STRUCTURES CONTROLLED IRON-ORE DEPOSITS OF KANJAMALAI, SALEM, INDIA USING IRS-1C DATA

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ABSTRACT

A comparative study was carried out for the structural discrimination and lithological mapping using IRS-1C data and aerial photographs to describe iron ore deposits of Kanjamalai region Tamilnadu, India. Various structural features were identified viz. folds, joints, faults, lineaments and interpreted. It is observed that the deposits are controlled by doubly plunging syncline. The lineament study had brought out the joint and fracture patterns. The major rock types are magnetite quartzite, pyroxene granulite and gneisses. The field relationships among the formations indicate that the magnetite quartzite deposits are the oldest in the study area.

1 INTRODUCTION

The art of Remote sensing proves to be a boon in various scientific applications especially in the field of mineral exploration and resource mapping. It provides information in the form of imageries and aerial photographs which cover vast area of earth's surface. The revisit capabilities of the present day satellite mapping helps to understand more about the nature of mineral and ore deposits.

The directional data are an integral part of geologic information. The fold axes, joints, strike and other structural elements exhibit linear pattern on remote sensing data product (Verma, 1993). Thus, after the advent of remote sensing, geological interpretation begins from the lab with the aid of imageries and aerial photo and ends with correlating the interpreted data in the field. So, using IRS-1C data and aerial photographs, various structurally related features such as folds, joints and lineaments were identified and the lithological contacts were interpreted in order to map the iron ore deposits of the study area.

2 STUDY AREA

The area under investigation is located about 8 km from Salem town, Tamilnadu state and lies between the North latitude N 77° 59' - N 78° 08' and East longitude E 11° 34' - E 11°40', covering an area of around 180 sq.km (Rajendran, 1999), with an elevation 986 mt above Mean Sea Level. The plains around Kanjamalai (hill) have elevation of about 300 mt above Mean Sea Level. It has a total length of 7.2 km from east to west and a width of about 3.2 km. The hill is nearly elliptical with repetition of lithology in northern and southern side. The occurrence of iron ore deposits are subjected to intense weathering that has resulted in thick piling of weathered products at foot hill areas. The weathering has produced reddish soils, loamy sand and sandy soils in the plain ground. The fractures in the form of joints are also observed in the formations.

3 DATA USED IN THE STUDY

1. Base map 1: 12,500 scale by using the Survey of India Toposheet No.58 I/2 of 1981
2. Black and White aerial photographs (NRSA ; 1979 - 1980, scale 1:4,000).
3. IRS-1C Geocoded data of 1:50,000 scale.

4 METHODOLOGY

Using the base map, by the visual interpretation of IRS-1C imagery, major structural features were interpreted. The lithological and structural details were identified and demarcated using aerial photographs (1:4,000 scale) and mirror stereoscope based on photogrammetric elements like tone, texture, pattern, shape etc. The different scales of interpretations were integrated and a map of 1:12,500 scale was produced. Field checks were carried out before final lithological and structural maps of the study area were prepared.

5 RESULTS AND DISCUSSION

The integrated maps (Fig.1) of the area exhibits the following major structures namely fold, lineaments, joints and lithological unit's viz., magnetite quartzite, pyroxene granulite and gneisses were identified.

5.1 Structure

The structural features like dip, strike, folds, joints, faults, lineaments were recognised by the visual interpretation and the details are given below (Table.2).

CHARACTERS		Interpretation of Aerial photo	Interpretation of IRS-1C	Field Study
1.	**Lithological units**	Visible	Visible	Iron bands mapped
2.	**Attitude of beds**	Strike & Dip marked	Trends interpreted	Attitudes measured
3.	**Folds**	Syncline	Basin	Doubly Plunging Syncline
4.	**Joints**	Numerous	Invisible	Horizontal, Vertical & Inclined
5.	**Lineaments**	Very Good	Fair	Good

Table. 2 Remote Sensing and field characteristics of magnetite quartzite iron bands.

5.1.1 Fold

In the study area, the major geological structure is fold and this had been recognised by many earlier workers (King and Foote, 1864 ; Krishnan, 1921 ; Aiyengar, 1964; Saravanan, 1969) had described it as a plunging syncline on the basis of plunge towards east with amounts of 15° to 20°. The aerial photos interpretation helped in demarcating the different thickness and attitudes of bands of magnetite quartzites and basic granulites. It also, revealed the closure of beds along eastern and western margin. In field, the northern flank dips towards south from 52° to 57° and southern flank dip towards north with 45° to 47°. It is recognised as asymmetrical doubly plunging syncline.

5.1.2 Joints

The fractures are in the form of joints observed in the rocks. These fractures were also interpreted through aerial photographs and satellite imageries. The banded magnetite quartzite exhibits large number of joints. These rocks are broken along joints and are observed as boulders and blocks. There are three sets of joints observed viz. vertical, horizontal and oblique whose lengths varies from 15 cm to 3 mt. They trend in all directions without any specific preference , which may be attributed to forces, provided by the intrusion of basic magma and granite gneiss. The joints are observed only in the deformed zones suggesting deformation.

5.1.3 Faults

The fault zones that were identified through remote sensing were meager and are distributed on the eastern and western margin of Kanjamalai trending in NNE-SSW directions. These run for 20-35 mts and brought slight displacement of magnetite quartzites bands without much deformation. Thus, these are considered as a minor structural feature.

5.2 Lineaments

The next structurally controlled features are the lineaments that are clearly interpreted on both imagery and aerial photographs. This category includes all structural alignments, topographic alignments, vegetation linear, shapes and lithological boundaries and contacts between physiographic units. These appear to reflect the geology and are of surface expression of buried structure. The study area has lineaments trending in NNW-SSE, E-W, and NE-SW directions. Based upon the lineament concentration, three groups of major lineaments were identified viz.,

Group 1. Lineaments of Tirumanimuttar river

A major lineament trending NNE-SSW running to a length of 8 km had been observed. It runs parallel to Tirumanimuttar river representing a weak zone. It is located close to the deep main fault zones near Salem (Grady, 1971).

Group 2. Lineaments of Gneissic area

These are distributed at different direction and at various places. Further, the lineaments in this area are small and short trending in NNE-SSW, NE-SW and NNW-SSE directions.

Group 3. Lineaments of Kanjamalai area

It includes lineaments that are in and around Kanjamalai which are small and trending NNE-SSW and NE-SW directions. They pass through the area from where minor streams drains from the hill top. A major lineament was identified which cuts across the Kanjamalai hill and is trending in E-W direction. This lineament is parallel to Godumalai shear zone , which is an extension of Attur Fault Zone in Salem. The development of these lineaments is attributed towards the forces that had developed the folds or later deformation of Kanjamalai hill.

5.3 Lithology

In the area, the magnetite quartzite is associated with pyroxene granultie and granitic gneiss and shows sharp contact. The iron ore exhibits dark grey tone, medium to coarse texture with linear banding and are easily differentiated from the other rock types (Table.1). In field, their contacts with other rock types are difficult on account of highly fractured and broken down pieces of ores in the form of float ores / debris at the foot hill. The intermixing of granulites and magnetite quartzite is absent. The minerals of granulites exhibit parallelism with magnetite quartzite. At some places, the contact zone is covered by weathered zone. It also shows sharp contact with the gneisses of the study area and exhibits parallelism to the banding of gneissic contact and there is no indication of intermixing.

6 CONCLUSION

The utilisations of aerial photograph and satellite imagery have proved fruitful for the present study. Aerial photos have provided details , which have its own relation with relief and because of stereoscopic vision and higher resolution the lithology and structure were identified. Visual interpretation of IRS-1C data was much beneficial for geological and structural studies as it has provided synoptic view of large area at a time. The interpretations suggest that the Kanjamalai represents asymmetrical plunging synclinal hill and the major lithological types are magnetite quartzite iron ore formations, granulites and gneisses.

DESCRIPTION		ROCK UNITS		
		Magnetite Quartzite	**Granulite**	**Gneiss**
1.	**Tone**	Dark grey	Light grey	Light
2.	**Texture**	Coarse uneven	Medium	Fine
3.	**Shape**	Elongated	Oval	Plain
4.	**Formations**	Dark toned Linear	Linear	Interlayers
5.	**Topography**	Linear ridges Rugged	Linear ridges Rugged	Planation surfaces
6.	**Vegetation**	Moderate	Good	Moderate
7.	**Landuse**	Poor	Poor	Fair to Poor
8.	**Remarks**	Highly fractured	Fractured	Resistant & Weathered

Table.1 Photo / image characteristics of lithological units.

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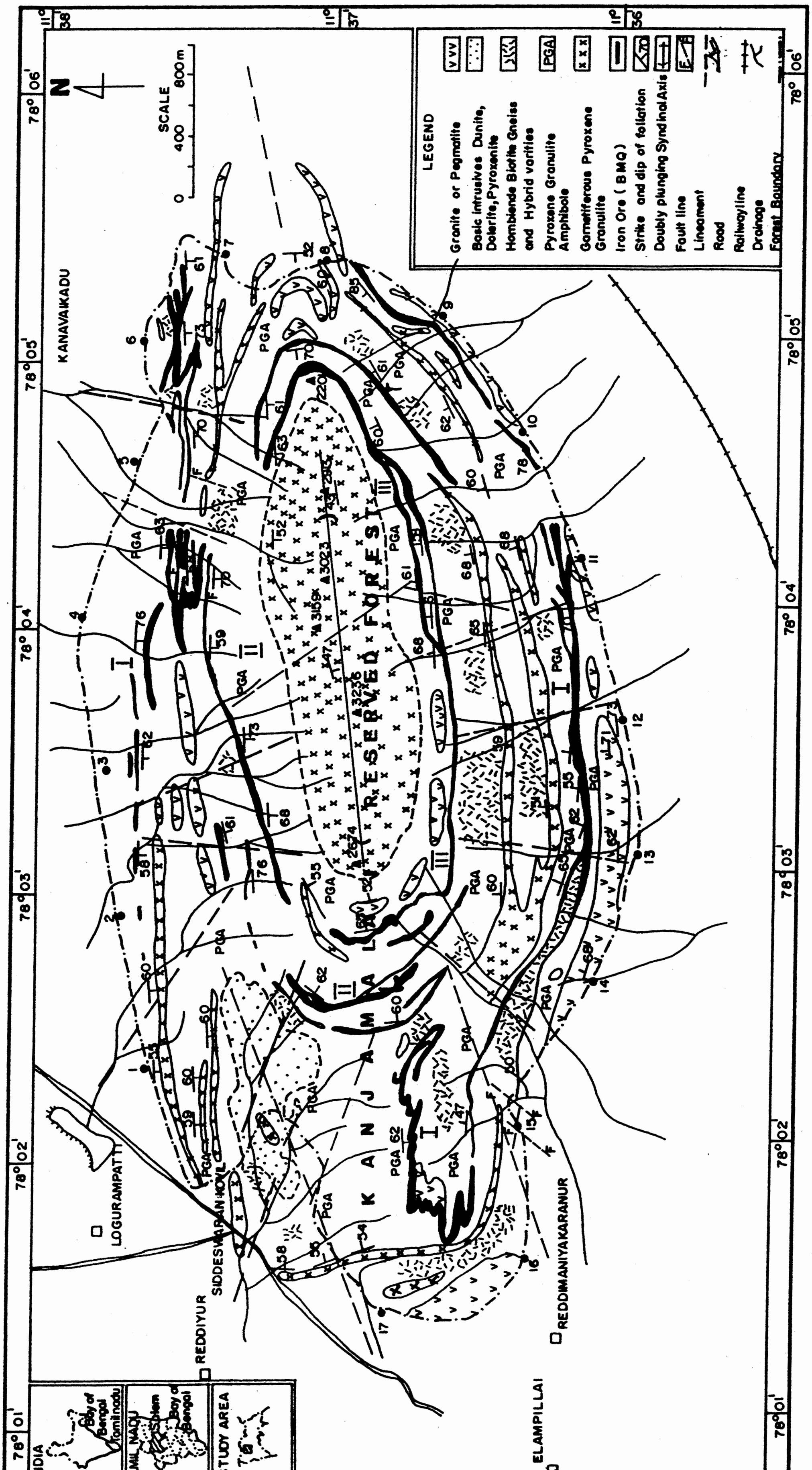

Figure 1. Lithology, Structure and Lineament map of the study area interpreted from Remote sensing and field data.