Introduction to Special Issue of Bulletin of Volcanology on “Advances in Kimberlite Geology and Volcanology”

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The volcanology of kimberlite pipes and volcanoes has been a neglected area of mainstream volcanology research, until the last several years. Previously, published kimberlite research focused largely on petrological and geochemical aspects, with few studies on the physical eruption processes, the volcanic facies characteristics and their volcanological significance from the perspective of modern volcanology. To some extent this situation arose because of the constraints of confidentiality associated with the research, which was commonly controlled by major diamond mining and exploration companies in a very competitive industrial environment, as well as a lack of awareness of the opportunities for research amongst the volcanological community.

The Canadian kimberlite fields, newly-discovered in the early 1990's, featured diamondiferous pipes with a greater range of geometries and deposit types, including crater fill deposits, than occurred in the traditional southern African pipes. These deposits were diverse in componentry, texture,

and origins and, more often than not, diamond grades varied greatly across the different lithofacies. The variations in diamond distributions within these deposits created an immediate need to develop a better understanding of the factors that control diamond grade distribution and variations in economic kimberlite pipe systems and provinces. Thus, several years ago, the diamond industry began to invite interest from parts of the academic volcanological research community to undertake research on the volcanological aspects of kimberlite volcanoes and pipes.

Kimberlite pipes or bodies occur in geographic and age clusters, much like small intraplate basaltic monogenetic volcanic provinces and fields. From what we can tell many kimberlite bodies appear to have been monogenetic volcanoes, although there are also pipe complexes, which consist of coalesced, overlapping pipes, resulting from a succession of eruption events, although the temporal spacing of these is generally unclear. In general, however, each eruption phase appears to have been short-lived, much like many monogenetic volcanoes. Most kimberlite pipes that reached the Earth's surface were largely explosive in their behaviour, although the Igwisi Hills complex in Tanzania is an exception because lavas have been found in parts of a preserved edifice (R.J. Brown, M. Field and R. S.J. Sparks, pers. comm.).

There are few kimberlite bodies or pipes where surface deposits and the supracrustal volcanic edifice are preserved in situ and intact, for documentation and study as is commonly the case with Cenozoic volcanoes of other, more common magma suites. The youngest kimberlite has an age of 32.3 Ma. Thus, for most kimberlites, their volcanic edifices have been eroded. Exceptions include the Igwisi Hills complex in Tanzania, and the Fort a la Corne kimberlite field in Saskatchewan, Canada. For most kimberlite bodies, understanding of the eruption behaviour

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and nature of kimberlite volcanoes must be derived from the deposits preserved and mined in kimberlite pipes, which are the remains of the sub-surface vents and conduits of kimberlite volcanoes. This is a challenge for volcanology, because we almost always work on extra-vent deposits to reconstruct volcanic processes. It also, however, represents a new and exciting opportunity because young volcanic conduits are inaccessible to direct observation. Many insights into conduit processes require study of ancient conduits exhumed by erosion. In this regard kimberlite bodies are ideal, and their access is facilitated by the exploration diamond drilling and open pit and underground mining activities of the diamond industry. Without this economic interest, our understanding of the geology and volcanology of kimberlite pipes and volcanoes would be very limited.

This Special Issue of Bulletin of Volcanology on Kimberlite Volcanology comprises a collection of 8 papers, which were presented at the 2009 Toronto AGU meeting, in a symposium convened by the guest editors of this special issue, and with the same title: “*Advances in kimberlite geology and volcanology*”.

The papers in this special issue cover a spectrum of the many research aspects related to the volcanology of

kimberlite pipes, including volatile solubility in kimberlite magmas (Brooker et al.), country rock fragmentation processes associated with kimberlite pipes (Barnett et al.), fragmentation of kimberlite in kimberlite pipes (Moss and Russell), emplacement temperatures of volcanoclastic kimberlites in kimberlite pipes (Fontana et al.), the problems of distinguishing coherent kimberlite from fragmental or volcanoclastic kimberlite resulting from alteration effects (Hayman and Cas), recognizing clastogenic coherent kimberlite (van Straaten et al.), the interplay between primary eruption and mass wasting processes in kimberlite pipes (Buse et al.), and the influence of volcanological and sedimentary processes on diamond grade in kimberlite pipes (Porritt et al.).

We hope that both the volcanological and diamond industry communities involved in kimberlite research will find this collection of papers useful. We also hope that these papers will engage the non-kimberlite volcanological community and that they will find the content and ideas interesting and informative about a range of topics relating to the processes associated with the eruption of kimberlite magmas and the formation of kimberlite pipes and deposits.

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Guest Editors.