Rift cave: For lava to get out onto the surface, there must be a hole in the ground. It is effectively impossible to make such a hole without cracking the ground. Rifts form. Lava (usually) flows downhill. A crack is a low spot, so the lava will run down the crack. A lava channel forms, using the rift as a bed. It may roof, and there is then a lava tube roof on a rift. (Rift Cave.) This type of rift cave is actually quite common. Lava tube caves that are predominatly in rifts include: Sentinel, Crystal Ice, Ovis, Merril, and Skull at Lava Beds National Monument; Lava River, Wind, "40-Mile", and others in Oregon; Ape, Lake, Dynamited, Cheese, and others in the Mount Saint Helens-Mount Adams area in Washington. Nearly all superposed multilevel lava caves are in rifts. Rift caves are hollow dikes. The direction of flow within a rift is independent of the fact that a 'rift cave' has formed.

Interior tube: In a single lava flow-unit, channels form within the mass of the stream. The channels are slightly elliptical in cross section. Interior tubes exist, but do not make caves. They invariably collapse or plug. The 'interior' shape is the equilibrium shape, so modifications (stoping, lining, erosion) tend to develop other shapes toward it.

## TERRESTRIAL ANALOGS TO LUNAR SINUOUS RILLES

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Lunar sinous rilles are meandrous channel-like depressions restricted mostly to mare areas. Several diverse models have been proposed to explain their origin; these include erosion by either volcanic ash or running water, surface collapse resulting from intrusive stoping, fluidization of surface regolith by outgassing through fractures, or that the rilles are lava channels, collapsed lava tubes, or both. Considerations of the composition of lunar mare lavas and geomorphic evidence support an origin by lava tubes and channels for at least some sinuous rilles. Lava tubes and channels on earth commonly (and nearly exclusively) form in basaltic flows; and since lunar mare lavas are predominatly basalts it is reasonable to assume that these features would be present in the maria. Lunar sinuous rilles generally flow around topographic highs, and are often composed of discontinuous segments, have pronounced lateral levees or a broad topographic high along the rille axis, originate in irregular craters, and may have distributary structures (rather than tributaries). Nearly all aspects of rille morphology are analogous to terrestrial lava tubes and channels except that of size: sinuous rilles are considerably larger than the terrestrial structures. However, considerations of the lunar environment may account for the difference in size. Laboratory determinations obtained independently for Apollo 11 samples indicate that at least some lunar lavas have a much lower viscosity and thermal conductivity than terrestrial lavas; thus, the lunar lava flows could be longer. Lava tubes and channels, therefore, could be correspondingly larger on the Moon. Although these interpretations may explain certain lunar sinuous rilles (e.g. Hadley Rille, rilles near Herigonius), it is possible that other rilles were formed by other mechanisms.