Carbonatites and Related Alkaline Rocks with Special Reference to India – P. Krishnamurthy, Formerly Atomic Minerals Directorate for Exploration and Research (AMD). Department of Atomic Energy, Government of India, Begampet, Hyderabad – 5000 16, Telengana

"Carbonatitic magmatism is like a poorly managed industry, at the mercy of erratic supplies of raw materials, inefficient processing, wasteful storage of the inventory, and fitful distribution of the finished product." – Barker, 1996, p.380

Carbonatites, simply defined as 'carbonate-rich rocks of magmatic origin' were first recognised by Högbom (1895) from the Alnö Island in Sweden. However, the name 'carbonatite' was first used by Brögger (1921) for his study of the carbonate-rich rocks of the Fen complex in Norway in 1921. However, the proof for the existence of a 'carbonatite magma' came from experimental petrological evidence by Wyllie and Tuttle in 1960 from studies in the synthetic $CaO\text{-}CO_2\text{-}H_2O$ system that was confirmed in the same year by the eruption of the Natro- Carbonatite-nephelinite volcano at Oldoinyo Lengai in Tanganyika in Africa. The debate since then has continued on the carbonatites and their associated alkaline rocks.

Woolley and Kjaarsgad's (2008) compilation of the carbonatites of the world lists five hundred and twenty seven (527) examples along with the associated alkaline rocks with or without ultrabasic rocks, often with alkaline characters.

Excellent compilation of major alkaline rock provinces of the world including India have been published in two edited volumes which provide a comprehensive data base and reference-listings base that enable a better understanding of their evolution and genesis (Fitton and Upton, 1987; Leelanandham, 1989). At least six groups have been recognised (with petrological features that are inherited from mantle depths). These include the following suites. Some Indian examples are also indicated (c.f. Krishnamurthy, 2019, Table 1 and references therein).

1. Carbonatite and kimberlite as partial melts from a metasomatised mantle (diamond stability field, i.e. > 150 km depth). The carbonatites acquires a separate entity at shallower levels, possibly through liquid-immiscibility (e.g. Khaderpet pipe, Anumpalle cluster of the Wajrakarur kimberlite field, Cuddapah Dt., Andhra Pradesh, which host some micro-diamonds).
2. Carbonatite-nephelinite-phonolite derived from metasomatised upper mantle in which the carbonatite may be a differentiate, possibly through liquid-immiscibility (e.g. Amba Dongar, Gujarat).
3. Carbonatite -Melanephelinite-alkali pyroxenite-melteigite-ijolite-teschenite (e.g. Sarnu-Dandali-Kamthai, Rajasthan).
4. Carbonatite - melilitolite with ultramafic-mafic suite (dunite, pyroxenite), the latter possibly cumulates and the carbonatite may be a differentiate through liquid immiscibility (e.g. Sung Valley, Meghalaya).
5. Carbonatite - Syenite ± dunite, pyroxenite with predominant syenite plutons (e.g. Sevathur, Samalpatti, Elagiri, Pakkanadu).
6. Carbonatite alone lacking associated alkaline rocks (e.g. Newania).

Carbonatite complexes invariably have a Na- or K- metasomatised 'fenite envelope' that can be extensive, often a few kilometres around the complex, unlike other igneous rocks, depending upon the size of the carbonatite bodies and their depth of emplacement within a given complex.

The petrological evolution of these complexes have a spatial relations to the Wilson cycle, often related to mid-continental rifts, initiated by mantle metasomatism and domal upwarps that may later develop into collision zones, accreting such diverse materials on to the continental nuclei of the cratons.

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