CHAPTER: 1
INTRODUCTION

1.1 GENETIC TYPES OF TALC/STEATITE DEPOSITS & THEIR DISTRIBUTION.

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Steatite (or soapstone) is a compact, often impure variety of talc (3 MgO.4SiO2.3H2O). It is gray to green, has a soapy feel, and resists acids, heat and chemicals. It is extensively used for decorative work, fashioning images and occasionally as building stones. When strongly heated, it breaks into clinoenstatite and free silica, which are relatively hard and infusible and were used by the Indus valley civilization craftsmen for engraving mythological scenes and animals. For centuries, soapstone has been quarried and used throughout the world and it was traditionally used in colonial New England for fireplace, hearths, sinks, countertops, and wood stove. In addition to traditional uses, it is currently used for its unparalleled heat retention characteristics for cookware, cook tops, oven floors, masonry heaters and fireplace liners. On heating from burning wood, pellets or coal, steatite slowly radiates the heat evenly for hours, even after the fire is extinguished. It is also an excellent alternative natural stone in place of granite or marble and is used in the manufacture of electronic insulators.
Commercial talc falls into four categories:

- **Steatite**: Compact, massive and fine grained that can be sawed, drilled or machined to required shapes. Usually it is heat-treated to convert the talc to clinoenstatite which is used as insulation.

- **Soft platy talc**: An alteration product of dolomite with chlorite as a common accessory. This is the most important type of talc and is used in wide variety of ceramic, paper, roofing and plastic products.

- **Tremolite talc**: Massive or laminated rock with varying percentages of tremolite, anthophyllite, calcite and dolomite. It is characterized by a high CaO content, and is often in demand for products that require a greater cohesive strength.

- **Mixed talc**: Any of the above types, which is not characterized as one of the above. Used for applications, which are less selective in terms of oxide mineral content.

Most commercial talc products are a blend of two or more types specifically designed to meet varied specifications of the industry. For example, the ceramic industry prefers hard, massive, white talc while the paint and plastics industries prefer soft, foliated talc.

1.1 GENETIC TYPES OF TALC/STEATITE DEPOSITS & THEIR DISTRIBUTION

Talc/Steatite deposits differ according to the parent rock from which they are derived as follows:-

1. **Magnesium carbonate derivative ore bodies**: This type results from the transformation of carbonates (dolomite and magnesite) in the presence of silica. Deposits of this variety represent about 60% of world production
and provide some of the whitest and purest talc ores. The Yellowstone (Montana, USA) and Respina (North-West Spain) talc deposits are good examples.

2. Serpentinite derivative ore bodies: - About 20% of world’s production comes from the transformation of serpentinite. This type of deposit is distributed along ultramafic belts of the world, amongst which are the deposits in Vermont USA, Quebec and Ontario in Canada, and Finland.

3. Siliceous or silico-aluminous rock derivatives: - In this type, talc results from the transformation of siliceous rocks such as quartzite. If the parent rock has a silico-aluminous composition like pelitic schist or gneiss, chlorite forms in addition to talc. This type of deposit can be found in association with the magnesium-carbonate as is the case of Trimouns in the French Pyrenees and constitutes about 10% of world production.

4. Magnesium sedimentary deposits: - This type is generally found in association with impurities such as quartz, mica, clay, organic materials and iron hydroxides. No deposits belonging to this category are currently being mined.

The four types of deposits outlined above yield a wide variety of ores that differ considerably in their mineralogical composition, color (measured in terms of whiteness or brightness) and crystalline structure (compact or platy). These parameters govern the specific nature of each commercial talc/steatite deposits as well as their industrial application.
Fig. 1.1 Genetic types of Talc deposits of the world. USGS (2001)
The world distribution of the above genetic types of Talc/steatite deposits is given in Fig. 1.1.

Steatite and talc in India occur in the states of Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh (Fig. 1.2). The best deposits in terms of quality and reserves are confined to Peninsular India, of which Rajasthan account for nearly 97% of the total known reserves of India and present a wide and interesting spectrum of association with various types of rocks belonging to different age groups. The associated rock types and the important occurrences of steatite/talc deposits of India are as follows.

In Rajasthan, steatite deposits are generally associated with Aravalli quartzites, Alwar quarzites, impure calcareous rocks, Railo dolomites and altered ultrabasic intrusives. Steatite deposits of Rajasthan are known to occur in the districts of Ajmer, Alwar, Banswara, Bharatpur, Bhilwara, Chittorgarh, Dungarpur, Jaipur, Jhunjhunu, Pali, Sirohi, Sawai Madhopur, Tonk and Udaipur. Economically important deposits are confined to Bhilwara, Dungarpur, Jaipur and Udaipur districts. The Degota jaharna and Ghevaria deposits associated with Raialo dolomites in the districts of Jaipur and Bhilwara, respectively, are the two largest deposits in the country. In the southern parts of peninsular India, talc schists occur extensively amongst the crystalline rocks of Archean and Dharwars and are essentially derived from the alteration of basic and ultrabasic rocks.
In the Maharashtra state, talc-schists occur as lenses or lenticular bands interbanded with hornblende-mica schists, amphibolites and altered mafic-ultramafic rocks in the Ratnagiri district (Godke 1971).

In the Jabalpur district of Madhya Pradesh state, compact, foliated masses of steatite occur as irregular, lenticular pockets and veins in magnesium-rich marble (Chibber, 1953; Venkatesh, 1951).

In Bihar and Jharkhand states, talc schists associated with chromites and hosted in ultramafic-mafic rocks occur in Hazaribagh and Singhbhum districts, respectively (Thiagarajan, 1958).

In Uttar Pradesh state, deposits of massive soapstones occur in association with dolomites in Almora and Chamoli districts.

In Orissa state, soapstone deposits are found in the districts of Cuttack, Koraput, Mayurbhanj and Sundargarh, and hosted in ultramafic-mafic hosted.

In the state of Jammu & Kashmir, talc occurs in limestone in the Udhampur district.

In the state of Tamilnadu, steatite deposits associated with ultramafic-mafic rocks are reported from the districts of Salem, Coimbatore and Tiruchirapalli districts.

Steatite and talc deposits in the form of planks and raft-like bodies hosted in the Precambrian migmatites of Kerala state, which are genetically ascribed to alteration of ultramafic bodies by Vidyadharan (1984).
Fig. 1.2 Distribution of Steatite / Talc deposits of India.

1. Rajasthan
2. Andhra Pradesh
3. Madhya Pradesh
4. Bihar
5. Maharashtra
6. Uttar Pradesh
7. Karnataka
8. Orissa
9. Gujarat
10. Goa
11. West Bengal
12. Jammu Kashmir
13. Himachal Pradesh
14. Tamil Nadu
15. Kerala
In Karnataka state, steatite deposits of economic importance are reported from the districts of Hassan, Tumkur and Mysore districts, all of which are hosted in the ultramafic-mafic rocks. The deposits of Hassan district being the subject of the present work has been discussed in detail elsewhere.

1.2 AIM & SCOPE OF THE PRESENT INVESTIGATION

Steatite/talc with wide diversified applications and varied compositions is one of the most important industrial minerals. Each deposit being unique, needs to be characterized in terms of its genesis and more so in respect of ultramafic-derived talc/steatite deposits which although minor account for the best in terms of quality and application. Earlier workers have not investigated the genesis of steatite deposit in the ultramafic-mafic rocks in the present study area, although steatites from this area have been employed in various applications for many years now.

In the present work, geological features, petrographic and mineralogical aspects of the steatites and the associated rocks have been characterized to decipher its genesis. Geochemical investigations have been carried out to investigate the major and trace element behaviour during the mineralization process and to constrain the physico-chemical parameters related to steatite mineralization. Fluid inclusion studies and isotope analysis of carbonate minerals co-existing with steatite has been carried out in order to decipher the nature of fluids responsible for steatite mineralization. The results of the present investigation has an important bearing on the other spatially and temporally associated, ultramafic-mafic hosted mineralization in the area.
1.3 METHODOLOGY OF INVESTIGATION

The results of investigation have been presented in the following chapters.

Chapter 1 deals with introduction to steatite and talc deposits describing its application in various fields, its world distribution and distribution in India. Aim & scope of the present investigation is also given in this chapter.

Chapter 2 on Geology of Karnataka describes the lithology, structure, metamorphism, and evolution of the terrain. The salient features of the western and eastern blocks of the Karnataka craton have been discussed.

Geology of study area steatite mineralization in Chapter 3 discusses the status of Bageshapura area with respect to geology of the Karnataka craton. The lithological divisions of the rock formations in the area and the geological aspects of the rock types in the Bageshapura and Kalyadi area are dealt with. Geological aspects of steatite mineralization in the Bageshapura area is also included.

Chapter 4 on Petrographic and mineralogical features of the various rock types associated with steatite mineralization in the area is given. Petrography of the talcified rock types, X-ray mineralogy and I.R. studies of the talcified rock types is discussed.

Geochemistry of the steatites and associated rocks forms part of Chapter 5. In this chapter, the behaviour of elements during the formation
of steatite is discussed based on whole-rock elemental analysis of host rocks, talcified rocks and steatites. Results of microprobe analysis data of the talcified samples is used to explain the behaviour of elements during the transformation of the primary minerals to talc/steatite.

In the Genesis of steatite mineralization of Chapter 6, genesis of steatite mineralization based on the above stated field and laboratory investigations is interpreted. The nature and source of mineralizing fluids is discussed using results of fluid inclusion studies and stable isotope investigations. The evolution of the terrain vis-à-vis steatite mineralization and its implications on the genesis of other spatially and temporally associated mineral deposits is discussed.

Chapter 7 recapitulates the salient conclusions of each chapter.