Geophysical Research Abstracts
Vol. 17, EGU2015-7032, 2015
EGU General Assembly 2015

Spatial patterns in the distribution of kimberlites: relationship to tectonic processes and lithosphere structure

Zurab Chemia, Irina Artemieva, and Hans Thybo
IGN, University of Copenhagen, Denmark (zch@ign.ku.dk)

Since the discovery of diamonds in kimberlite-type rocks more than a century ago, a number of theories regarding the processes involved in kimberlite emplacement have been put forward to explain the unique properties of kimberlite magmatism. Geological data suggests that pre-existing lithosphere weakness zones may control the spatial patterns of kimberlites, but this hypothesis has never been tested by geophysical methods. As the first step in our analysis of tectonic and lithosphere control of kimberlite-type magmatism, we perform a detailed global analysis of the spatial patterns of kimberlites, and present the first results. The analysis is based on the assumption that the kimberlite emplacement is a two-stage process, and the two stages are controlled by the crustal and lithospheric mantle rheologies, respectively. Stage 1 includes the first-order, lithosphere-scale process that initiate the rise of kimberlite melts through the lithospheric mantle, which forms the major pipe. Stage 2 (second-order process) begins when the major pipe splits into daughter sub-pipes (tree-like pattern) at crustal depths. We apply cluster analysis to the spatial distribution of all known kimberlite fields with the goal of establishing characteristic scales for the stage 1 and stage 2 processes. To reveal similarities between the kimberlite data we use the density-based clustering technique, such as density-based spatial clustering of applications with noise (DBSCAN), which is efficient for large data sets, requires one input parameter, and can deal with clusters of any shape. The results indicate that characteristic scales for the stage 2 are almost globally uniform and thus are almost independent of the structure and the mantle lithosphere. In contrast, the characteristic scales for stage 1 (lithosphere-scale process) that initiate the rise of kimberlite melts through the lithospheric mantle forms the major pipes with characteristic distance ranging from 100 to 300 km and are, apparently controlled, by the past structure of the lithosphere and a “vigor” of lithosphere-mantle interaction.