

# Mapping of Gem Mineral Deposits Using GIS Technique in Salem District, Tamil Nadu, South India

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**Abstract:** Southern Indian states are endowed with rich gem mineral wealth. High potential region for the occurrence of gem deposits appear to be the Precambrian region in the Eastern Ghats. Gemstones which are of mineral origin are found largely in metamorphic terrain. Salem district which is primarily enclosed by high grade metamorphic rocks is the study area. This study addresses field investigation and the potential capabilities of Geographical Information System (GIS) to point out the potential zones of gem deposit.

**Keywords:** Gemstone, Field investigation, Geographical Information System (GIS).

## 1. Introduction

Salem district is also called the singhbhum of South India and it is known to be the geological paradise of the state. The natural gemstone is a mineral, stone or organic matter that can be cut and polished. These gem varieties can be categorised as precious, semi-precious and rare varieties. Larger percentage of high grade metamorphic type is attributed to many of the gem deposits (Dissanayake and Rupasinghe, 1995). Salem district is surrounded by high grade of metamorphic rock and it has a higher density of gem deposits compared to its landmass and only a very small area is still mined. The gemstones found in this area are associated with pegmatites, carbonatites, syenites, pyroxenite and related alkaline rocks. Further, gem potential maps or compressive database have not been prepared in the Salem district with proper scientific background. Anbazhagan and Nair (2004) have used the geographical information system (GIS) to represent and understand the spatial data. GIS can help in many aspects of the mineral exploration activities: such as data collection, management, analysis, and reporting. Field geologists can now capture field data electronically, using global positioning system (GPS) receivers. All of these data sets can be integrated, manipulated, and analyzed using GIS. Thus this research focuses on mapping of potential zones of gem mineral deposits using GIS technique in Salem district.

## 2. Study Area

The Salem district forms part of varshanad upland consisting of a number of isolated hills which are parts of eastern ghats. Shevaroys, kalrayan, kollimalai and pachamalai are the important hills in the district. There are also a number of isolated hillocks like kanjamalai, godumalai, nagaramalai, suriyamalai and alavoyamalai. The highest peak in the district is solarikaradu in shevaroys hills with an elevation of 1640 meters above mean sea level (msl). The low lying plains in between the hills are having a general elevation of 119 to 300 m above msl with low lying plains in the southern side of the district. The district can be grouped into various

geomorphic units namely, structural hills, residual hills, rocky pediments, buried pediment and valley fills. The structural hills in the districts are dominant in the northern and eastern side while the residual hills are noticed in south western sides. The granitic intrusive generally from the residual hills while quartzite's, magnetite quartzite's, gneisses and charnockite constitute the structural hills. The rocky pediments are common in the intermontane areas and buried pediments and valley fills are limited to low lying areas in the thirumanimuthar river course. The study area located between 11°15'N to 12°00'N latitude and 78°00'E to 78°45'E longitude is shown in figure: 1.

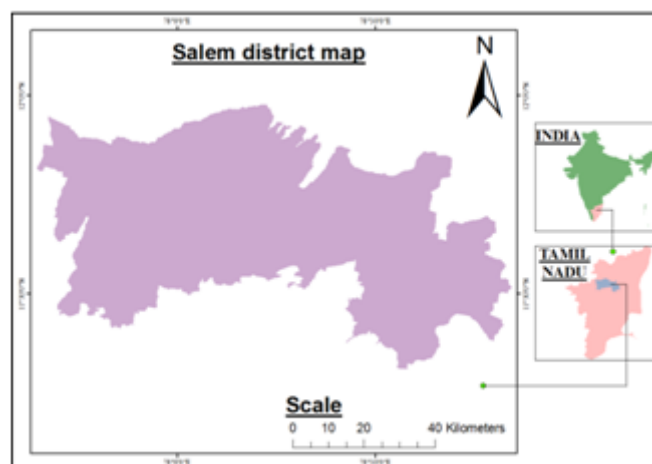


Figure 1: Study area location map.

## 3. Geological Setup of Salem district

The Salem district is mainly underlain by crystalline metamorphic rocks is shown in the figure: 2. The geological formations of the study area can be grouped into four units namely.

- a) The older granulite group found in most part of the study area.
- b) The meta sediments showing repeated deformation and mineralization covering isolated structures in the central part

- c) The younger granite intrusive in the west and east west of the study area.  
d) The ultramafic and basic intrusive.

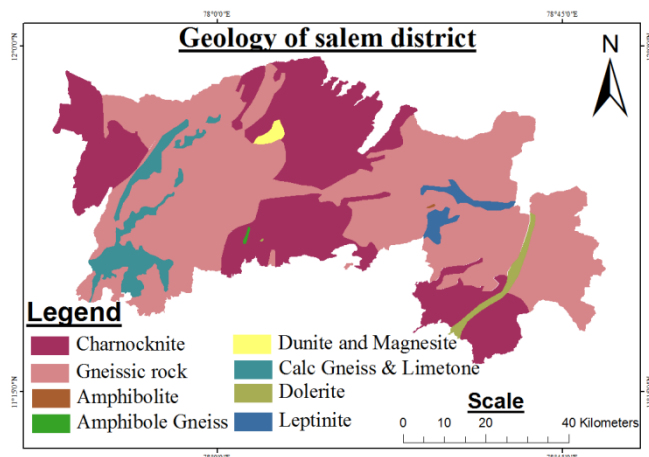


Figure 2: Geology map of the study area

## 4. Methodology

The Methodology mainly comprises of literature survey, field investigations and GIS analysis. Field investigations have been carried out based on available geological maps and topographic maps, satellite image and land-use maps of the area. During the field survey, primary data on gem mining activities were collected through direct interviews of local villagers, gem mining people, and government officials. Further, primary gem deposit occurrences were plotted through field surveys. All of these field, topographical, geomorphological, geological, mineralogical, and remote sensing data were analysed. Finally, these data were integrated using GIS to obtain the gem potential map of the area.

## 5. Results and Discussion

According to detailed field survey and secondary data analysis, the result shows only three locations having high potential zone for gem stone deposits as shown in figure: 3. The locations are.

### 5.1 Pakkanadu Alkaline Ultramafic Complex

The Pakkanadu-Mulakkadu alkaline ultramafic complex is an alkaline complex with ultramafic rock types. This complex is lineated south east of mettur reservoir and about 5 Km west of jalakandapuram town. The complex is elongated in the NE – SW direction with a maximum width 7 ½ km along EW and 22km along NE – SW. The complex is composed of proterozoic rocks which have been emplaced into archean host rock. The dominated rock of the complex in terms of area is syenite followed by dunite, pyroxenite and carbonatites. Related rock types include cataclastic fields-pathic, breccias and calcite mica fenite within the complex. Several zoned pegmatites occur around the syenite. The older enclosing rock is composed of migmatized amphibolites gneiss and granulites (Suryanarayana Rao *et al.* 1978). Two patches of pyroxenite outcrop occur within the complex. The larger outcrop occurs near pachaikadu village. The smaller outcrop occurs northwest of pakkanadu towards

the vedakallipallam temple near a small water tank at a stream section. Gemstone observed in Pakkanadu-Mulakkadu alkaline ultramafic complex are beryl, sphene, diopside, tourmaline, smoky quartz, epidote, white moonstone, hornblende, brown moonstone, serpentine and apatite clastics. Sphene and minor beryl occur in the allied rock associated with altered pyroxenite. Diopside and epidote are associated with altered pyroxenite and carbonatites-pyroxenite respectively.

### 5.2 Stanniferous granite from the Idappadi

Granites and pegmatite's abound in Idappadi area which is located towards the northern part of sankari-tiruchengodu structural dome. The Stanniferous - white pegmatite idappadi granite is best exposed on the left flank of sarabanga river located towards the south of kullampatti. The rock body runs as elongated body running in an E-W direction that is almost parallel to the granite – gneiss contact. The idappadi granite are emplaced within the tonalite- trondhjemite-granodiorite gneisses of bhavani gneissic complex and the associated of sathyamangalam supracrustal block possibly belonging to archaean age. This zones characterized by the presence of layered ultramafic sequence of sittampundi and mettupalayam complex. This area represents a zone of collision between the northern and southern tectonic blocks. The gemstones observed in these rocks are quartz crystal, beryl, diopside, smoky quartz, moonstone and rosy quartz.

### 5.2 Kanjamalai hill

Kanjamalai hill occurs as an isolated, ellipsoidal shaped, residual hill located 8 km SW of Salem town. This hillock is known for its banded iron formation along with outcrops of ultramafics. The hill has a canoe like shape with a maximum length 8 km along EW and maximum breadth of 4 km along NS. The banded iron formation and associated metamorphic are thus distinctly older than the dunite. Minor lineaments also occur within kanjamalai hill (Dubey and Karunakaran 1943), with a small scale shears and mylonitization along well developed fracture. Shear plane mineralization in the older metamorphic is unique in the development of inclusion rich garnet porphyroblasts, giving an external appearance of eclogitic rock. The gemstones such as garnet, magnetite crystals and opal are found in Kanjamalai area.

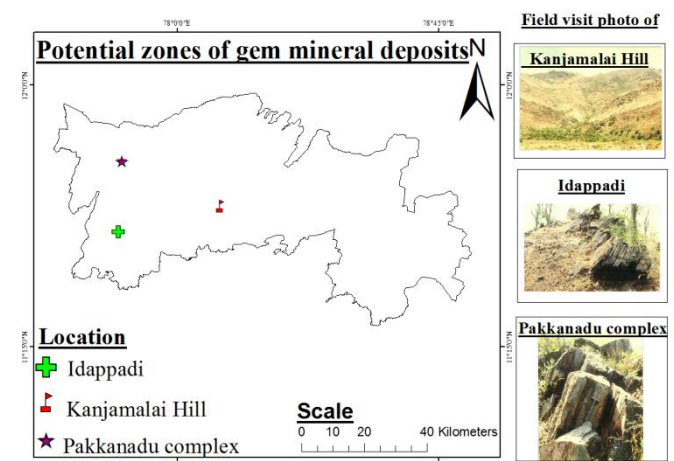


Figure 3: Potential zones map for gem mineral deposits

## 6. Conclusion

The origins of the gem minerals of this area are metamorphic rocks and it is in-situ (primary) deposit. According to the results of field investigation and secondary data, three locations are pointed out in GIS platform which are Pakkanadu complex, Idappadi and Kanjamalai hill area. The Pakkanadu complex which includes pegmatites and carbonatites are rich in gem stones like diopside, sphene, beryl, quartz and tourmaline. Idappadi is also known for their rich gemstone deposits in pegmatite vein and gemstones like diopside, trapezohedral quartz, pure quartz crystal which includes rose, smoky, pink quartz are transparent varieties which are of very good quality. At Kanjamalai hill area, only a small amount of gemstones like garnet, magnetite crystals and opal are reported along with pyroxenite, amphibolites intercalated with magnesite veins and banded iron ore formation. However, detailed geological investigation of the particular area should be carried out with the help of relevant government organizations like State Mines and Geology Department, as it can be developed into an important source of income for the government. The gem industry can be developed with the cooperation of women self-help groups and related cooperative sectors which can develop the area and can offer high employment potential for the local communities.

## References

- [1] C.B. Dissanayake and M.S. Rupasinghe (1995). Classification of gem deposits of Sri Lanka, *Journal of Geologie en Mijnbouw* Vol. 74, p. 79-88.
- [2] S. Anbazhagan and A.M. Nair (2004) Geographic information system and groundwater quality mapping in Panvel Basin, Maharashtra, India. *J Environ Geol* 45:pp 753– 761.
- [3] C. Suryanarayana Rao., G.R. Narayan Das., B. Krishnaiah Setty., and N.V.A. S. Perumal (1978). Radioactive carbonatites of Pakkanadu and Mulakkadu, Salem district, Tamil Nadu. *Jour. Geol. Soc. India*, 19, 55-63.
- [4] V.S. Dubey., and C. Karunakaran., (1943). The iron ore deposits of Kanjamalai hill Salem District, Madras. *Jour. Geol. Min. Met. Soc. Ind.* Vol. XV, pp. 320.