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PETROLOGICAL STUDIES OF ASSOCIATION OF PYROXENITES-CARBONATITES FROM GARIGEPALLY AREA KRISHNAGIRI DISTRICT, TAMIL NADU, INDIA

B. Naveen[1]*, K. Sreenu[2], V. Lingaswamy[3], Bhagathlal Gatla[4], and Mahender Bogi[5]

[1,2,3,4&5] **Department of Geology, Osmania University, Hyderabad-500007, India**

ABSTRACT

This paper relates the petrological studies of pyroxenites-carbonatites from Samalpatti Complex Southern Granulite Terrane (SGT) of peninsular India. The Samalpatti complex (SC) is one of the complexes in Tamil Nadu consisting mostly associated with alkaline rocks of Carbonatites, Pyroxenites, Peridotite and Syenites. In the research area Gerigepally Pyroxenites-Carbonatites are occur as outcrops, thin lensiod bodies and bands. The study area comes under the Samalpatti Complex and situated under Southern Granulite Terrain (SGT). From the field of study area samples were collected along the fresh outcrops and well cuttings. Megascopy of the samples shows dark coloured, fine to coarse grained and massive form of pyroxenites. Pyroxene is the essential mineral, biotite and hornblende are accessory minerals and showing coarse grained poikilitic texture. Whereas carbonatites are calcite rich coarse grained rocks. In the laboratory prepared thin sections most of the Pyroxenites observed that more ultramafic minerals like augite, diopside, biotite, enstite.

Key words: Pyroxenite-Carbonatite, Garigepally, Samalpatti Complex, SGT, Tamil Nadu.

INTRODUCTION:

Pyroxenite is an ultramafic, plutonic igneous rock consisting the predominantly of pyroxene group minerals such as augite, diopside, hypersthene, bronzite or enstatite. Pyroxenites are categorized into clinopyroxenites, orthopyroxenites, and the websterites which contain both types of pyroxenes. Pyroxenite is also an ultrabasic rock that consists of Pyroxenes i.e., mostly ferromagnesian minerals. The southern Indian granulite terrain is a combination of crustal blocks exposing mid and lower levels of the continental crust, and dissected by large, intra-continental Proterozoic shear zones and lineaments, namely, the Moyar-Bavani Shear Zone, Palghat-Cauvery Shear Zone and the Achankovil Lineament (Anbarasu.K et al., 2011). Carbonatite, an igneous rock containing >50% of calcite-rich minerals according to the IUGS classification, is primarily composed of carbonate minerals. These enigmatic igneous rocks have been emplaced into Earth's crust or erupted onto its surface across various tectonic settings since the Archean (Humphreys-Williams & Zahirovic, 2021). Despite longstanding academic and economic interest, many aspects of their origins and evolution remain obscure. Nevertheless, they are currently receiving enhanced attention among researchers due to their significant role in the deep-time and deep Earth carbon cycle, as well as their association with resources of niobium (Nb), rare

earth elements (REE), and other important commodities such as iron (Fe), copper (Cu), phosphorus (P), fluorine (F), tantalum (Ta), and uranium (U) (Fortier et al., 2019; Løvik et al.).

LOCATION AND ACCESSIBILITY OF THE AREA:

The research area, Gerigepally, is strategically positioned along the Kallavi-Thirupattur highway, conveniently accessible between the towns of Krishnagiri and Dharmapuri districts. Located approximately 50 kilometers north of Krishnagiri and 54 kilometers southeast of Dharmapuri, Gerigepally enjoys a central location within this region. Furthermore, its connectivity is augmented by its proximity to the southern railway mainline, linking it to both the northern region of Jolarpettai and the southern city of Salem. Situated within the Southern Granulite Terrain (SGT), Gerigepally presents an intriguing landscape for geological investigation. The primary objective of research in this area is to conduct a comprehensive analysis of the petrological characteristics, focusing on the intriguing association of pyroxenite-carbonatite rocks within the Samalpatti complex. This complex is located in the Krishnagiri district of Tamil Nadu.

CLIMATE AND VEGETATION:

The study area Gerigepally experiences a borderline hot semi-arid climate, tropical savanna climate. The temperature here averages 26.5 °C or 79.7 °F, and annual rainfall averages 794 millimetres or 31.3 inches. There are three distinct seasons observed in study area. During the monsoon season, the region receives a substantial amount of rainfall in short intervals, although the monsoon is long but not intense. Winters are generally very warm but dry, with morning temperatures possibly falling to 13 °C or 55.4 °F, making it the best time to visit. Summer, from March to June, brings hot to sweltering temperatures, with mercury rising to around 38 °C or 100.4 °F and dipping to a minimum of 32 °C or 89.6 °F. April and May are typically the hottest months of the year, and the heat during this time can be uncomfortable. The investigated research area consists of a pediplain, small mounds, and valley fill formations extending from the south to the east direction.

GEOLOGICAL SETTING:

The Southern Granulitic Terrain is indeed closely associated with Tamil Nadu, a state located in the southern part of India. Tamil Nadu encompasses a significant portion of this geological region, particularly in its southern and western parts. In Tamil Nadu, the Southern Granulitic Terrain consists of ancient granulite facies metamorphic rocks that have been subjected to high-grade metamorphism during the Archean and Proterozoic eons. These rocks are prominently found in regions such as Salem, Dharmapuri, Krishnagiri, and parts of Coimbatore and Madurai districts. The northern part of the Southern Granulitic Terrain (SGT) is in contact with the Dharwar Craton, which comprises granites and greenstone terrains. This terrain has been divided into several distinct crustal blocks based on their structural and isotopic evolution from north to south: the Northern Block, the Nilgiri Block, the Salem–Madras Block, the Cauvery Suture Zone (CSZ), the Madurai Block, and the Trivandrum Block (Naqvi and Rogers 1987; Santosh 1996; Bartlett et al. 1998; Chetty and Bhaskar Rao 2006; Ramakrishnan and Vaidyanathan 2008; Clark et al. 2009; Santosh et al. 2009; Plavsa et al. 2012; Collins et al. 2014). The study area is within the Dharmapuri Suture Rift Zone, which is situated within the Precambrian granulite terrains (Southern Ghats Terrain, SGT) along NE–SW trending fault systems (Grady, J.C., 1971; Randive, K et al., 2020; Viladkar, S.G et al., 1995). The Samalpatti igneous complex consists of various rock types including carbonatite, syenite, pyroxenite, and dunite. These intrusive rocks penetrate the hornblende-epidote-bearing basement gneisses (Subramanian et al., 1978; Srivastava, 1998). Among these intrusive rocks, syenites and pyroxenites are the predominant lithologies within the complex. Pyroxenites forming a near circular structure around the syenite body. Dunite exposures are seen at several places in the pyroxenite body.

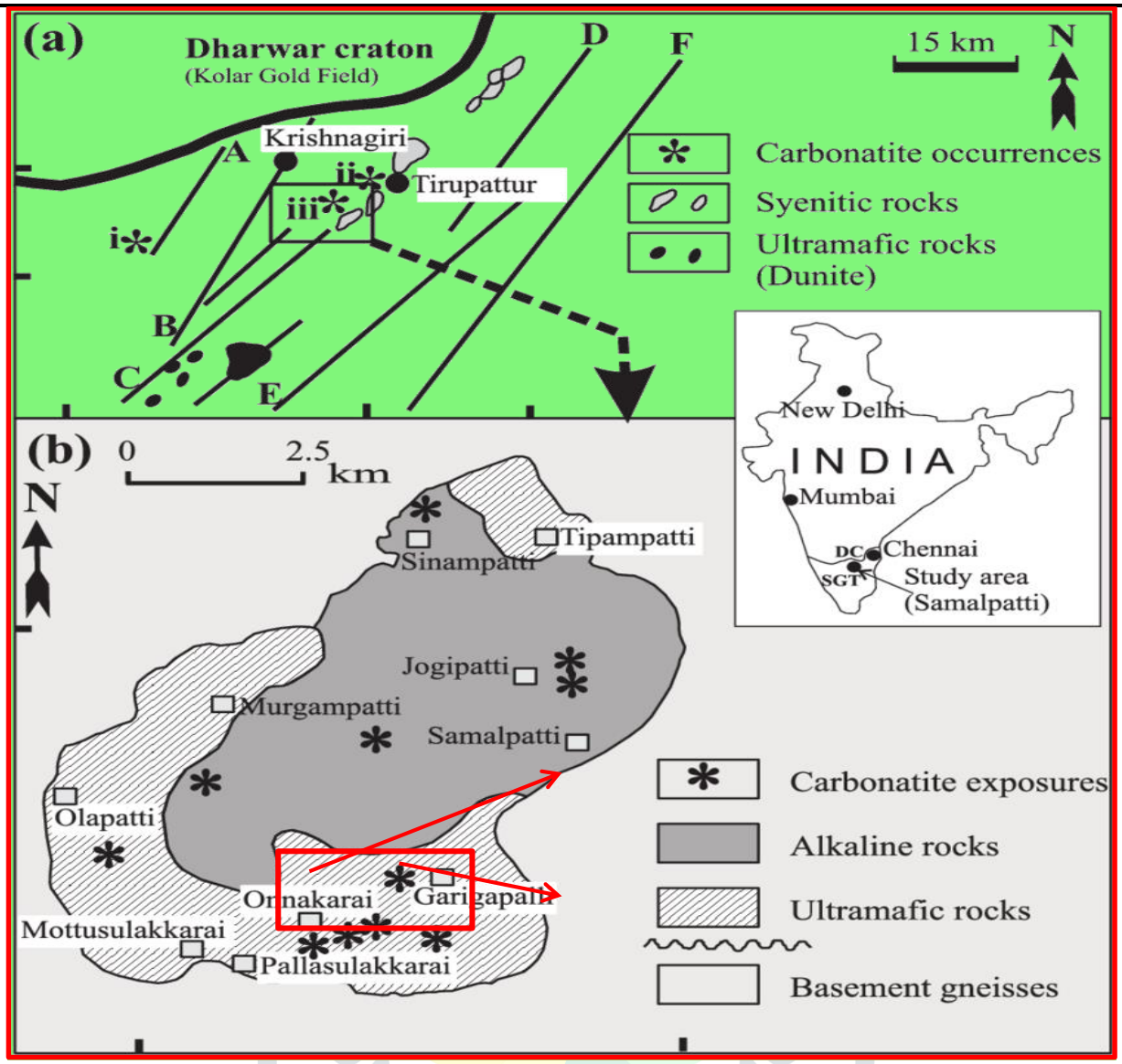

Figure 1: Geological Map of the study area (a) Koratti fault system and carbonatite occurrences (after Grady, 1971). A and B– Mettur faults, C–Koratti fault, D–Amiridi fault, E–Kottapatti fault, and F–Attur fault. i–Hogenakal, ii–Sevathur-Koratti, and iii– Samalpatti. The thick line separates the Dharwar Craton from the charnockite mobile belt. (b) Geological map of the Samalpatti igneous complex (after Subramanian et al., 1978; Srivastava, 1998).

PETROGRAPHY:

The pyroxenites of Gerigepally exhibit colours ranging from dark greyish to light green and have a coarse- to medium-grained texture. Microscopically, the grains display primary magmatic cumulus textures with the following mineral composition: clinopyroxene (augite: 55–75%), amphiboles (10–18%), biotite (4–8%), K-feldspar (2–5%), and magnetite (2%). Additionally, accessory minerals such as sphene, zircon, and apatite occur in the rocks, typically constituting up to 1% of the rock composition.

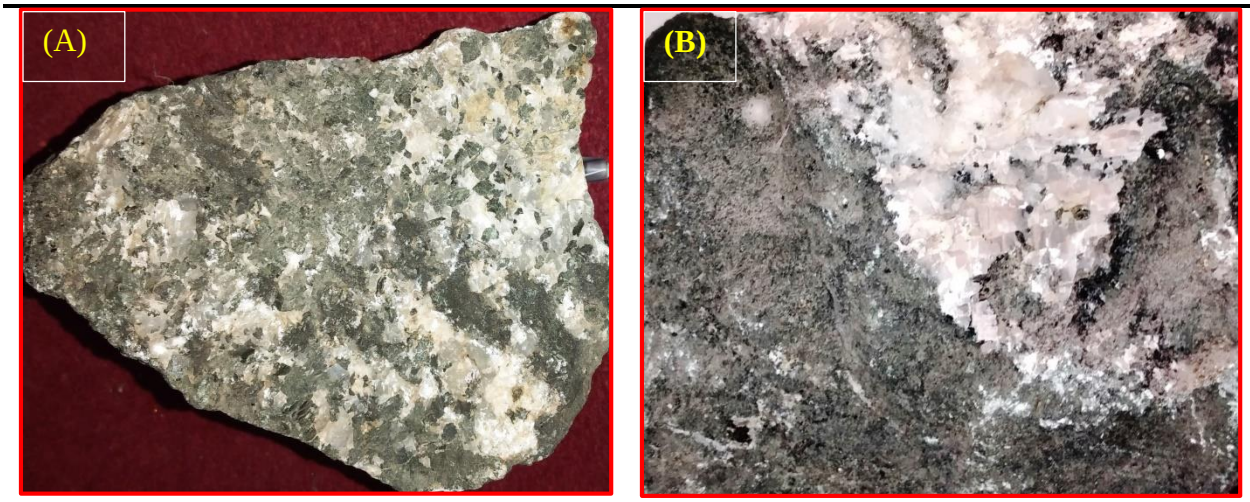

Figure: 1. Megascopic samples of carbonatite rocks are associated with pyroxenite rocks as formed by the liquid immiscibility process in the Garigepally area.

The pyroxenite samples from Gerigepally appear pale green to dark in colour, possess high specific gravity, and display a white streak. They typically exhibit a massive form, indicating a homogeneous and solid appearance at the megascopic scale. Previous studies, including those by Subramanian et al. (1978), Viladkar and Subramanian (1995), and Srivastava (1998), have extensively described the petrography of carbonatites and associated rocks within the Samalpatti igneous complex. These studies have focused on igneous textures and minerals present in the Samalpatti carbonatites. Srivastava (1998) provided a preliminary report on some of the metamorphic minerals and pyroxene-hornfelsic textures found within the Samalpatti complex. In this study, the authors selected typical metamorphosed carbonatite samples for detailed petrographic examination and petrologic investigation. As such, the focus was on identifying and characterizing the metamorphic minerals and textures present in the carbonatite samples rather than reiterating the descriptions of igneous features already documented in previous studies. Carbonatite rocks are indeed often associated with pyroxenite rocks, and the liquid immiscibility process can play a significant role in their formation. In the Garigepally area, this geological phenomenon might be particularly evident. Liquid immiscibility (Fig. 1) occurs when magma separates into two distinct liquid phases with different compositions. In the case of carbonatite and pyroxenite association, the magma initially contains components that can form both types of rocks. As the magma cools, it undergoes differentiation, a process where different minerals crystallize at different temperatures. Carbonatite rocks, which are primarily composed of carbonate minerals such as calcite and dolomite, form from the carbonate-rich portion of the magma. Pyroxenite rocks, on the other hand, are composed mainly of pyroxene minerals like augite and enstatite, and form from the pyroxene-rich portion of the magma. The association between carbonatite and pyroxenite can provide valuable insights into the geological history and processes that occurred in the Garigepally area.

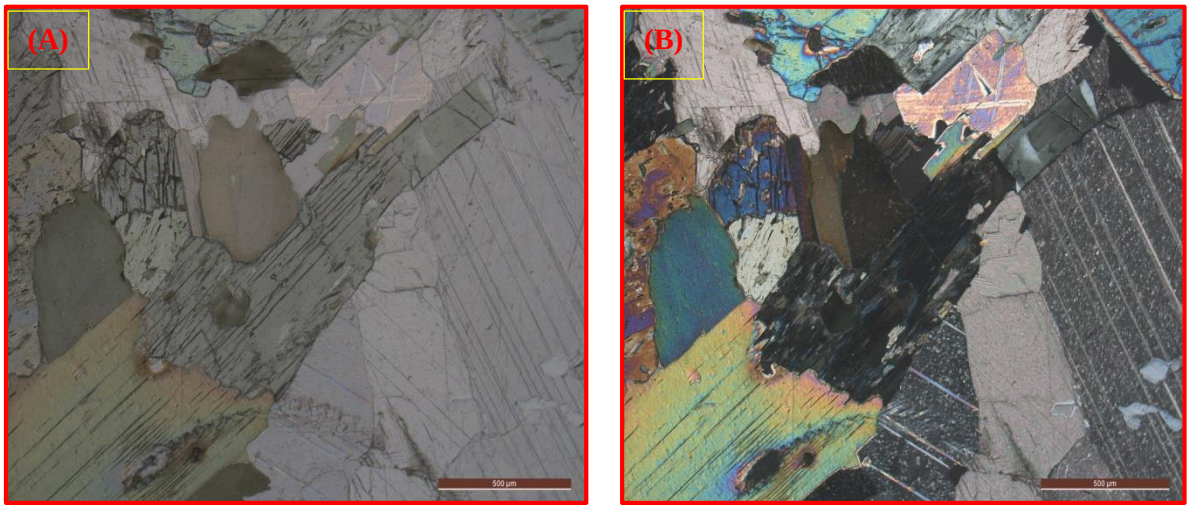

Figure. 2: Microscopic sections of Pyroxenites from Gerigepally area of Samalpatti complex.

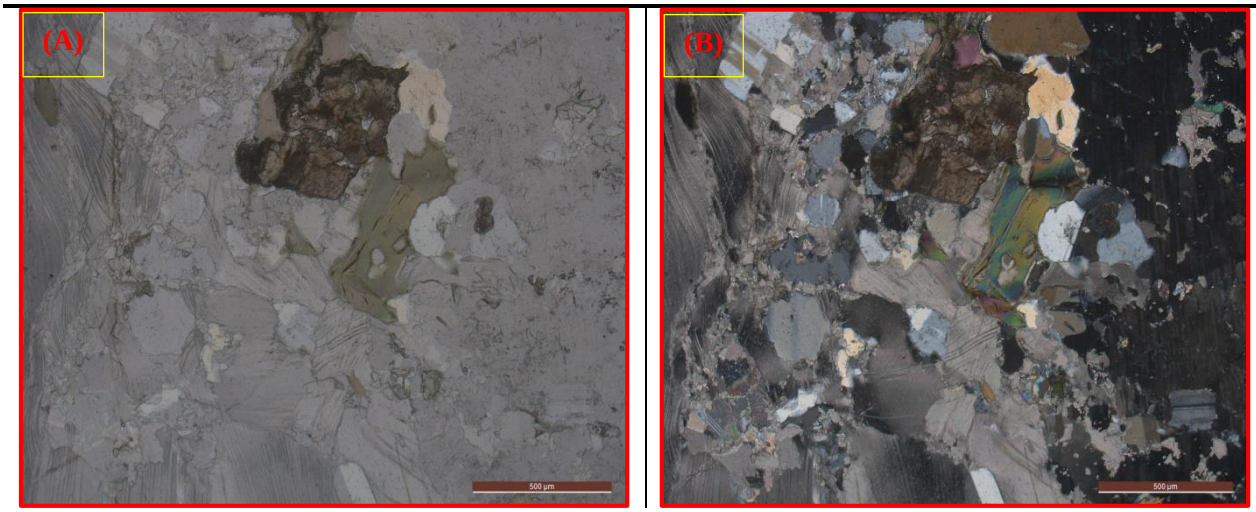

Figure. 3: Microscopic sections of carbonatites having deformed calcite mineral from Gerigepally area of Samalpatti complex.

Microscopic examination of pyroxenite rocks reveals a variety of minerals and textures that provide insights into their formation and geological history. Pyroxenite rocks are primarily composed of pyroxene minerals, such as augite, enstatite, and diopside (Fig.2). Under a microscope, these minerals appear as elongated crystals with distinct cleavage planes. The color and composition of the pyroxene crystals can vary, providing clues about the conditions under which the rock formed. In addition to pyroxene, pyroxenite may contain accessory minerals such as olivine, plagioclase feldspar, magnetite, and chromite. These minerals can appear as smaller crystals or as inclusions within the pyroxene matrix. Carbonatites are fascinating igneous rocks primarily composed of carbonate minerals such as calcite, dolomite, and siderite, with minor amounts of other minerals. When studying carbonatite thin sections under a microscope (Fig. 3) Identified the various carbonate minerals present in the thin section. Carbonatites typically contain abundant calcite, but may also have dolomite, siderite, ankerite, or others. Additionally, look for accessory minerals such as apatite, magnetite, pyrochlore, and rare earth element minerals. Coarse grained calcite is deformed in the section and pyroxene minerals are present in considerable amounts.

ANALYTICAL METHOD:

The Garigepally pyroxenite-carbonatites were prepared as thin sections with a thickness of up to 0.03 mm to facilitate microscopic examination of their petrographic features. These thin sections were analysed using a **LEICA DM750P** model petrological microscope in the microscope lab at the Department of Geology, Osmania University, Hyderabad, Telangana, India. This analytical approach allowed for detailed investigation and characterization of the mineralogical and textural properties of the pyroxenite-carbonatite samples.

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CONCLUSIONS:

Petrological studies on the Garigepally pyroxenites-carbonatites of Samalpatti Complex are suggested the following conclusive remarks. The pyroxenite samples from Garigepally are mainly composed with clinopyroxene minerals as essential and accessory minerals like olivine, plagioclase feldspar, and magnetite. The carbonatite is made of medium to coarse grained, euhedral to sub-euhedral grains of calcite deformed grains. A calcite grain shows clearly cleavage. Carbonatites are rich in calcite and accessory minerals Cpx,

biotite, apatite, and pyrochlore. Based on the petrological characteristic features of Garigepally carbonatites are calcio-rich carbonatites. The pyroxenite-carbonatite association in the Garigepally was formed by the liquid immiscibility process by the mantle source magma.

REFERENCES:

Anbarasu, K., et al. "Field characteristics and geochemistry of pyroxenite and gabbro from Odhimalai and Thenkalmalai hillocks of Bhavani ultramafic complex-South India." *International Multidisciplinary Research Journal* 1.2 (2011).

Anbarasu.K, Ali Mohammed Dar, A. Karthikeyan(2011); Geochemistry and Petrography of Pyroxenites from Mettupalaiyam Ultramafic Complex,Tamil Nadu, Recent Research in Science and Technology ISSN: 2076-5061, 3(4): 66-70

Chetty, T. R. K., and YJ Bhaskar Rao. "The Cauvery shear zone, Southern Granulite Terrain, India: a crustal-scale flower structure." *Gondwana Research* 10.1-2 (2006): 77-85.

Humphreys-Williams, Emma R., and Sabin Zahirovic. "Carbonatites and global tectonics." *Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology* 17.5 (2021): 339-344.

Indian Minerals Yearbook 2013 (Part- III : Mineral Reviews) 52nd Edition Dunite & Pyroxenite Government Of India Ministry Of Mines Indian Bureau Of Mines

Le Bas, M. J., K. V. Subbarao, and J. N. Walsh. "Metacarbonatite or marble?—the case of the carbonate, pyroxenite, calcite–apatite rock complex at Borra, Eastern Ghats, India." Journal of Asian Earth Sciences 20.2 (2002): 127-140.

M.J. Le Bas, K.V. Subbarao, J.N. Walsh (2002); Metacarbonatite or marble? — the case of the carbonate, pyroxenite, calcite–apatite rock complex at Borra, Eastern Ghats, India, Journal of Asian Earth Sciences: Vol 20, Issue 2, January 2002, Pages 127-140

Miller, J. S., Santosh, M., Pressley, R. A., Clements, A. S., & Rogers, J. J. (1996). A Pan-African thermal event in southern India. *Journal of Southeast Asian Earth Sciences*, *14*(3-4), 127-136.

Naqvi, S. Mahmood, and John James William Rogers. "Precambrian geology of India." *(No Title)* (1987).

Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press. Streckeisen, A. (1976). To each plutonic rock its proper name. Earth-science reviews, 12(1), 1-33.

Pyroxenite dykes with petrological and geochemical affinities to the Alaskan-type ultramafics at the northwestern margin of the Cuddapah basin, Dharwar craton, southern India: Tectonomagmatic implications

Ramakrishnan, M. "Vaidyanathan 2008 Geology of India; Vol. 1." *Geol. Soc. India, Bangalore*.

Recent Research in Science and Technology 2011, 3(4): 66-70 ISSN: 2076-5061 www.recent-science.com Geology Geochemistry And Petrography Of Pyroxenites From Mettupalaiyam Ultramafic Complex,Tamil Nadu

Rohit Kumar Giri, Praveer Pankaj, Dinesh Pandit, Samarendra Sahoo, Ramananda Chakrabarti and N V Chalapathi Rao (May 2019); Pyroxenite dykes with petrological and geochemical affinities to the Alaskan-type ultramafics at the northwestern margin of the Cuddapah basin, Dharwar craton, southern India: Tectonomagmatic implications, J.Earth syst.sci.(2019) 128:114

Srivastava, Rajesh K. "Petrology of the Proterozoic alkaline carbonatite complex of Samalpatti, district Dharmapuri, Tamil Nadu." *Geological Society of India* 51.2 (1998): 233-244.

Srivastava, Rajesh K. "Petrology, geochemistry and genesis of rift-related carbonatites of Ambadungar, India." Mineralogy and Petrology 61.1-4 (1997): 47.

Srivastava, Rajesh K., and Anup K. Sinha. "Early Cretaceous Sung Valley ultramafic-alkaline-carbonatite complex, Shillong Plateau, Northeastern India: petrological and genetic significance." *Mineralogy and Petrology* 80 (2004): 241-263.

Viladkar, S. G. "The carbonatites of Amba Dongar, Gujarat, India." Bull. Geol. Soc. Finland 53.1 (1981): 17-28.