# Using technical of remote sensing to discriminate the percentage of iron raw in the Wadi El-shati

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## Abstract

The rock units of Wadi El-shati were classified to group of clusters to explain the concentration of iron ore by using enhanced satellite image. The several images of single band of Thematic Mapper (TM7) of Landsat were combined to produce multispectral image bands. It was processed by group of filters after the false color image has been made. The filtered image was classified with unsupervised classification after the image ratio has been done by dividing band 3 on band1. Finally, we reached the classified image has concentration of iron tone.

**Keywords**: Band – False Colour Image – Unsupervised Classification – Image Ratio

## Introduction:

Remote sensing, also called earth observation, refers to obtaining information about objects or areas at the Earth's surface without being in direct contact with the object or area. Humans accomplish this task with aid of eyes or by the sensor; so, remote sensing is day-today business for people. Reading the newspaper, watching cars driving in front of you are all remote sensing activities. Most sensing devices record information about an object by measuring an object's transmission of electromagnetic energy from reflecting and radiating surfaces. Satellite remote sensing and GIS applications have introduced in fields; agricultural, meteorology, military, oil exploration, mining ….etc. Principles of remote sensing and remote sensing techniques allow taking images of the earth surface in various wavelength region of the electromagnetic spectrum. One of the major characteristics of a remotely sensed image is the wavelength region it represents in the electromagnetic spectrum. Some of the images represent reflected solar radiation in the visible and the near infrared regions of the electromagnetic spectrum, others are the measurements of the energy emitted by the earth surface itself i.e. in the thermal infrared wavelength region. The energy measured in the microwave region is the measure of relative return from the earth's surface, where the energy is transmitted from the vehicle itself. This is known as active remote sensing, since the energy source is provided by the remote sensing platform. Whereas the systems where the remote sensing measurements depend upon the external energy source, such as sun are referred to as passive remote sensing systems. Principles of remote sensing detection and discrimination of objects or surface features means detecting and recording of radiant energy reflected or emitted by objects or surface material. Different objects return different amount of energy in different bands of the electromagnetic spectrum, incident upon it. This depends on the property of material (structural, chemical, and physical), surface roughness, angle of incidence, intensity, and wavelength of radiant energy. The Remote Sensing is basically a multi-disciplinary science which includes a combination of various disciplines such as optics, spectroscopy, photography, computer, electronics and telecommunication, satellite launching etc. All these technologies are integrated to act as one complete system in itself, known as remote sensing system. There are a number of stages in a remote sensing process, and each of them is important for successful operation. Stages in remote sensing they are: emission of electromagnetic radiation, transmission of energy from the source to the surface of the earth as well as absorption and scattering, interaction of electromagnetic energy with the earth's surface as reflection and/or emission, transmission of energy from the surface to the remote sensor, sensor data output and data transmission that are processing and analysis what we see at temperature above absolute zero all objects radiate electromagnetic energy by virtue of their atomic and molecular oscillations. The total amount of emitted radiation increases with the body's absolute temperature and peaks at progressively shorter wavelengths. The sun, being a major source of energy, radiation and illumination, allows capturing reflected light with conventional (and some not-so-conventional) cameras and films. The basic strategy for sensing electromagnetic radiation is clear. Everything in nature has its own unique distribution of reflected, emitted and absorbed radiation. These spectral characteristics, if ingeniously exploited, can be used to distinguish one thing from another or to obtain information about shape, size and other physical and chemical properties. Modern remote sensing technology versus conventional aerial photography the use of different and extended portions of the electromagnetic spectrum, development in sensor technology, different platforms for remote sensing (spacecraft, in addition to aircraft), emphasize on the use of spectral information as compared to spatial information, advancement in image processing and enhancement techniques, and automated image analysis in addition to manual interpretation are points for comparison of conventional aerial photography with modern remote sensing system. Remote sensing process built-up area sun distribute for analysis pre-process and archive satellite reflected solar radiation forest grass water bare soil paved road atmosphere down link 26 principles of remote sensing during early half of twentieth century, aerial photos were used in military surveys and topographical mapping. Main advantage of aerial photos has been the high spatial resolution with fine details and therefore they are still used for mapping at large scale such as in route surveys, town planning, construction project surveying, cadastral mapping etc. Modern remote sensing system provide satellite images suitable for medium scale mapping used in natural resources surveys and monitoring such as forestry, geology, watershed management etc. However the future generation satellites are going to provide much high-resolution images for more versatile applications [4,5].

Many image analysis and processing techniques are used to extract information from remote sensing spectral data. Several of the more commonly used ones are described here for possible mineral deposits detection. Remote sensing instruments detect electromagnetic radiance from few microns to millimeters of any surface. The target surface must be exposed to sunlight. The major limitations of the Landsat MSS (Multi Spectral Scanner) for geologic studies were its coarse spectral resolution and its limited spectral coverage, which does not extend into the region most useful for defining the spectral characteristics of minerals important to exploration, that is the SWIR (Short Wave Infrared). This changed with the launch of Landsat 4 and 5, which carried the TM (Thematic Mapper) sensor, and later ETM+ (Enhanced Thematic Mapper). The TM system added coverage in the SWIR and MIR (mid infrared), providing explorationists with a tool for identifying hydrothermal alteration on the earth's surface potentially indicative of ore deposits. The TM is now a routine exploration tool for many mineral exploration companies [1,2].

## Historical Geology:

The Libyan iron ore deposit occurring in Wadi Al-Shati area, Fezzan, is dominantly composed of magnetite Fe + 2Fe2 + 3O4 which reveals well developed oolitic texture, indicating that is was most probably formed under shallow marine environment of deposition. According to Goudarzi and other workers, Wadi Al-Shati iron mineralization is believed to be of syngenetic sedimentary origin. However, the genesis of magnetite remains a questionable problem since it can hardly be explained from the sedimentological point of view. It is well known that magnetite could be formed in appreciable amounts under a relatively high temperature and low negative Eh values. Such favourable physico-chemical environment might be fulfilled by contact or regional metamorphism. Mineralogical and geochemical investigations, by microscopic and X-ray methods, of more than 60 magnetite-rich ore samples from Wadi Al-Shati has shedded some light on the genesis of magnetite revealing whether it has been formed by sedimentary or metamorphic process or it is of polygenic origin. The present study has discerned that Wadi Al-Shati iron ore deposit was initially deposited, under marine conditions, as synsedimentary goethite and berthierinc (chamosite) during Upper

Devonian time. The post mineralization processes, including diagenesis and low-grade metamorphism, resulted in the partial transformation of goethite and berthierine to magnetite while retaining the original oolitic texture of the ore. Heat was the main agent of metamorphism and was most probably related to Tertiary volcanic activity, which is manifested by the extensive basaltic flows outcropping in the northern and eastern parts of Wadi Al-Shati area [3,5].

## The tools of study:

1-geological map

2-satellite image

3-ERDAS program

4- Previous study

## Research Objectives:

The study aims to mapping the percentage of iron ore deposit in Wadi Al-Shati area

## Location of study area:

Study area located on southwest part of Libyan country near Sabha city. It is the main city in south of Libyan country. The study area lies northeast Sabha city about 146 Km. the study area located between latitude 27° 00′ north and 27° 50′ north and longitude 14° 00′ east and 15° 00′ east. It is occupied area reach about 350 square kilometers. Samno and El-Fukhah are nearest cities to the study area. Also, there are huge ancient basalt flows that named El-Harug El-souda. This ancient igneous rock is located at 200 kilometer eastern of the study area.

## Methodology:

The multispectral image was produced by combining seven single band images figure (1) of Thematic Mapper (TM7) of Landsat.

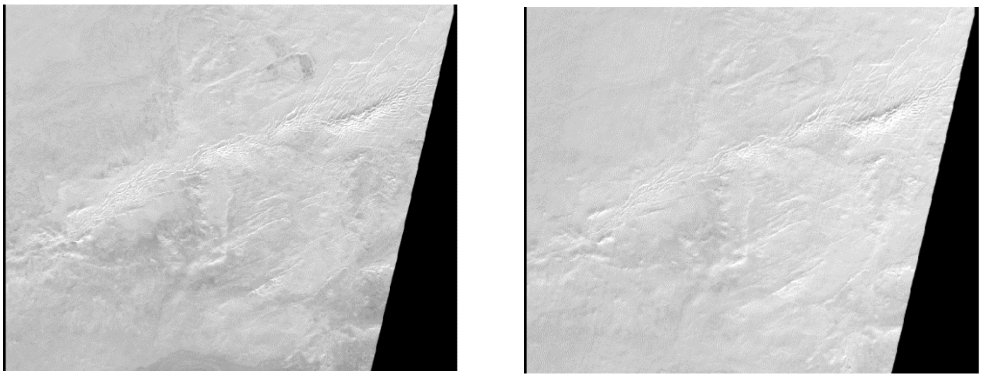

**Figure (1): the single band images displayed by ERDAS viewer program 2014.**

When the multispectral color image has been formed by ERDAS program, the false color images were displayed by ERDAS viewer program as shown in figure (2).

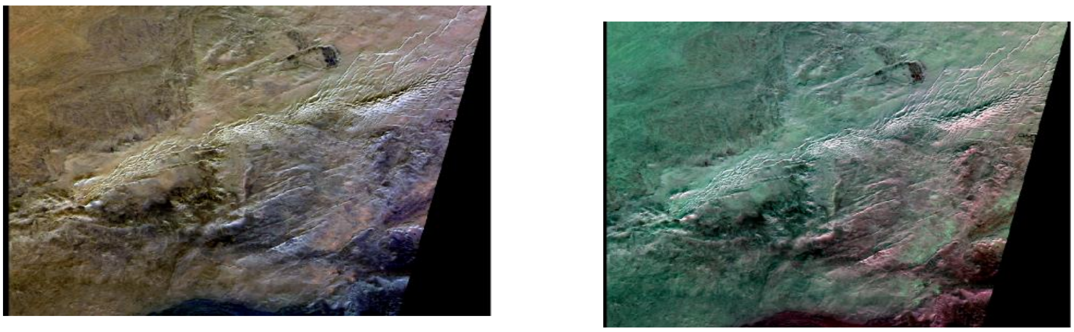

**Figure (2): false color images, have produced by combining single band images through ERDAS program.**

The false color image has been made by merging three signal images through Layer Stack option that can find under Spectral option in ERDAS program. This option is using to create multi-spectral image by combining signal images have taken to same place and same time.

The main target from producing false color images is determining identity of zones in the study region. If zones change their color, but they hold over same shape then these zones roughly have the same lithology. Furthermore, the multispectral image used to creating image ratio. This image mostly use to classify different categories that show in area. This image also employed to detecting the tones of iron ore in our case. The ratio image as shown in figure (3) are prepared by dividing the digital value in one band by the corresponding digital value in another band for each pixels. Then, each produced value has stretched on same digital value scale that expand between 0 to 255 shadow tones. The new pixels are plotting to make the new image that named image ratio. The image ratio have made by utilizing NDVI option that lie under Unsupervised option through ERDAS program.

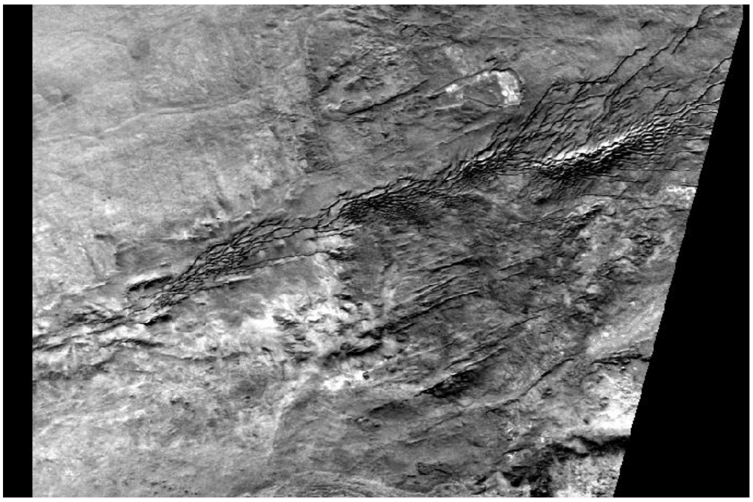

**Figure (3): image ratio of iron oxide created by dividing image band 3 on image band 1**

The red materials, such as the formations with its high content of iron oxide, have their maximum reflectance in band 3. Thus, in the ratio image 3/1 (red/blue) the formations have iron ore outcrops have very bright signatures. Finally, the image ratio band3/band1 has classified by using unsupervised classification method. This classification divide the pixels of image to groups of categories depending on digital value at the histogram.

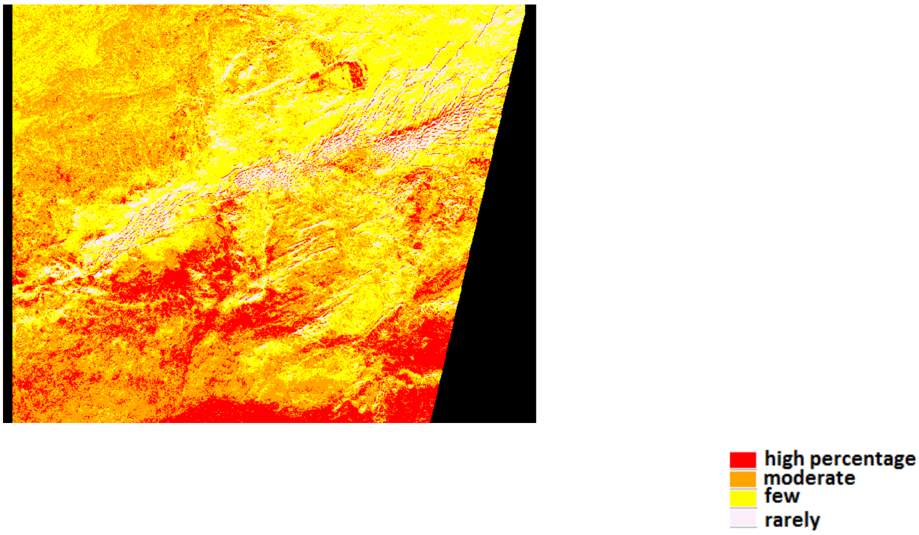


**Figure (4): unsupervised classification image formed from image ratio by ERDAS program after it has assigned color for every class.**

The computer separates the digital values of each pixel into groups of categories without analyzing or taking samples from the field. Then, the classified image distinguished all the categories by specializing color for every class as shown in figure (4). The last enhanced has been accomplished by ERDAS software program. This classified image has generated by Unsupervised option that located on main menu of ERDAS program.

## Discussion and conclusions:

The classified colored image shows the percentages of iron ore on the study area. The last image exhibits the areas have high and low proportions of the ore, so the assessment can do in the specified regions that able to interpreting without specialized. The operations of exploring will concentrated on the regions that have high ratio of iron ore. The region that has high chance is located at southeastern portion of the study area. Also, we can result that the area beside this study area from the southeastern way may have high chance to exploration and study. The resulted distribution in last map will save effort and time, and it will make exploration easier. The map of percentages has produced without field trip and it will employ to confirming the result by doing the field trip to specific areas not to surveying whole region.

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