Some Natural Conduit Analogues for Potential Igneous Activity at Yucca Mountain
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Eruptive conduit geometry has direct relation to number of waste packages that would be damaged if a new volcano were to form at the proposed Yucca Mountain radioactive waste repository, and therefore is a key factor in predicting the consequences of such an eruption. Current risk calculations treat conduits as having circular plan view and range from a few meters to 150 m diameter at repository depths (~300 m). We present new observations of shallow basaltic plumbing at analog sites aimed at testing these parameter values. East Grants Ridge, NM, is a remnant of a ~2.6 Ma alkali basaltic volcano with a chain of 2-3 vents that fed ~10-km long lava flows. The south side of the ridge exposes a plug of vertically jointed, dense basalt that intruded rhyolitic tuffs. The plug is exposed vertically for ~125 m, including 40 m beneath the paleosurface, and has a relatively constant width of ~135 m with no indication of downward narrowing. The size of the plug in the third dimension is not well known but could extend laterally up to ~1.5 km beneath the chain of vents. Paiute Ridge, NV, is an 8.6 Ma alkali basalt intrusion into Paleozoic carbonate and shale and Miocene silicic tuffs and includes extrusive equivalents. Dikes, small sills and lopoliths, scoria, and flows are exposed in a 2 km-wide graben. Depth of intrusion has been estimated at 100-250 m beneath the paleosurface. Dikes range from 3-20 m in width and produced limited contact vitrophyre in the host tuff. At least one sub-volcanic neck is preserved. The top of the plug is ~27 m lower than the base of related basalt flows 1 km distant. This neck is irregularly shaped by intersection of feeder dikes and has a sheath of mixed basaltic magma and host tuff (with both breccia and fluidal textures). The basalt interior of the plug is ~100 m x 70 m in map view but inclusion of the mixed zone increases this to ~220 m x 110 m. Basalt Ridge, NV, contains two remnants (9.1 Ma; 8.8 Ma) of basalt dikes, vent, spatter, scoria, and flow facies, with exposures to ~270 m beneath the paleosurface. Basalt Ridge "East" (BRE) contains breccias, agglutinates, and flows capping a linear ridge for 1,600 m; feeder dikes extend laterally beyond the eruptive products. The adjacent canyon reveals gradual decrease in feeder thickness from an 80-100 m-wide vent to a 40 m-wide zone of dikes plus host tuff (35 m beneath paleosurface), to 1-2 dikes in a 4 m-wide zone (270 m beneath paleosurface). BRE reveals no "conduit" extending to significant depth. Instead, multiple thin dikes rise vertically in non-welded and welded tuffs at repository depths. The above observations are roughly consistent with the range of conduit diameters currently used in consequence calculations, although they may support an extension of the size range so that some large diameters are accounted for at lower probabilities.