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Volcanic venting and the eruption of alkaline igneous rocks

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Over Earth history volcanic vents have played a crucial role in delivering important materials to the surface, sculpting the composition of the Earth's crust and atmosphere. Vents (or diatremes) occur at the Earth's surface and ocean floor, effectively marking the interface between the solid Earth and ocean-atmosphere systems. Vents are capable of discharging enormous volumes of volcanic detritus to the Earth system, and play a major role in modulating rates of gas (e.g. CO_2) and aerosol release to our atmosphere. There have been periods during Earth history when unusually intensive venting processes are thought to have significantly perturbed the carbon cycle and climate. There have been other periods when vent complexes have been the locus of intense eruptions that involved diamond ascent from Earth's deep interior. However, there is no general consensus on the triggering mechanism of these unusually energetic and deep-sourced eruptions; existing models include phreatomagmatism, exsolution of magmatic volatiles, 'Verneshot' events and meteorite impacts. In addition, what remains uncertain is the dynamics of gas transfer through vents over time, and how these are controlled by the geometry, composition and permeability of their constituent deposits. This talk will describe the architecture and textural attributes of vent-fills over a range of compositions (kimberlitic, alkali basaltic and lamproitic). The examples described are from particularly well-exposed and accessible sites across southern Africa (e.g. Jwaneng and Orapa, Botswana), northern Europe (e.g. East Fife, Scotland) and India (Majhgawan, Madhya Pradesh), all of which offer exceptional insights into the deep plumbing systems of alkaline volcanic complexes. These data and models have important implications for assessing the potential amounts of gas released over the lifetime of a volcanic system – a fundamental pursuit in determining feedbacks between volcanism and climate during specific periods in Earth history when vent complexes were widespread.