

## **Carbonatite petrogenesis: evidence from the known occurrences of extrusive carbonatite**

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The known occurrences of extrusive carbonatite provide much important evidence for carbonatite petrogenesis that is not seen in the far more numerous intrusive occurrences. The results of investigations of the tectonic setting, structure, lithologies, associated silicate rocks, chemistry and presence in many occurrences of mantle materials will be described. Half the 38 known occurrences form diatremes and the rest occur within substantial volcanoes. Pyroclastic carbonatitic rocks are present at all localities with carbonatite lava flows at only 12. The pyroclastic rocks vary from lapilli tuffs composed principally of carbonate to ashes with as little as 20 % igneous carbonate. Nearly half of all extrusive carbonatites were erupted from centres with associated melilite-bearing rocks, just over half with nephelinite and/or phonolite, and a third with no associated silicate rocks. 15 occurrences, most of them diatremes, contain mantle xenoliths or megacrysts with spinel lherzolite the most abundant rock type but amphibole, phlogopite and garnet are also recorded. The lack of such materials in intrusive carbonatites may reflect their less energetic mode of emplacement. It is proposed that carbonatites are essentially of two types: (a) those rising energetically and rapidly directly from the mantle, which form diatremes, have only low-volume associated silicate rocks, and entrain mantle debris, and (b) those that form more substantial volcanoes, are associated with large volumes of silicate rocks and follow a more complex genesis involving ponding and differentiation (separation from carbonate-bearing silicate magma) at higher levels in the mantle and crust.