International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

National Conference on Recent Advances in Civil Engineering Infrastructure (rACEi-2021)

Advanced Techniques in Mineral Exploration

Dr. Narayan Sangam

Associate Professor. Vignan Institute of Technology and Science, Deshmukhi(v) Yadadri Bhuvanagiri (Dist)Telangana. India.

Received 05 Aug 2021, Accepted 10 Aug 2021, Available online 15 Aug June 2021, **Special Issue-9 (Aug 2021)**

Abstract

In recent years, large and voluminous information is available on the management and use of remote sensing and GIS techniques and several websites of leading agencies are providing distinct analyses with the available geodata sets and their applications in different fields of earth sciences. There are a number of websites that deal exclusively with remote sensing studies for instances: (http://terra.nasa.gov,http://www.nima.mil, http://infoserver.ciesin.org, http://www.geographic.com, http://www.landinfo.com, http://www.grida.no, http://www.geospatial.online.com, http://www.ogis.org, http://www.asprs.org) Remote sensing is applied in the field of exploration, which directly maps the broad range of alteration minerals associated with ore deposits. Satellite systems have evolved to provide higher spatial and spectral resolutions, essential for mineral exploration. Manual interpretation of the remote sensing results on printed maps is rapidly giving way to full digital integration of data and use of Geographical Information Systems (GIS) for statistical based analysis and interpretation.

Keywords: *Mineral Exploration, Remote Sensing, Geographical Information System.*

Introduction

Remote Sensing is a technique in which acquisition of data for deriving information about objects or materials (targets) located on the earth surface or on its atmosphere is made without any direct contact. (Lillisand, T. M and Keifer, R. W., 1979) However, innovations in this field by using sensors mounted on different types of platforms located at a distance from targets have been made to collect precisely accurate data. The platforms are generally aircrafts or satellites. MSS (Multi Spectral Scanner), TM (Thematic Mapper), LISS (Linear Image Self Scanner) are some of the examples of sensors. Measurements are made in different spectral regions on interactions between the targets and EMR (Electromagnetic Radiation) Spectrum. The information from the object to the sensor is carried by the electromagnetic energy and these are encoded in the form of frequency or intensity or polarization. The values of spectral reflectance of objects arranged over different well-defined wavelengths comprised the spectral signature of the objects. These are the characteristic features by which the objects can be uniquely distinguished. The output of satellite remote sensing is generally in the form of an image. Visual or Digital interpretation of these images will be used in various application areas.

Remote sensing is generally described as the measurement of reflected or emitted electromagnetic radiation (EMR) in the range of about 300 nanometers (nm) to 1 meter (m) in wavelength. The use of remote sensing in mineral exploration began about 60 years ago with the help of hand-held cameras, and has since evolved through stereoscopic aerial photography to sophisticated space age technology with satellite and air borne multispectral and digital imaging systems (Stettler, E.H 2007).

Remote Sensing in Mineral Exploration

Remote sensing is applied in the field of exploration, which directly maps the broad range of alteration minerals associated with ore deposits. Satellite systems have evolved to provide higher spatial and spectral resolutions, essential for mineral exploration. Manual interpretation of the remote sensing results on printed maps is rapidly giving way to full digital integration of data and use of Geographical Information Systems (GIS) for statistical based analysis and interpretation.

Applications of Remote Sensing:

The applications of air photo interpretations on a variety of areas, viz, land cover mapping, soil and geologic mapping, zones of mineralization, agriculture, forestry range, land management, water resources, urban and regional planning, wet land mapping, wild life ecology, archaeology, environmental assessment, land form identification and evaluation is the real time programme of different agencies. With the help of remote sensing, geological contacts, faults, and fractures are brought out clearly which help in prospecting mineralized areas (Gold, 1980). Air borne satellite hyper spectral data has been used for mapping mineral abundance (Hewson et al 2005). Synthetic Aperture Radar (SAR) is an important tool in lineament mapping. Lineaments give information about the strike direction and foliation trends of geological structures like faults, joints, shear planes, fractures, gneissosity etc.

Remote sensing has proven to be a valuable tool in exploring the mineral resources and isolating the favourable areas from unfavourable areas. Remote sensing data provide the litho logical, geomorphological and structural guides essential for understanding various parameters responsible for localization of most of the ore deposits. (Rawashdeh, S.A 2007).

Table 1: Electromagnetic Spectrum used for mineral exploration

EM Region	Minerals
Visible and Near Infrared region. 400-1000 nm (Very Near Infrared)	Iron oxides, REE's, Vegetation
Short Wave Infrared region (1000-2500 nm)	(OH) bearing minerals, Clays, Phyllosilicates, Amphiboles, Sulphates, Carbonates.
Mid or Thermal Infrared (8000-12000 nm)	Silicates, Quartz, Feldspars, Garnet, Pyroxenes, Carbonates.

Table 2: IRS Satellites and their Resolutions

Resolution (m)	Sensor	Satellite
2.5	PAN Stereo	IRS-P5
5	PAN	IRS-1C, IRS-1D
24	LISS-III	IRS-1C, IRS-1D and IRS-P6
36.25	LISS-II	IRS-1A, IRS-1B
56	AWiFS	IRS-P6
72.5	LISS-I	IRS-1A, IRS-1B
180	WiFS	IRS-1C, IRS-1D and IRS-P3
360	OCM (Multispectral)	IRS-P4

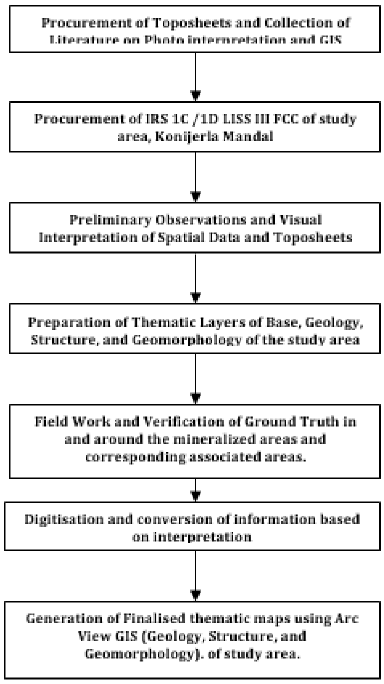
Procedure for Generation of Thematic Maps

The following steps were taken in the preparation of thematic layers (geology, structure, and geomorphology) of the area:

1. Preparation of base layers using SOI toposheet (1:50,000 scale) and updation of additional features using IRS 1C/ID LISS III geocoded FCC (1: 50,000 scale)
2. Visual interpretation of each thematic layer (lithology, geomorphology, and structure) using both SOI toposheets and IRS 1C/ID LISS III FCC.
3. Collection of data on existing maps/ remote Sensing data on the study area.
4. Quality check-I involved in scrutinizing the available data of thematic layers prepared earlier.
5. Field verifications of ground truth for each thematic layer and also collection of information on the area from D.M.G office, Konijerla Mandal, Khammam District Andhra Pradesh.
6. Updating additional information in the thematic layers, after field observations and verifications.
7. Quality checks II involving cross checking the remote sensing data and field observations in each thematic layer from the ground truth.
8. Scanning of final thematic layers, digitization of features, integration, map composition and output of the thematic layers using Arc View GIS 3.2.

Flow Chart for Generation of Thematic Maps

The activities for generation of GIS based maps of the area.



Geologic *Mapping,*

Geomorphologic Mapping and Structural Mapping

Geologic Mapping:

It involves identification of rock types and configuration of geologic units on a map in their correct spatial relationship with one another.

Corundum occurrence and exploration is an important activity in the area as there is no definite methodology so far adopted for geologic mapping.

The geological map of the study area was prepared using the SOI Toposheet Nos.65 C/7 and 65 C/8 on 1:50,000 scale, and IRS 1C/ID LISS III geocoded FCC image. The various rock types / geological units were marked using the SOI toposheets and IRS 1C/ID LISS III geocoded FCC image. Field verification / ground truth with respect to the rock types was carried out in detail to establish the correctness of the interpreted geological units and broad correlations were made with the existing maps. The lithological units thus interpreted out from the detailed studies are granite gneisses / biotite gneisses, amphibolites. anorthosites, gabbroic anorthosites, pegmatites, schistose rocks of various types and basic rocks as pyroxene granulites and met dolerites

Geomorphological Mapping:

From the Air photo interpretation, landform identification and evaluation was made and studied stereoscopically for topography, drainage pattern and texture, erosion, photo tone, and vegetation.

Topography:

Each landform and bedrock type has its own characteristic topographic form including a typical size and shape. There is often a distinct topographic change at the boundary between two different landforms.

Preparation of Geomorphological Map:

The Geomorphological Map of the study area was prepared through an analysis of the elements of photo interpretation (topography, drainage pattern and texture, erosion, photo tone, and vegetation) using the SOI toposheet, IRS 1C/ID LISS III and existing maps / literature. The various landforms were interpreted and verified through field verifications / ground truth. The geomorphological units thus derived include hills (Denudational, Residual and Structural hills), pediplains (shallow weathered and moderately weathered), inselbergs and valleys (Shallow fill material)

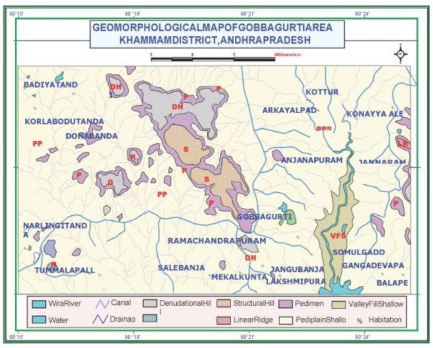


Fig1.Geomorphological Map of Study Area

Structural Mapping:

Tonal features in many areas are the surface expressions of fractures or fault zones. Major lineaments range from a few to hundreds of kilometers in length. The mapping of lineaments is important in mineral resources studies because most of the mineral deposits are localized along structural traps. Several factors influence the detection of lineaments. One of the most important is the angular relationship between the linear fracture and the illumination source. In general, features that trend parallel to the illumination source are not detected as readily as those that are oriented perpendicularly.

Preparation of Structural Mapping:

A Structural Map of the study area was prepared using the IRS 1C/ID LISS III geocoded FCC image and the various structural trends were marked. Field verifications / ground truth was carried out in establishing the presence of all the structural features in the study area. The structural units observed included lineaments (major and minor), fault zones, fractures, joint patterns, structural trends, and zones of mineralisation of corundum.

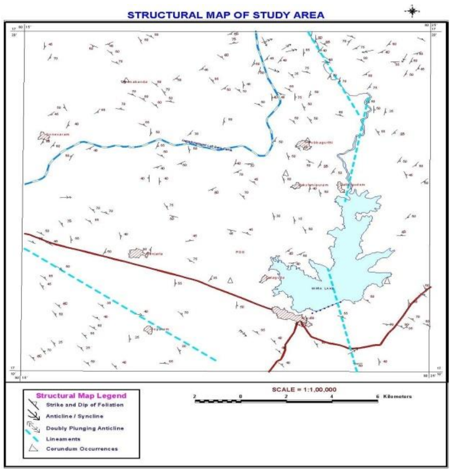


Fig.2. Structural Map of Study Area

References

Hewson, R.D. et al (2005) "Seamless geological map generation using ASTER intheBrokenHill-CurnamonaprovinceofAustralia" Remotesensingofenvironment.Vol.99, Issue1-2Pages 159-172

Chung, C. F., Jefferson, C. W.and Singer, D. A. (1992). "A quantitative link among mineral deposits modeling, geosciences mapping and exploration resource assessment" Jour. of Economic Geology, Geol. Surv.Canada, Ottawa, Vol. 87, Issue1, Pages 194-197

Lillisand,T.MandKeifer,R.W(1979)"RemotesensingandImageinterpretation" JohnWileyPublications,Newyork,Chishester.

Rawashdeh,S.A(2007)"Useofremotesensingtechnologyingeologicalinvestigations in mineral detection in EL Azraq,Jordan" European Journal ofGeography.Article358.

Stettler,E.H(2007)"InnovationsinElectro-Magnetic,Gravity andMagneticmethods:anewperspectiveforexploration"ExtendedAbstract.EGM.April2007