

Petrogenesis and Diamond Prospectivity of kimberlites of Anumpalli cluster, Wajrakarur field, southern India

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The Wajrakarur kimberlite field (WKF) records >45 pipes so far, majority being diamodiferous. In addition to pipe-10 (Anumpalli) and 11 (Dibbasanipalli) discovered by the Geological Survey of India, of late, Rio Tinto Group has discovered three more outcropping pipes in this area (east of Dibbasanipalli, west of Anumpalli and Khaderpet) and termed all these five pipes as Anumpalli kimberlitie cluster (AKC). The AKC pipes contain crustal granitoid xenoliths. The Khaderpet and Dibbasanipalli east pipes show effects of fenitisation in the country rock granitoids and are intensely chloritised kimberlite granite breccias; however, the former is unique in having its association with carbonatite (sovite) intrusion. Petrographically, the AKC kimberlites exhibit inequigranular texture resulted by anhedral to subhedral olivine macrocrysts and pseudomorphs, phenocrysts of Cr-diopside, ilmenite, perovskite and minor or no amounts of phlogopite with two generations of olivine within a fine-grained matrix of same mineral phases. Based on the major element geochemistry the AKC pipes are classified as Group-I archetypal. Based on trace element modeling, the AKC pipes appear to be originated from garnet lherzolite source with residual garnet of 0.5 to 5%, associated with stable continental and/or orogenic area and remarkably belong to non-subduction environment. The observed LREE enrichment and low HREE concentrations in the AKC, is consistent with inferior degrees of partial melting (0.1 to 2%). The AKC pipes appear to have originated from a hydrous magma enriched in volatiles. Exploration evidences support that kimberlites of the AKC are diamodiferous. The calculated diamond grade (DG) values of the AKC pipes are high (3.43 to 8.48) which are inversely proportional to the TiO₂ content. In the binary diagram of Ta and Sc (ppm), the AKC pipes plot in the field of 'Fe-Ti diamodiferous kimberlites'. In the Fe₂O₃ (wt %) vs. Y (ppm) diagram, the AKC pipes plot in the 'prospective' field. The diamodiferous nature of the AKC pipes indicates the conditions of diamond preservation at metastable phases in crustal environment during rapid ascent of kimberlite melt to the surface from the deep mantle, which is supported by low density and ultralow viscosity of these intrusions.