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ORIGINAL ARTICLE

The Use of Remote Sensing Techniques for Enhancement and Detection of Koopan Laterites (Zagros Region), North East of Shiraz, Iran

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ABSTRACT
Koopan regional laterites in the East Village is located in 130 kilometers North East of Shiraz. The rock strata, Koopan Laterits set on Neyriz ophiolites that this ophiolites are actually part of a series Zagros ophiolite with of Upper Cretaceous age. This laterites are covered with Nummulitic limestone equivalent Jahrom formation with Eocene age. So the lateralization (Lateralization event) should be after the Upper Cretaceous and before Eocene in which case it can be assumed Paleocene age for this event. In terms of lithology, the study area includes serpentinized peridotites, Red laterites, Yellow laterites, Eocene limestone and young Quaternary sediments. The aim of the current study, Enhancement and Detection of Koopan regional laterites has been by remote sensing techniques for this purpose ASTER images was prepared and pre-processing. The studies also conducted field surveys on various rock units, it has been picked and geographical location of the units were recorded by GPS. Then, in the main processing, using the spectral reflectance curves of laterite, used to identify the best color combinations. This study showed that the combination of RGB = 541 for the red laterite and RGB = 721 for the yellow laterite is the best detection to follow. Principal component analysis (PCA) standard method that with all the bands as well as the enhancement on them was performed the best difference for detection and enhancement of Laterits was followed and Finally by using the training field points and the use of standard PCA, Operations supervised classification done that studies indicated Supervised classification method with Maximum Likelihood algorithm associated with the greatest enhancement..
Keywords: Zagros, Koopan laterite, Remote Sensing, Enhancement, Detection

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INTRODUCTION

The use of remote sensing techniques has long been in the various branches of earth sciences particularly in the field of detection and separation of rock units and mineral exploration applications. The purpose of this technique is that the integration of remote sensing data and field information,

It can spend less time and costs and also using more accurate digital methods, operations enhancement (Enhancement), identification (Detection) and separation (Slicing) different units to carry out [4] for example, Noori and colleagues [6], Taherzadeh and others [2], Sekhavati and colleagues [9] and Faridi and colleagues [2] noted. In the meantime, for various reasons, using ASTER data has wide application in the study of land resources. ASTER (Aster) installed on the Terra satellite (TERRA) as part of the Earth Observing System (EOS) was placed in orbit by NASA in 1999. This sensor has 14 spectral channels, which can record the electromagnetic waves in the range of 0.52 to 11.65 mm. This 14 channel for imaging in three spectral region visible to the near infrared (VNIR), shortwave infrared (SWIR) and thermal infrared (TIR) are set and the spatial resolution of each section respectively 15, 30 and 90 meters which from this point of view, information three bands (VNIR) ASTER is one of the best data on the spatial resolution of the data used to detection and separation of vegetation and many minerals and rocks used [7]). Data six bands (SWIR) ASTER base for identifying minerals that have hydroxyl (OH-) and carbonate (CO3-2)are very suitable because these minerals within the SWIR spectral absorption significant and especially due to the range of absorption bands of water (Water Absorption Bands) at three wavelengths 2.7, 1.9 and 1.4 mm show high absorption. Therefore, The regional data (SWIR) ASTER to identify Alunite, Kaolinite, Dickite, Pyrophilite,Illite, Muscovite, Jarosite, Hematite (minerals and epithermal deposits) and Jarosite, Alunite, Kaolinite, Dickite, Epidote, Chlorite, Muscovite, Illite and Hematite (associated Minerals porphyry deposits) are widely used [7]. The importance of these techniques for separating rock units of this collection first set due to less time and cost of such operations in remote sensing and secondly the use of digital techniques can improve accuracy studies. In the current study has tried to use a combination of field information with ASTER data and using remote sensing techniques, to detect and enhance Lateritic units Koopan area but first introduced geological area.

Geology of the area

In terms of geology and based on existing maps(3), the study area Koopan located at Zagros folded–Thrustedbelt(Figure 1). THE outcrops of red Laterit and yellow Laterit in this area can be seen in the series of Neyriz ophiolite that covered by Nummulitic limestone Jahrom formation(Figure 2).According to the series of Neyriz ophiolite with Upper Cretaceous age (8) and also for Jahrom formation Eocene age is mentioned [5]) Thus, the formation time of Zagros laterites in Koopan area should be between the Upper Cretaceous to the Eocene In other words, the occurrence of lateritization of Zagros likely occurred in the Paleocene. Figure 3 position of Koopan laterites associated with serpentinized periodontitis and also displays Nummulitic limestone area. Figure 4 also shows the general regional Laterites outcrop. Description of the field points taken from rock units in Table 1.

Figure 1. The location of Koopan areain Zagros Folded- Thrusted belt (Base map from Ghorbani, 2007)

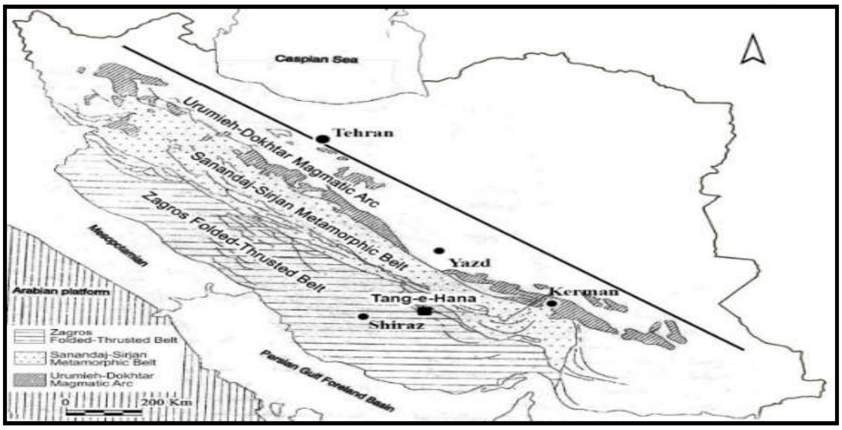


Figure 2- Slice of the geological map of Koopan area (derived from the geological map 1: 250,000 GSI)

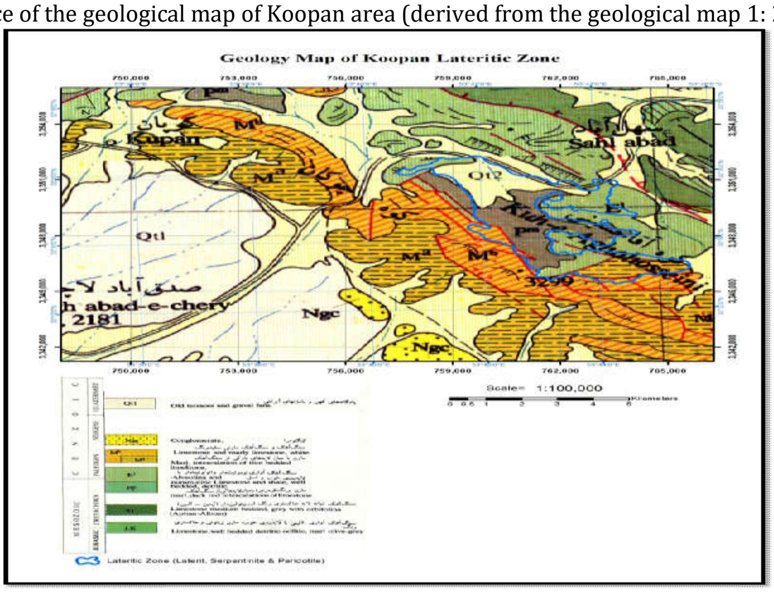


Figure 3. Its field Koopan laterites with serpantinized peridotites (lower part) and Nummulitic limestone (upper section)

Figure 4. General laterite outcrops of Koopan below Nummulitc limestone Jahrum Formation (Eocene)

Table 1- Description of the fieldpoints of Koopan area

Rock samples	Geographical coordinates		Description
RS1	30 15 28.2	53 42 49.3	Limestone
RS2	30 15 28.7	53 42 49.1	Limestone with contact of Red Laterite
RS3	30 15 9.8	53 42 42.2	Nummulitic Limestone
RS4	30 14 42.4	53 42 41.4	Red Laterite
RS5	30 14 41.4	53 42 36.8	Red Laterite
RS6	30 14 40.8	53 42 34.7	Red Laterite
RS7	30 14 39.9	53 42 34.1	Red Laterite
RS8	30 14 39.0	53 42 34.2	Red Laterite
RS9	30 14 37.8	53 42 31.2	Red Laterite
RS10	30 14 37.2	53 42 29.5	Contact of Laterite with Serpantine
RS11	30 14 35.8	53 42 29.9	Contact of Laterite with Serpantine
RS12	30 14 37.8	53 42 29.0	Contact of Laterite with Serpantine
RS13	30 14 37.5	53 42 28.6	Serpantenized Peridotite
RS14	30 14 37.0	53 42 28.7	Serpantenized Peridotite
RS15	30 14 35.5	53 42 28.9	Serpantenized Peridotite
RS16	30 14 36.4	53 42 26.7	Serpantenized Peridotite
RS17	30 14 37.9	53 42 25.7	Red Laterite
RS18	30 14 41.3	53 42 28.5	Limestone
RS19	30 14 42.3	53 42 30.5	Nummulitic Limestone

RS20	30 14 45.3	53 42 32.0	Serpantenized Peridotite
RS21	30 14 45.7	53 42 31.8	Serpantenized Peridotite
RS22	30 14 48.0	53 42 31.8	Contact of Laterite with Serpantine
RS23	30 14 48.2	53 42 32.5	Red Laterite
RS24	30 14 48.3	53 42 35.2	Red Laterite
RS25	30 14 48.3	53 42 35.2	Feroan Silis
RS26	30 14 48.4	53 42 37.3	Red Laterite
RS27	30 14 57.3	53 42 46.6	Yellow Laterite
RS28	30 15 19.9	53 42 47.8	Yellow Laterite
RS29	30 15 19.6	53 42 48.7	Yellow Laterite
RS30	30 15 41.0	53 42 18.8	Yellow Laterite
RS31	30 15 47.5	53 42 50.2	Yellow Laterite
RS32	30 15 50.8	53 42 34.9	Yellow Laterite
RS33	30 15 41.7	53 42 18.5	Yellow Laterite

REMOTE SENSING STUDIES

For remote sensing studies in this research, ASTER images were used. To perform these studies, satellite imagery processing operations at three levels: pre-processing, the main processing and final processing is done. Initially placed under a processing and correction to prepare images for the main processing. Geometric and Radiometric correction of this process are the most common. After initial corrections, the main process was initiated with the aim of detection and enhancement of Koopan Lateritic areas. The methods used in this part of the process is as follows:

- Preparation of spectral reflectance curves
- Preparation of color combinations (Color Composite)
- Principal Components analysis (PCA Method)
- Classification (Classification Method)

Using the above techniques, detection and enhancement of rock units was done and initial maps were prepared then the final processing was done on initial maps that the result of the processing is final maps (Finalized Map), which the following discussion of this section, recent cases are discussed.

PREPARATION OF SPECTRAL REFLECTANCE CURVES

Spectral information usually comes in the analysis of images. Control of each individual pixel values, the evaluation of statistical parameters of an image after a series of processing, view the histogram, and so on, all the topics are spectral data and spectral reflectance diagrams. To view this vector of spectral values, we can create a spectral profile for each pixel array. The spectral profile graph in practice that the horizontal axis is the number of the band and the vertical axis shows the amount of pixels. Profile spectral known in ENVI software called Z profile. Studying spectral reflectance curvesof ASTER According to the harvested points area showed that bands 1,4,5for red laterite and bands 1,2,7 for yellow laterite has The highest percentage of their reflection (Figures 5 and 6) Therefore the use of These bands have the best color combination for the detection of red laterites and yellow from other rock units

Figure5- Red laterite spectral reflectance

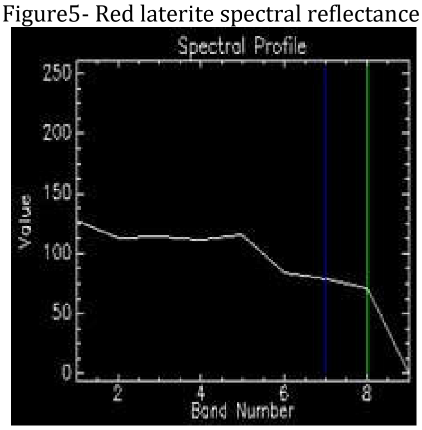
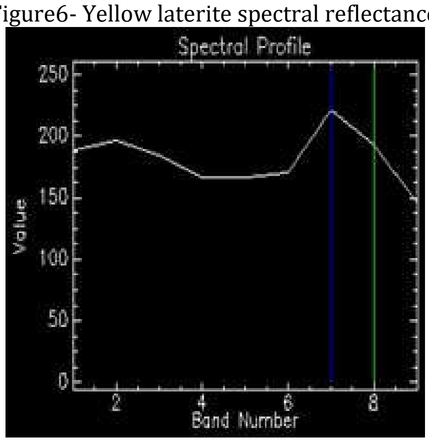


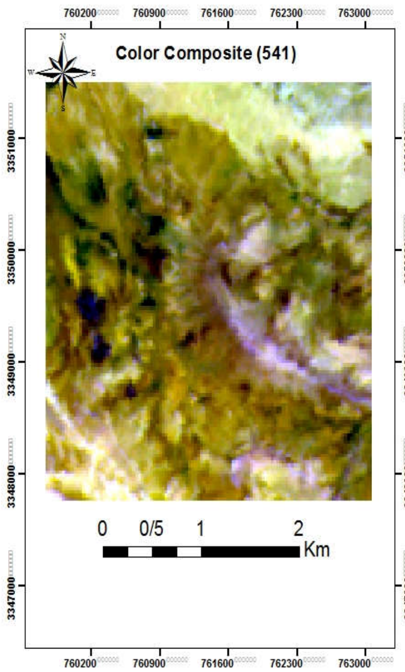
Figure6- Yellow laterite spectral reflectance

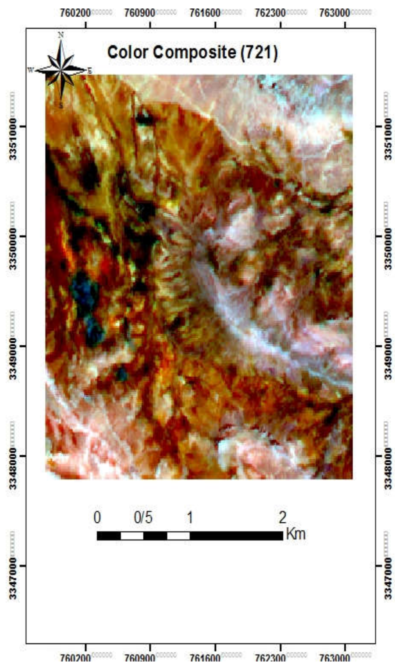


Preparation of color combinations (Color Composite)

ENVI software is capable of displaying images in shades of gray as well as color combinations (Color Composite) there. After opening a file, Available Bands List window appears. There are two options to display images as follows: Gray Scale and Color RGB. The first option is to display a single-band and in shades of gray and Color RGB option to display images in color combinations. According to the spectral reflectance curves (Fig. 5 and 6) the bands have reflecting higher than other bands were used to make Color combinations of red laterite and yellow laterite so RGB = 541 were considered for red laterite and RGB = 721for yellow laterite Fortunately, these compounds were able to make help in the detection of laterites (Figures 7 and 8).). In combination of RGB = 541 red laterite seen to color green and combination of RGB = 721 Yellow laterite to color yellow.

Figure7- 541 compound for detection of red laterite **Fig 8 -** 721 compound for detection yellow laterite

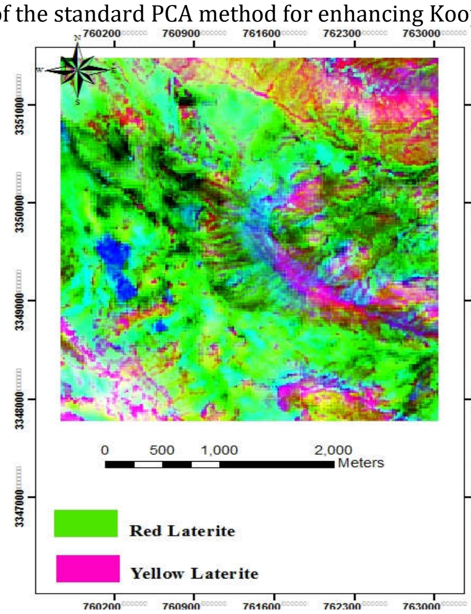




Principal component analysis Method

Principle component analysis method based on calculation of variance, covariance and standard deviation of different bands is done; the way to reduce compliance between different bands of data in multi-dimensional space makes clear a special phenomenon. PCA is a power statistical technique that can be used for image compression and eliminating the unwanted effects (1).Principal component analysis, a statistical technique for summarizing data in multiple bands remote sensing instruments and create images that have low correlation to each other. By looking at the correlation coefficients in data integration method (PCA) was used to assess the results. PCA is done in both standard and optional methods. The standard method that of all the bands used for enhancing rock units and the optional method that only high reflection bands used. Standard method was used in this study (Figure. 9).As a result, red and yellow laterites colors respectively bright green and pink be seen.

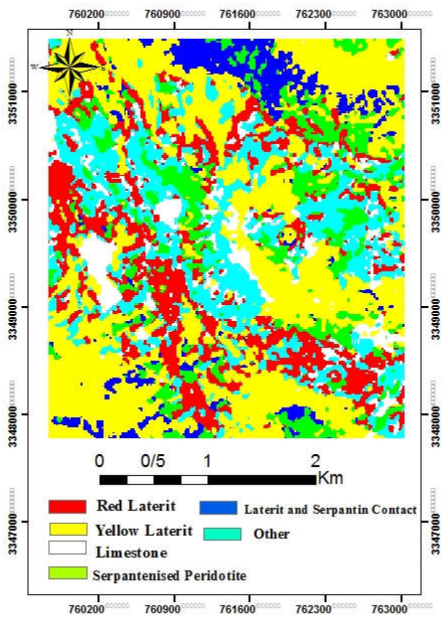
Figure 9 - Image of the standard PCA method for enhancing Koopan regional laterite



Classification Method

Similar spectral sets separation and division of its class that has the same spectral behavior the classification of satellite data said. In other words, the classification of the pixels forming images, assign each pixel to a class or a particular class, the classification of satellite data say. When all pixels in the image to be allocated a certain class, thematic maps obtained. Classification of satellite data in supervised methods and unsupervised split. In supervised classification method chosen number of pixels for sample and specifications those through the computer software used to be the rest of the pixels according to specific instructions that are classified. In this study, supervised classification was used on the standard PCA. First six class was defined for lithological units area then The most similarity algorithm (Maximum Likelihood) is the most widely used algorithms were used (Figure 10) As can be seen using this technique enhancement, red laterites seen to color red and yellow laterites to color yellow which is indicative of the success of this technique.

Figure 10 - Image of supervised classification method for enhancing Koopan regional laterite



Final processing

At this stage before output and Preparation of area map final processing was done. Final processing through filtering 3 * 3 Kernel Size to remove the scattered pixels in the images of the final output was done. Image enhancement according to the regional rocks units after final processing after adding guide, coordinate system, scale and other necessary information became to zoning map of Koopan regional laterites.

DISCUSSION AND CONCLUSION

In this study proved to be based on a combination of field data and remote sensing can be valuable information on how to extend the target rock units and their separation from the other units achieved. The processing on the images of ASTER it is concluded that the spectral reflectance curves in the enhancement of Koopan regional laterites are valuable. According to the spectral reflectance curves, color combinations RGB = 541 contains the maximum amount of information are for the detection of red laterite and RGB = 721 contains the maximum amount of information for the detection of yellow laterite. In these images, the pixels of red laterite to green color and yellow laterite to yellow color appeared. Also using principal component analysis technique (PCA) the standard method was determined that the pixels of red laterite to light green color and yellow laterite to pink color appears. Also in detection of laterites the standard method by using 9 band ASTER Better quality than the optional method for the detection of these units showed. Investigation usual classification methods showed that supervised classification method by using harvested points and most similar algorithm (Maximum Likelihood) had the most successful in detection of the regional lateritic units, in this classification the overall accuracy and Kappa coefficient respectively have been 64.32% and 0.52%.

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