Physical characteristics of kimberlite and basaltic intraplate volcanism, and implications of a biased kimberlite record

Richard J Brown[1], Greg A Valentine[2]

[1]Durham University, UK, [2]University of Buffalo, USA

E-mail: richard.brown3@durham.ac.uk

Kimberlite volcanoes are rarely preserved in the geological record and much of what we understand about the eruption of kimberlite magmas has been deduced from studies of sub-volcanic structures and deposits. This presents us with problems because the surface products that are commonly used to infer eruptive processes at other volcanoes have been removed. We have investigated bias in the record of kimberlite volcanism by using newly acquired size data on over 900 kimberlite bodies from 12 kimberlite fields eroded to depths estimated to be between 0 m to 1200 m, and by a cautious comparison with intraplate monogenetic basaltic volcanic fields. Eroded kimberlite fields are composed of pipes, or diatremes, and dikes and within any one kimberlite field, regardless of erosion level, kimberlite bodies vary in area at the Earth's surface over 2 to 3 orders of magnitude. Typically 60 to 70 percent of the bodies are less than 10 percent of the area of the largest body in the field. The data indicate that the selective removal of surface volcanic structures and deposits by erosion may have distorted the geological record of kimberlite volcanism. Selective mining of preferentially large, diamondiferous kimberlite pipes and underreporting of small kimberlite pipes and dikes adds further bias. A comparison of kimberlite volcanic fields with intraplate monogenetic basaltic volcanic fields indicates that both types of volcanism overlap in terms of field size, volcano number and size, and typical erupted volumes. Eroded monogenetic basaltic fields comprise dikes that fed effusive and weakly explosive surface eruptions, and diatremes generated during phreatomagmatic eruptions, and are structurally similar to eroded kimberlite fields. Published data suggests that kimberlite magmas can erupt in a variety of ways and that most data, gathered from the largest kimberlite pipes, may not be representative of kimberlite volcanism as a whole.