Application of IRS 1D data in lineament identification and interpretation of drainage product in Babina – Nivari region of Bundelkhand Craton, Central India

Khalid M. Mir[1], Arun Singh[2], Suhail A. Wani[3]& M. Imran Malik[4]
[1]Dept. of Geology, Govt. Degree College, Pulwama, J&K
[2]Project Coordinator, GreenLips, India
[3]Research Scholar, APS University, Rewa, MP
[4]Dept. of Geography, Govt. Degree College Boys Anantnag, J&K

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ABSTRACT
The application of remote sensing technology has shown a great promise for large-scale geological mapping. This work presents an investigation for enhancing lineaments with possible relevance to faults, in Bundelkhand Craton, India using IRS-1D satellite image and standard geographic information system (GIS) techniques. The capability of the IRS 1D infrared bands to detect lineaments that might be related to failure of the crust has been ascertained. The results obtained from the interpretation of remote sensing data have been compared with the drainage network at a scale of 1:50 000 and geological maps at a scale of 1:50 000. Lineaments related to quartz reef have been evaluated as potential faults. The methodological approach adopted in the present study has contributed not only in the identification of several known large-scale faults in the study but also in the mapping of their potential extensions.
Keywords: *Remote sensing; Lineament; GIS; Faults*

Introduction

Fault recognition is a basic component in the field of basic, monetary and natural topography (Colwell et al.,1983; Drury, 1987). Conventional techniques for mapping flaws require hands on work examinations. Be that as it may, field-work is generally tedious and may take up a very long time to finish, depending principally on the expansion and additionally the openness of the zone under scrutiny (Cracknell and Hayes, 1991). Geology, disintegration, over-development of vegetation, scale, involvement of the geologist and different variables control blame determination in the field.

Remote sensing has the benefit of giving brief diagrams of the locale; in this way it might specifically pinpoint the qualities of basic land highlights stretching out finished expansive ranges (Colwell et al.,1983; Drury, 1987). Instead of hands on work examinations, remote detecting alongside picture professional cessing systems represents a less tedious and a more financially savvy technique for blame identification. Regardless, such procedures not the slightest bit supplant field examinations, however despite what might be expected they supplement each other. Flaws are regularly uncovered as direct or curvilinear follows on satellite pictures. These picture lines of various complexities are generally alluded to as lineaments (O'Leary et al., 1976) and may reach out from a couple of meters to many kilometers long. Positively not all lineaments identify with blaming. They could likewise be at-tributed to lithological limits, limits between various land utilizes, waste lines or even to man-made developments, for example, streets. Accordingly, it is difficult to decipher the potential basic inception of lineaments in view of satellite pictures as it were. Besides, any vertical ground relocation going with disappointment of the outside layer can't be effectively identified on satellite pictures as a result of their planar view.

A fault plane may offer a favored road to dampness, or vegetative development, and may frame particular waste examples effortlessly distinguished on satellite pictures. All the more especially, streams have a characteristic inclination to wander. Subsequently some regularly discovered sorts of stream oddities, for example, straight portions, sudden twists saw along stream courses, dislodging or even neighborhood vanishing of seepage framework into lines of sinkholes could check a blame line on a picture (Cracknell and Hayes, 1991; Miller, 1961). Moreover, groundwater exchanged through flaws builds the dampness substance of soil in connection to the encompassing zone and advances particular arrangements of vegetation, unexpected changes in vegetation shade and sudden vanishing of a specific plant animal types (Miller, 1961).

Geological setting of study area

The study area being a part of Bundelkhand Craton is located in the northern segment of the Bundelkhand massif. The area is constituted by Archean gneissic complex. metavolcanic meta- sedimentary suit and Precambrian granitic complex. On the basis of field setting and petrological observations, the following rock types and litho-stratigraphic set up of the area were recognized.

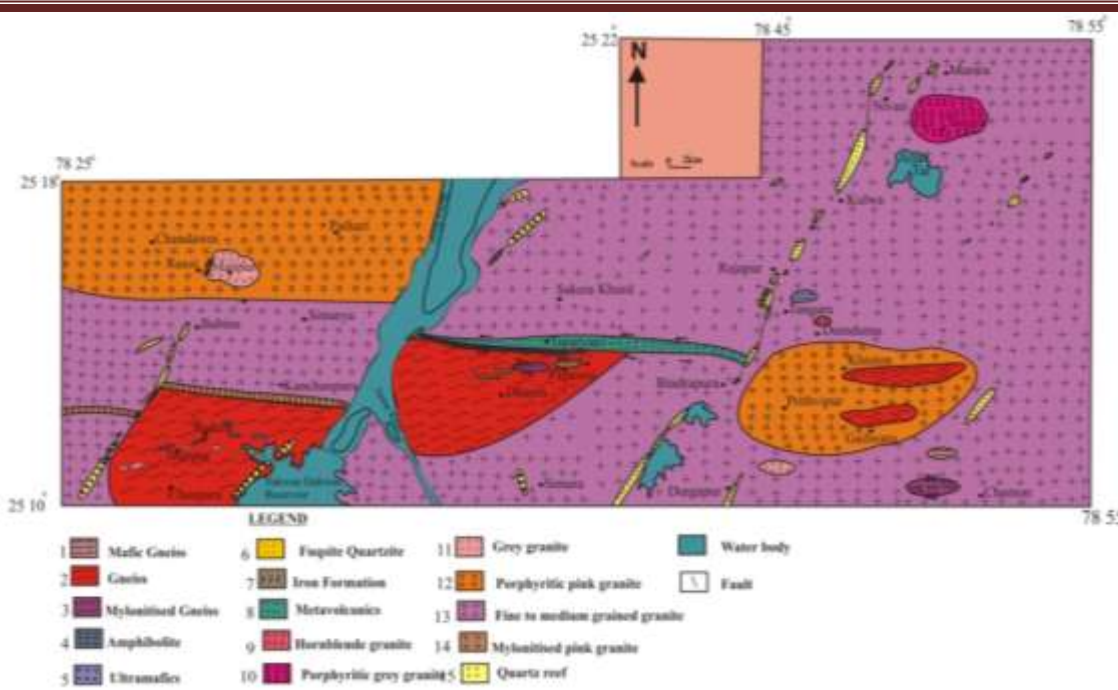

Fig 1: Geology map of the study area.

The banded light to dark grey and fine to medium grained mfic gneisses outcrop in and around Ghisauli, Badera , Jaunpur and Chaurara villages located in the south of Babina town (Fig.1)and were considered equivalent to Kuraicha gneisses (Mondal et al., 2002). In the west of Chamonvillages , the strongly foliated streaky gneisses identified by wide leucocratic bands are expose (Fig. 1) The outcrops of grey and pink banded gneisses are largely exposed in the west of Papawni and Dhaura villages (Fig. 1) The lensoidal bodies are also observed in the south of Khiston and north of Gailwara villages (Fig.) All these lithtypes of gneisses are characterised by well developed foliation striking in E-W to ESE- WNW directions with moderate to steep dips. Besides these rocks are folded, sheared and mylonitised. At some places the inclusions of metabasalt , banded iron formation (BIF) are also noticed within this gneissic complex.Few isolated fine grained,greyish green to dark green lensoidal bodies of amohibloites associated with thes gneisses are exposed in the south of Badera (Fig.1) The fine grained greyish green to dark green low grade metamorphic and ultramaficlensoidal bodies asdociated to this gneissic complex occur in a small hillock located in the north of Tangara and in the eastern segment of Baderavillages(Fig.1). The isolated patches of well foliated fuchsite quartzitescharacterised by thinner quartz and thick dark green fuchsite bands are exposed in the south of Babina and near SukwanDukwan reservoir. In between the southern gneissic gneissic complex and northern granitic massif are exposed redfish to dark brwon banded quartz magnetite rocks to the southwest of the study area. The moderately elevated hillocks of BIF are exposed in the west of Papawnivillageand in the south of Babina village. Large outcrops of fineto medium greyish to dark pink and highly sheared volcano felsic plutonic rocks occur along E-W trending curvilinear zone. This myloniti zone is exposed at Taparyan village and extends uptoDhaura village (Fig. 1).

The fine grained greyish green hornblende granites are exposed n both sides of Nivari -Prithipur road near Dumduma. In the estern flanks of Nivari are exposed coarse grained light to dark grey granites. Few outcrops of fine to medium grained massive grey granitoids are also mapped in the SE and SW of Prithipur. These rocks also occur in few patches to the south of Badera and west of Jaunpur villages. The vast tracts of massive ,compact, pinkish to dark red and coarse grained pink granites occur around Prithipur and its adjoining areas (Fig 1). These granites are also reported in the south of Khiston,n besides near Chandawni, Pathari and Rasoui villages and in the northwestern parts of the study area. In the northern ans southern extremities of the study area, the fine to medium grained light to dark pink granitoids are exposed. The noteable places are the surroundings of Nivari ,Rajapur ,Durgapur and Babina localities (Fig 1).

Methodology

The methodology presented in this paper for the identification of lineaments with possible structural origin has been divided into three implementation phases:

a. Image processing for the enhancement and digitizing of lineaments in using aIRS 1D LISS III product (Fig. 2).
b. Emphasis has been given to large-scale lineaments that might have relevance with specific geomorphology and drainage patterns commonly related to faults.
c. Setting up procedures through a Geographic Information System (GIS) for the evaluation of the quartz reef lineaments detected on IRS 1D, for identification of potential faults.

Evaluation of lineaments as potential faults

Any linear or curvilinear features observed on the processed IRS 1D multispectral image that might be related to potential fault and alignments have been digitized. Auxiliary data, such as:
1) The geological maps published by the GSI at scales 1:200 000;
2) The drainage network, digitized by the Survey of Indiatoposheetsat a scale of 1:50 000; and have been inserted into a GIS for the evaluation of the lineaments detection.

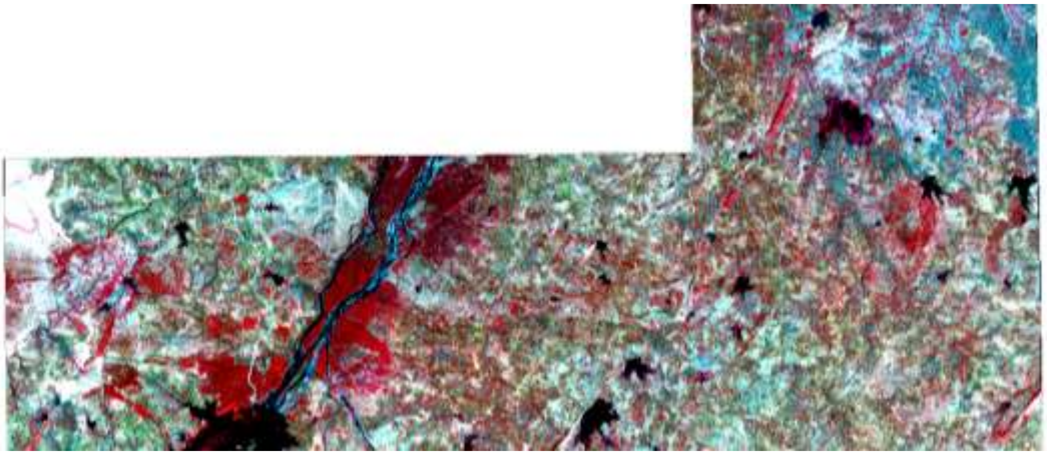

Fig 2: IRS 1D (LISS III) Satellite image of study area in FCC

Result

The determination in the source information is a confinement in basic understanding of landforms. This impediment is identified with the remote-detecting strategies utilized, and the assistant data (e.g. topographical information, maps and field perceptions) that can bolster the elucidation. Various examinations have been made to grow such connection between the tectonics and streams in the different structural zones by traditional field strategies.

At first the base information for lineament thinks about were immediate perceptions of the scene and geographical maps. A lineament translation can be made outwardly. The translations of lineaments in view of geographical rise information and geophysical information are essentially fundamentally the same as and area of a lineament is predominantly distinguished by:

i. Change in altitude/level
ii. Change in gradient
iii. Change in pattern
iv. Occurrence of linear minima/maxima
v. Displacement of reference structures/surfaces.

When handling base information for lineament understanding the general thought is to improve the area of minima/maxima and changes in dislodging of reference structures (drainage). This study also attempts the possibility to visualize the effect of neotectonic activity (Pliocene – recent) by dealing structures that comprises five complementary approaches:
(1) Lineament analysis
(2) Drainage analysis to define the regionalfracture pattern
(3) Analysis of the volcano morphology
(4) Interpretation of remote sensing data (satellite images, air photos) and digital elevationmodel (DEM) imagery
(5) Field work to verify the interpretations toinfer the kinematics of the interpreted fractures.

Lineament analysis

The lineaments in form of quartz reef are identified in the study area. The orientation of majority of quartz reef is NE-SW. the other orientation identified are NW-SE and E-W. The most spectacular linear features of the study area are quartz reefs. These reefs are mostly trending in NE-SW directions although very few trend in NW-SE directions. A major quartz reef offsetting the gneisses and banded iron formation is passing from Babina and extendaupto the southern part of the study area (Fig. 3) Another major quartz reef encompassing from north of Nivari and extending to the southwest of Durgapur is recognised as the longest quartz reef in the Bundelkhand massif. Lying in the southeast of Arjar Tal are exposed dark grey, fine to medium grained and NW-SE trending doleritic dykes (Fig. 3)

Drainage pattern

The drainage of the area and the quartz reef (Fig3) have been examined and generated. Linearity of quartz reef has been examined in relation to the course followed by the streams. Quart reef doesn't coincided with long linear drainage lines, but seems to act as breaker or diverter in drainage linearity and sudden river bends may be attributed to potential fault zones.These particular lineamentsare also related with a sudden course shift and inactive stream channel.The area is hard rockyterrain but still higher drainage density in such a region must indicate that some active tectonic activity is present. Here in this study only first two approaches could be discussed due to absence of other three approaches required.Drainage anomalies occur in all subareas irrespective of the age of outcropping rock. The fact that the youngest rocks affected by drainage anomalies are of Pliocene age indicates their neotectonic significance. The major trend of drainage network anomalies in the study area is NW-SE in all subareas and all rock types. This argues that arc-parallel anomalies represent neotectonic features. Another trend observed in the study area is NE-SW.

Results of drainage network anomalies are consistent with results of lineament analysis. Both methods reveal the significance of NE-SW and NW-SE oriented lineament sets which are interpreted as subvertical fracture zones. Possiblity of arcparallel and arc-oblique lineaments has been recognized in this study area.

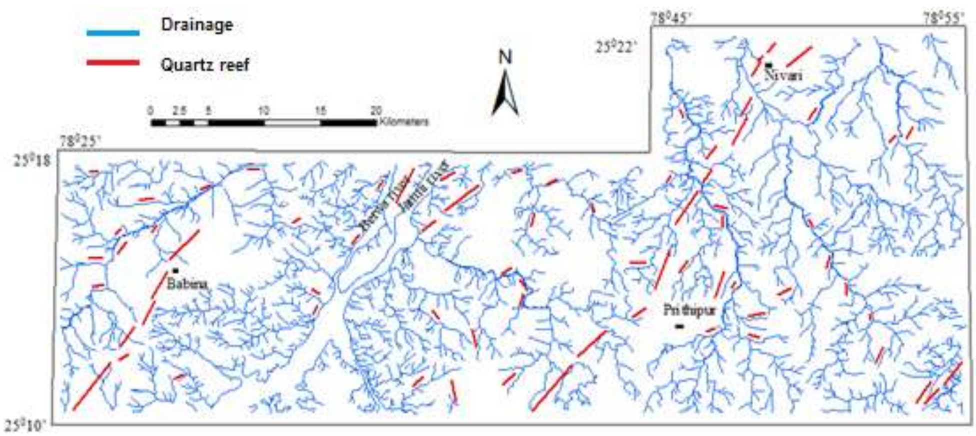

Fig 3: Drainage and Lineament map of study area

Conclusions

The adjustment toward stream is for the most part because of tectonics and the subsurface lithology of the zone. The waste system of the range keeps on creating with the difference in tectonics. Because of the basic multifaceted nature it is essential to quantify the impact of streams and lineaments on each other. The neighborhood connection recommends that the lineaments and streams in the territory collaborate with each other and impact their introduction and style. The principle wellspring of this impact might be tectonics of the zone.

We at that point look at lineaments and seepage system and attempt to make sense of their impact on each other, yet the visual translation isn't sufficient to give adequate data because of auxiliary intricacy of the Bundelkhandcraton area. It is particularly a methods for preparatory graphical exploratory examination that empowers the client to rapidly assess in how far streams are influenced by dynamic structural procedures. The restricted lineaments have their play fit as a fiddle of the neighborhood seepage however they are additionally controlled by major structural components.

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