along preexisting topography extending from the vent before collecting in topographic lows at its base. This apparently unusual mode of channelized basalt flow may have been an important means for erupting mare basalt within basins. The mare fill of the near side basins has possibly buried similar structures. Vallis Schröteri may be a more advanced version of this type of rille formation. The cobra head begins on an elevated plateau of highlands material [11] and flows northward where basalt collect in Oceanus Procellarum.

References: [1] Oberbeck et al., 1969, *Mod. Geo.*, **1**, 75-80; [2] Greeley, 1971, *Science*, **172**, 722-725; [3] Howard et al., 1972, *PLSC 3*, 1-14; [4] Carr, 1974, *Icarus*, **22**, 1-23; [5] Head & Wilson, 1980, *LPS XI*, 426-428; [6] Head & Wilson, 1981, *LPS XII*, 427-429; [7] Greeley, 1976, *LPSC 7*, 2747-2759; [8] McCauley, 1968, *Amer. Inst. Aeron. Astron.*, **6**, 1991-1996; [9] Head, 1974, *The Moon*, **11**, 327-356; [10] Spudis et al., 1988, *PLSC 18*, 243-254; [11] McEwen et al., 1993, *Science*, **266**, 1858-1862.

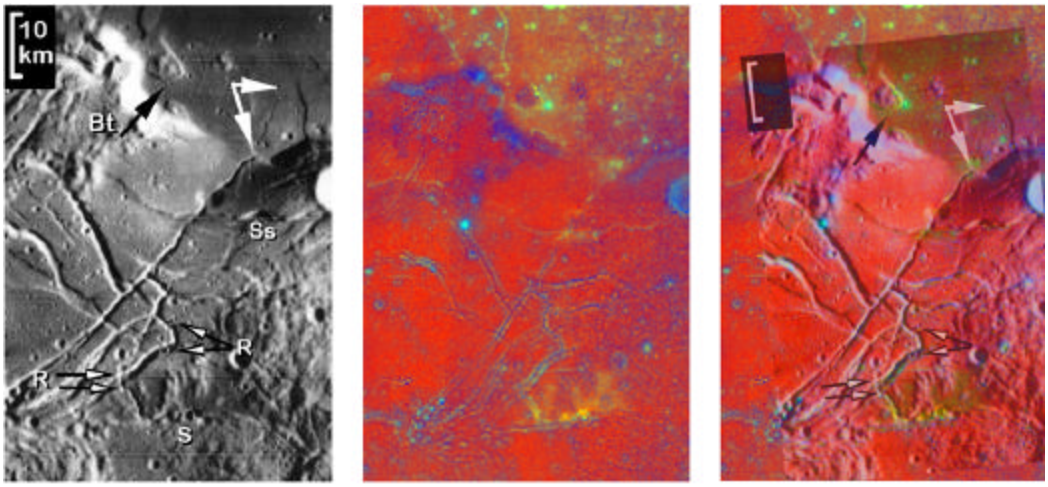

Fig. 1. A) Lunar Orbiter image of the Orientale graben structure and rille. The source of the basalt eruptions (S) is at the head of the graben. Smooth, low-albedo, basaltic material has spilled over the confines of the graben at times of high effusion. Areas along the graben are roofed over (R). A second area (Ss) of basalt eruption is also identified. The back arrow points to a terraced mare deposit surrounding preflow topography. The two white arrows indicate the point where the rille emerges from the graben and where it terminates on the shelf of Mare Orientale. B) Clementine three-color ratio image of the corresponding area (Red=750/415, Green=750/950 Blue=415/750). The smooth, low-albedo region surrounding the head of the rille displays a mafic 1 μm absorption, greenish-yellow color. The walls of the graben displays a weaker 1 μm absorption, cyan color. This evidence shows that the material in these areas is mafic, which is atypical of the Maunder Formation. C) The Lunar Orbiter image is rotated and merged with the Clementine three-color ratio to provide morphologic and compositional information.

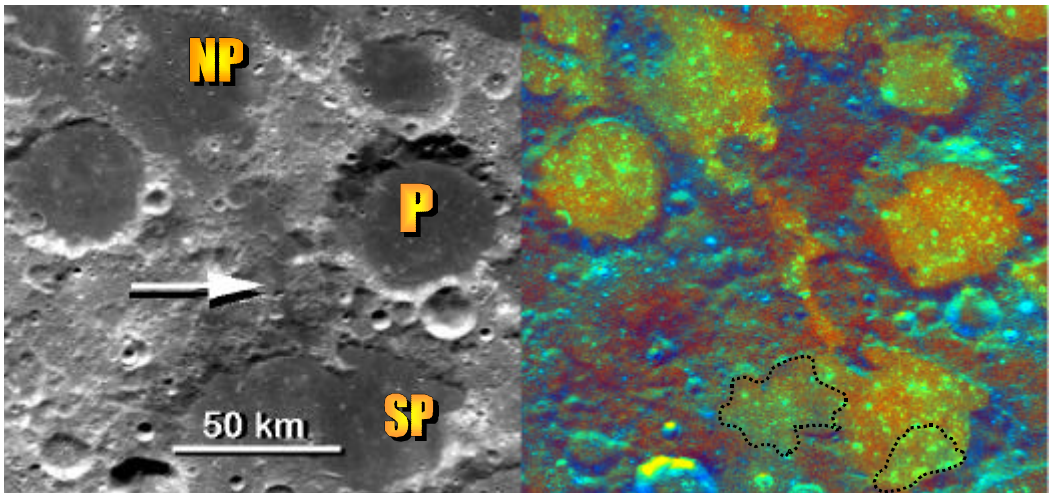

Fig. 2a. Clementine 750 nm image illustrating how lava has erupted in one locality and collected in another. The arrow points to a kidney-shaped volcanic vent left of the crater Petrov (P). Mare basalt traveled in channeled flows and collected in ponds to the south (SP) and possibly north (NP)of the source vent. Fig. 2b is a color composite image of the same area merged with Clementine 750 image. Mafic materials appear greenish-yellow, highlands material is red and blue. Lava erupted from the vent and flowed to the north and south, downhill away from the vent. Impact craters at the base of the hill collected the basalt in a reservoir. The areas enclosed by the dashed line are the older of the two mare deposits in this lava-filled depression.