MAGMA EMPLACEMENT AND FEEDER CONDUIT GEOMETRIES BENEATH MONOGENETIC VOLCANOES REVEALED VIA STRUCTURAL AND ROCK MAGNETIC STUDIES, AND GEOPHYSICAL IMAGING

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Common models of the magma feeder systems in monogenetic volcanoes, and also for many stratovolcanoes, envision that the magma flows within a dike or pipe-like conduit transporting molten rock from a reservoir to the eruptive vent producing lava flows and pyroclastic materials. Here we report the results from three continental rift systems that are host to suites of apparently monogenetic volcanic systems. These include the Eger Rift, Czech Republic that hosts the several Oligocene to Pleistocene Cenozoic volcanic fields; the Limagne Rift, central France home to the late Miocene to Pleistocene Chaîne des Puys volcanic field; and the Rio Grande Rift, New Mexico, USA that hosts the Pliocene Cerro del Rio volcanic field. In the Czech Republic, we studied the Trosky volcano, Zebín volcano, and Zákupy diatreme combining volcanology and petrography with ground geophysics and paleomagnetic-rock magnetic data. In France and the USA, we combined structural analysis, paleomagnetic, and anisotropy of magnetic susceptibility data to evaluate centers 1 and 2 of the Lemptégy volcano and Puy de Dôme, France, and the Cienega and Cerro Colorado volcanoes, USA. At all these sites, natural erosion or quarrying activities from medieval times to the present day have revealed windows into the roots of the volcanic system between 100 m to 200 m depths. The volcanic systems range in composition from picrobasalt to olivine nephelinite basanite (limburgite), alkali basalt, and basaltic andesite. We show that small volcanic plumbing systems actually involve numerous feeder dikes that interact and direct magma laterally and vertically beneath and within the cone. These observations are consistent with other studies that suggest magmas migrate laterally towards and/or away from the volcanic vent with control by pre-existing subhorizontal structures and studies that have documented lateral flow of shallow igneous bodies at a considerable horizontal distance (>20 km) from their ascent area. We propose that as magma flows upwards from a possible magma chamber, feeder dikes concentrate on a central vent. The evolving vent may attract later dikes due to weaker rock properties, heat concentration, and possibly lower pressure. As the system grows, often the vent area becomes blocked forcing magma to flow outwards or to deviate from the feeder dikes. Feeder dikes, themselves may cut the flanks and cause collapse and small flank eruptions. In addition, any flank collapse changes the local stress conditions resulting in an outward flow away from the central vent complex. Furthermore, at the Zákupy diatreme, late-stage magma emplacement seems to have been influenced by the regional stress field. The results from our combined studies at three different continental rift systems reveal that the feeder geometries beneath these apparently simple exteriors are more complex than is generally appreciated.

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