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Ratio Bands of Landsat 8 Satellite Images on the Example of the Central Part of the Bukantau Mountains

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Abstract:

This article presents the results of processing the Landsat-8 multispectral satellite images by the ratiobands method over the territory of the central part of the Bukantaumountains. The revealed color anomalies reflect lithological heterogeneities and zones of mineralization of the territory, which are a sign of endogenous mineralization.

Keywords: Earth remote sensing, ratiobands, multispectral images, divide, float, mineral composition.

Introduction

In modern geology, in prospecting and exploration of mineral deposits, more and more attention is paid to those forecasting and exploration methods that, with low financial costs and the use of small energy resources, provide more reliable information on the studied area. One of these methods in geology is Earth Remote Sensing (ERS).

Remote sensing is a method of obtaining information through space satellites, which photographing a given area under various wavelength spectra from 0.38 to 0.72 µm in the visible, from 0.72 to 1.3 µm in the near, from 1.3 to 3 µm on average, from 7.0 to 15 µm in thermal range give us the information we need. These satellite images are subsequently processed to correctly interpret the information received.

Remote sensing in combination with traditional geological, geophysical and geochemical methods can increase the objectivity of the received geological information about the structure of the earth's crust, structures, geological processes on the earth's surface. The obtained multispectral and panchromatic images allow fast and cost-effective mapping of large areas of the study area. Another advantage of remote sensing is the ability to obtain geological information on the entire surface of the earth, despite the territorial affiliation of a particular state. Multispectral imagery allows you to catalog the various properties of vegetation, rocks and minerals. Thanks to the data obtained, it is possible to assume possible weathering and geological changes in one or another field. So, for example, on the basis of the obtained image spectra, it is possible to determine various clay and oxide minerals.

Methodology of work

Landsat-8 satellite images, nomenclatures LC815803020131669LGN00 and LC81580312013169LGN00 obtained on June 18, 2013 were used to perform the ratios of the satellite images of the central part of the Bukantaumountains (Fig.1).

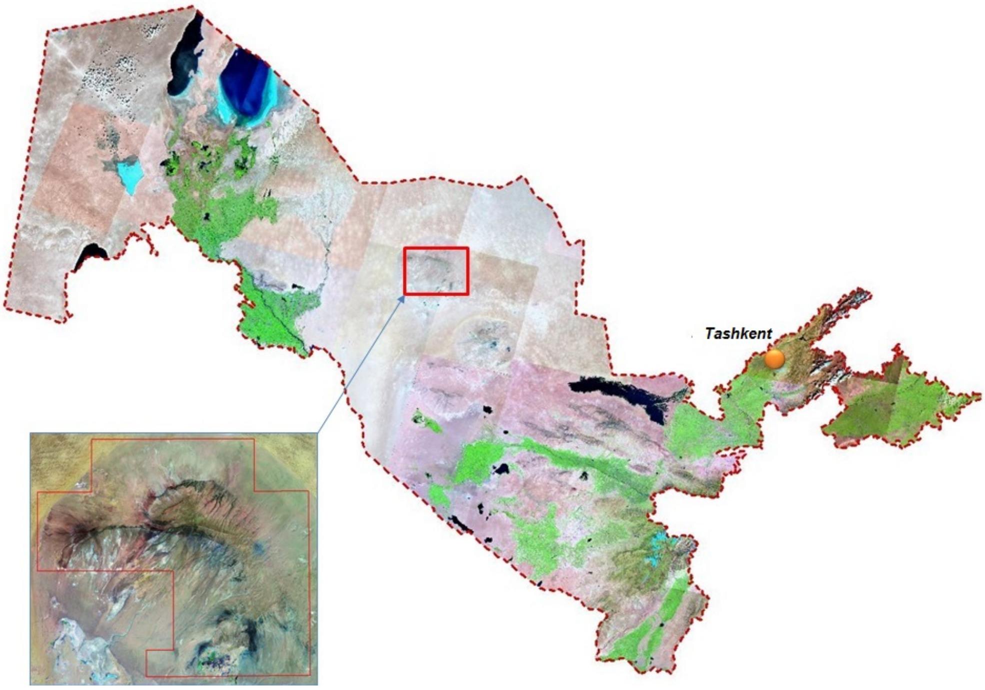

Fig 1. Location of the study area based on the Landsat-7 satellite image

The processing was carried out in the ArcGis 10.5 software. After receiving satellite images, it is necessary to carry out primary processing to improve the characteristics of the image to increase the reliability and objectivity of the information received. The process is based on geometric, radiometric and brightness correction. Geometric correction uses the principles of digital photogrammetry. Radiometric correction is divided into two types:

- distortions caused by the characteristics of the used visualization device;
- distortion due to the angle of incidence of sunlight in relation to the relief (removal of defects in spots and shadows).

Radiometric correction was performed using the (float) function in the ArcGis software to correct radiometric distortions caused by the characteristics of the survey device used.

The next step is the operation of the ratio of channels (Divide). In the process of executing Divide, various combinations of the visible and infrared range are created. This process distinguishes and represents different rocks and associated mineralization zones, through a change and increase in color intensity, through the creation of an additional artificial channel. The Divide function divides the values of two rasters on a pixel-by-pixel basis. (Fig. 2.)

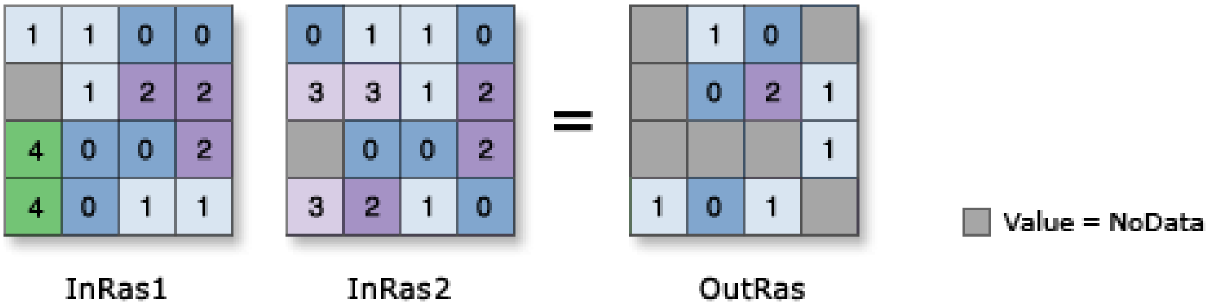

Fig. 2. Divide the values of two rasters" cell-by-cell &quot [2]

The order of the entries is important to this tool. If the value is divisible by 0, the corresponding cell in the output raster will contain the NoData value.

Input data types to determine the type of output data:

If the two input rasters are integers, integer division is performed and the result will be an integer. For example, if 3 needs to be divided by 2, the output is 1. If both input rasters are floating point, the floating point division is performed and the result is a floating point value. For example, if 3 needs to be divided by 2.0, the output is 1.5.

The division was carried out in the following sequence of dividing the 6th channel by 7, the 6th by 4, and the 4th by 2. Then the raster data for individual channels using the Composite Bands function are combined into a multispectral raster dataset and converted into RGB synthesis (Fig. 3.).

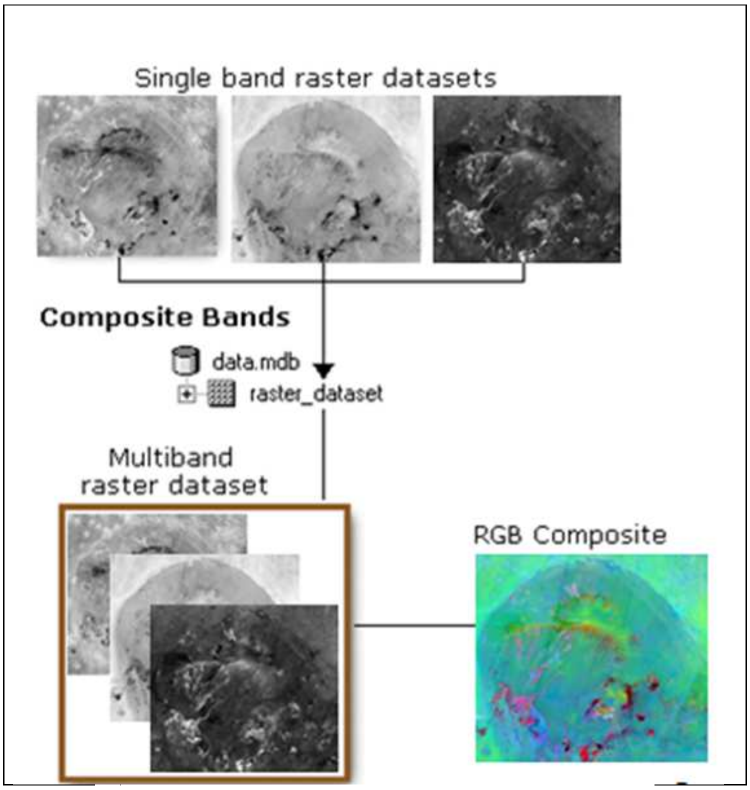

Fig. 3. Illustration of Composite Bands [3]

Figure 4.the results of processing a combination of channels of Landsat-8 satellite images by ratios (Mineral Composition) are presented.

The MinComp method is a method of mineral components, based on a color composition of 3 indices: clay rock index, iron-containing minerals index and iron oxide index. The indices are the result of a mathematical combination of digital values from different source channels of the same image. All indexes are based on absorbent and reflective properties. They are related to the chemical composition of the studied surface. From a geological point of view, these indices determine the difference between different types of rocks.

Results

Based on the results of processing by the Mincomp method, the contours of a promising color anomaly, differing in mineralogical composition, and colored in different colors, were identified.

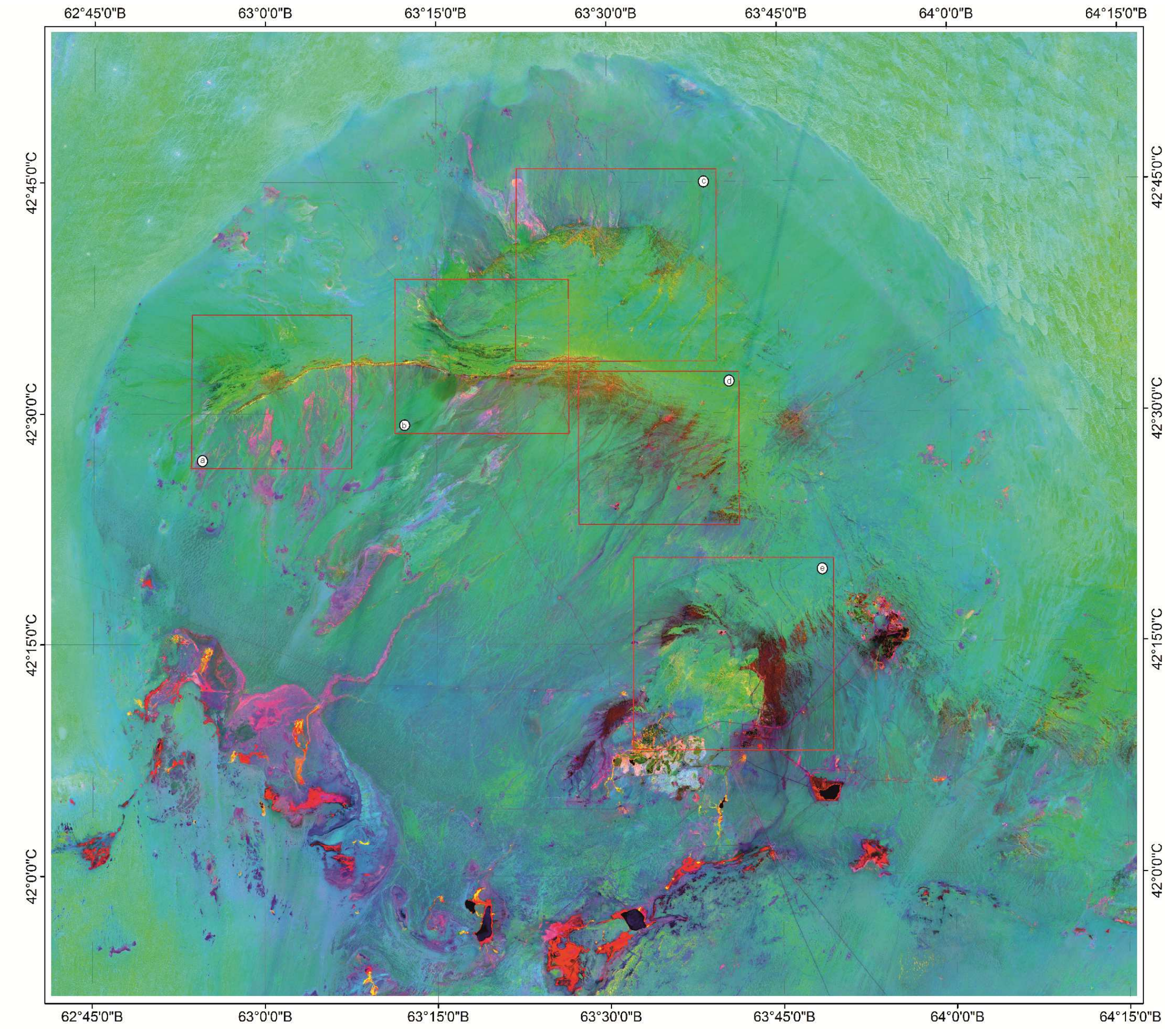

Fig 4 Landsat 8 satellite image in a combination of channels 6/7, 6/4, 4/2 of the Bukantaumountains with highlighted contours of the perspective color anomaly.

According to the approved method of cosmogeological research, an approximate study of the earth's crust from general to specific [1], that is, primary processing is carried out over a common area in regional generalization, from these results zones of color changes are identified (Fig. 5).

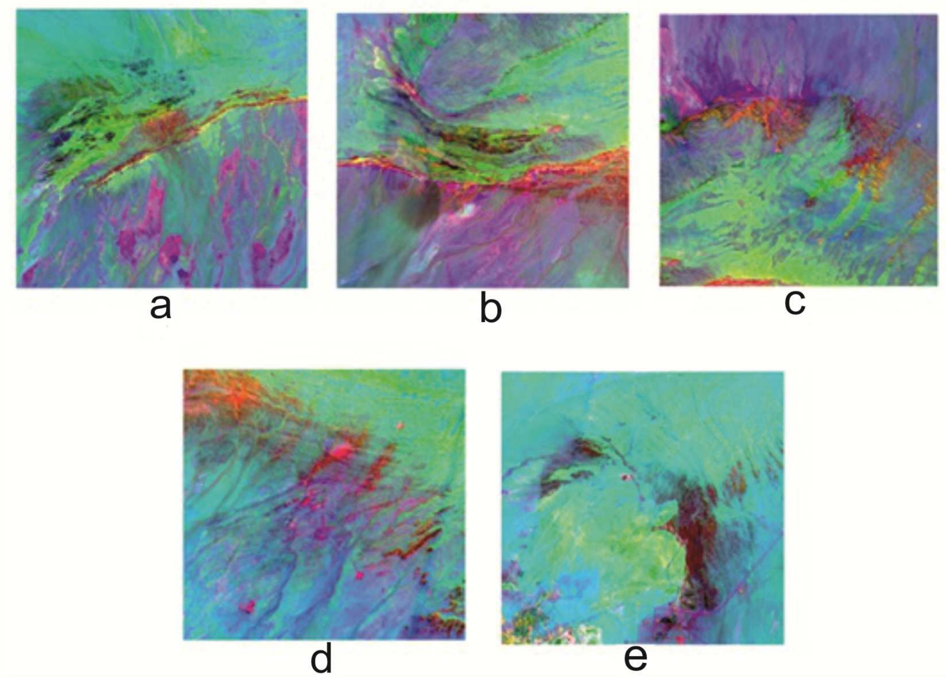

Fig. 5. Highlighted contour of lithological separation of heterogeneities: a-Karamurun deposit; b-Irlir deposit; c- Zhuzkuduk; Mr. Boztau; d-Altyntau intrusion.

In Fig. 5 (a, b, c, d, e) light green and green shades correspond to the upper Carboniferous age, (e) the Altyntau intrusion (granites, adamelites) is marked with a burgundy color, (a, b) yellow shades refer to the Frasnian stage, Oguetau suite, dolomites and limestones, brown and light brown shades - Upper Viseansubstage-lower Serpukhov stage. Dzhuzkuduk Formation. The satellite image shows proluvial (in the form of cones) deposits, which were formed as a result of weathering of stratal deposits along the channel.

The discussion of the results.

For visualization and comparison of our work, we combined the processed satellite image with a geological map made by Aisanov Ya.B. Egorov A.I. R.I. Mansurov 1984 Below we see the coincidence of the separately identified territories with the geological map of Bukantau. With this method, we can distinguish a large number of color anomalies that correspond to lithological heterogeneities. (Fig. 6.)

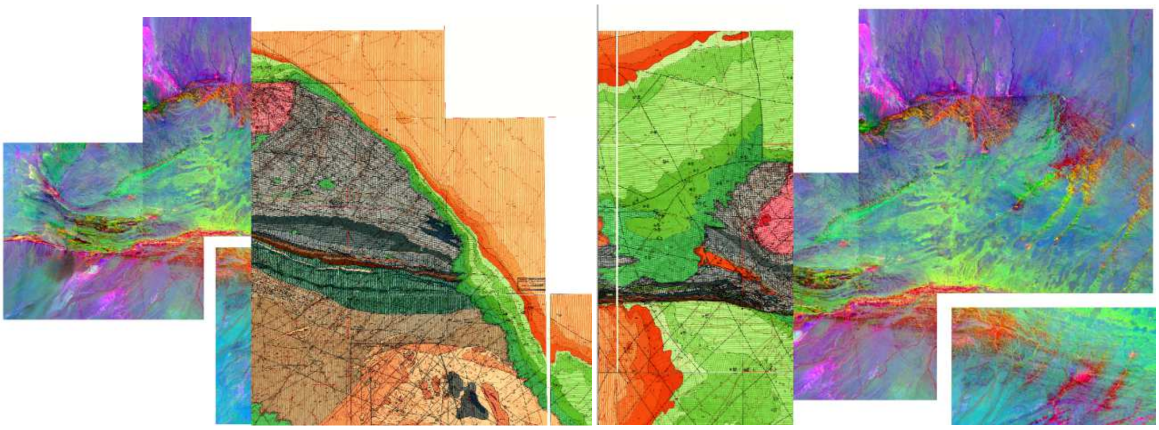

Fig. 6.Combination of the geological map made by AisanovYa.B.Egorov A.I. R.I. Mansurov 1984 with processed satellite image

Landsat 8.

Brief geological structure of the investigated territory explaining the color gamut according to the ratios of satellite imagery channels. In the study area, pre-Mesozoic formations are exposed, complicated by tectonic processes, in the southern part of which there are Cretaceous formations.

Stratigraphically, the pre-Mesozoic complex includes sedimentary, volcanogenic, metamorphic, intrusive Cambrian (?) - Triassic formations of different material composition and genesis, highly variable laterally in the meridional direction. On this basis, in the Caledonian-Variscian complex, different types and subtypes of sections are distinguished, corresponding to the consedimentation structural-formational (landscape-tectonic) paleozones and subzones with varying degrees of completeness of the preserved sections.

In the northwestern and northern parts of the study area, it is represented by the only petrotypically large (about 150 km², 25 x 6.0 km), elongated in the northeastern direction, the homonymous massif - a linear stock, called the Bokalatonalite-trondhjemite complex (C3b). The types of accessory mineralization of the complex are sphene-apatite-magnetite, apatite-sphene, pyrite-apatite. Geochemical specialization - copper, gold, arsenic.

Conclusion

In conclusion, it should be noted that space images have a large amount of information about the upper part of the earth's crust, which, if properly processed and interpreted, can achieve great results in various fields of geological research and thematic mapping. To solve most of the geological problems, it is necessary to use both traditional and modern methods of remote sensing of the Earth. With the help of remote sensing of the Earth, it is possible to carry out a large number of geological tasks, such as mapping lithological heterogeneities, zones of hydrothermal and mineralogical changes, which contribute to the determination of the ore potential of prospecting territories. The introduction of such innovative methods into the cycle of geological forecasting works will significantly reduce time and financial costs.

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