



with International participation

Geological Congress of Turkey

Geology and Geopolitics

May 24-28, 2021 MTA General Directorate Cultural Center/ANKARA

Processing of remote sensing data to determine the location of rare-earth and other mineralizations-a case study: Kuldzhuktau mountains

Akram Bayramovich Goipov, Shokir Islomovich Akhmadov

Introduction

Studies using remote sensing materials contribute to the improvement of existing and the creation of new research methods, the study of geological-tectonic and cosmostructural features of the studied territory, the identification of factors determining the relationship in the localization of endogenous mineralization. The structural features of mineralization localization in individual areas are revealed, and the relationships of cosmostructural objects with the distribution of minerals are studied.

In modern data processing packages, as a rule, there are a large number of algorithms for building maps. The reasonable choice of an algorithm that takes into account the features of the created map allows you to significantly increase the accuracy of forecast maps for a given set of source data.

When searching for mineral deposits, the main objects of decoding in satellite images are lineaments (linear structures or faults) and ring structures. The space-structural forecast maps reflect the information of structural and forecast content, which allows solving the main problems of geological exploration in combination with traditional research methods.

Research methodology

The Kuldzhuktau Mountains in the modern tectonic structure represent the Alpine uplift of the sublatitudinal strike, formed in the core by rocks of the Paleozoic folded basement, and in the wings – by deposits of the Meso-Cenozoic sedimentary cover. The most dense network of lineaments is observed within the Paleozoic basement outcrops, in conditions of open and semi-closed surface, and their rarefaction is noticeable in flat areas. As you move away from the mountains, the clarity decreases and the number of detected structural units decreases sharply [1].

The results of the processing allow us to map all structural units: presented in the geological map of the region, as well as new and proposed discontinuities, zones of regional fracturing of the meridional strike, ring structures, wedge-shaped blocks and other tectonic disturbances, as well as geological and structural complexes.

It is established that all deposits and ore occurrences within the study area are located in fault zones or their intersection, which is associated with structural and tectonic factors.

V. S. Antonov (2001) scientifically and practically proved the existence of an area of anomalies of spectral brightness (according to the data of the specialized processing of the ISS Landsat ETM+) over the Elkon gold-uranium-ore node and anomalies of radio brightness temperatures over the Darasun gold-ore field, according to the NOAA AVHRR space survey. To expand the scientific and practical direction of this industry, satellite images of known deposits and ore occurrences of Mount Kuldzhuktau were analyzed. Although the characteristic of the nature of the manifestation of the anomaly of endogenous mineralization deposits in contrast to the environment is known.

Results

The analysis of the obtained map by processing the infrared range of the satellite image allows us to identify linear changes in thermal anomalies within the known faults and large discontinuities and beyond. The increase in the intensity of thermal anomalies is associated with some band-shaped zones of the sublatitudinal direction, especially within known deposits and ore occurrences. To isolate thermolineaments, linear changes in thermal anomalies are associated with the boundaries of geological outcrops. Different rocks are distinguished by their thermophysical properties. Temperature changes are observed from 35 to 40°C on the surface of the terrain. The main deposits

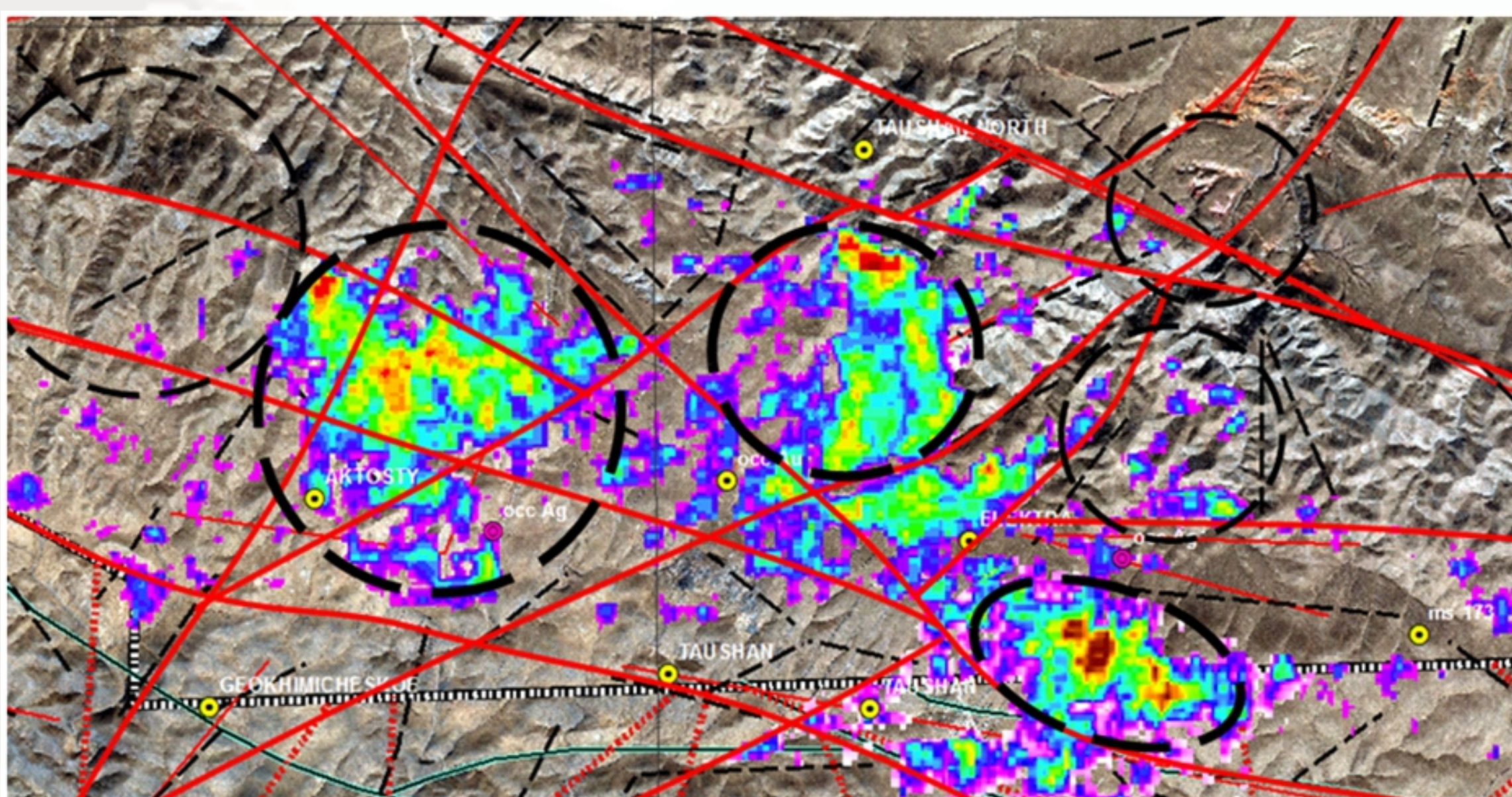


Fig. 1. Highly unreal anomalous zones of spectral brightness within the Taushan field and a number of ore occurrences, according to the spectral signature of the satellite survey (symbols: 1-field and ore occurrence; 2-halos of anomalous zones of spectral brightness; 3-lineaments established according to the data of remote sensing materials processing; 4-thermolineaments; 5-lineaments identified by visual decoding; 6-faults according to geological data; 7-ring structures.

and ore occurrences are located within the temperature range from 37 to 38.5°C. R. H. Fayzulin et al. (1982), according to Ya.B. Asanov et al. (1973), made a tectonic scheme of the central and western parts of the Kuldzhuktau and Kyngyrtau mountains on a scale of 1:200 000. This schematic map shows numerous tectonic elements. The thermolineaments that reflect thermal anomalies on the map are compared with previously known tectonic elements. Several large thermolineaments correspond to the Taushan, North-Sultanbibin uplift and the Taushan, Sultanbibin anticline, South-Sultanbibin syncline. The Central Kuldzhuktau and Shaidaraz faults are clearly displayed on the thermal fields with a difference in the linear temperature change.

The results of processing by these methods made it possible to map all the structural units represented on the geological map on the studied area, as well as to record new and suspected discontinuities, fracture zones, etc. These methods also made it possible to clarify the boundaries of structurally deciphered complexes.

Visual interpretation of the materials of satellite surveys of various ranges on the territory of the central and south-eastern parts of the Kuldzhuktau mountains was carried out, a space-structural scheme was created at a scale of 1:25,000 with the allocation of potentially promising forecast positions. It is necessary to note the faults associated with the Upper Carboniferous phase of folding within the Kuldzhuktau mountain. They are usually located near intensively updated violations of the ancient foundation or branch off from the latter. The vast majority of ore occurrences and gold scattering halos are spatially and probably genetically associated with the discontinuous structures of the Hercynian deposit.

The space-structured schematic map shows linear and ring structures. Thermolineaments are distinguished by the results of the distribution of changes in surface temperatures and the infrared range. The first-order lineaments are distinguished by automated decoding of the digital terrain model, and the second-order lineaments are distinguished by the automated deciphered methods of KIRSCH, ring structures, and assumed linear structures.

Discussion of the results

An important element of the distance basis is the ring structure (CS). They are the geomorphological expression of two-dimensional volumetric cosmotectonic structures formed under the influence of endogenous tectonic processes. Ring structures reflect "hot" points, undiscovered intrusive bodies, explain the uniformity of the structural plan of deposits located within them, and the combination of different sources in the mineralization space, contribute to the study of the zoning of mineralization. It is determined that the ring faults have a mineragenic value. Rare-earth mineralization (in the zone of the Uchkuduk thrust) among the brecciated, silicified and ozhelezny dolomitic limestones of the Lower Sillur is more often located on the centers of multispectral ring structures. Magmatic formations make up about 15% of the area of the Kuldzhuktau Mountains. In quantitative terms, intrusive rocks of the granitoid and gabbroid series strongly predominate among them. Kuldzhuktau gabbroid massif with manifestations of platinum-sulfide mineralization. Перспективны Бельтауский, Шайдаразский, Таушанский и Кийиктауский массивы габбро, габбро-сиенитов с сульфидно-медно-никелевым оруденением "типа Седбери и Норильска". The occurrence of the sulfide copper-nickel-cobalt mineralization of the Kuldzhuktau Mountains is determined by the magmatic liquation enrichment of the gabbroids of the Beltau, Shaidaraz and Taushan massifs. Ultramafic formations are developed in Western Uzbekistan, especially the nickel-bearing peridotite-norite-gabbro in the Kuldzhuktau Mountains [2].

Thus, through the mapping of ring structures, it is possible to use new, cosmostructural, localization criteria for rare-earth and other mineralization in the search and forecast. This should contribute to the purposeful conduct of search operations and forecasting. Zones of probable mineralization and the areal distribution of minerals and elements were determined and studied, and ASTER and LANDSAT-8 satellite images were processed in the Erdas Imagine programs. When determining promising positions, 4 gold mineralization deposits were selected as a reference: Aktosty, Taushan, Adylsay and Kamysti, and the Ayakguzhumda ore occurrence for rare-metal mineralization. The main characteristics of the reference objects are radio-brightness anomalies and the combination of channels in satellite images of the multispectral range, as well as geophysical and geochemical fields, faults and many other factors in the form of additional informative features. In many cases, within the studied area, discontinuous disturbances clearly coincide with the increased halos of the spectral signature of satellite images (Fig.1).

It is known that deposits in the area are confined to linear tectonic-geological objects, expressed on the surface and in the images in the form of extended linear formations (lineaments), fracture zones. Figure 1 shows the area of spectral brightness anomalies and the radio brightness temperature anomaly within the Taushan deposit and a number of ore occurrences.

Conclusion

Ore occurrences of endogenous sulfide copper-nickel-cobalt mineralization were found in the Kuldzhuktau mountains. To identify potentially promising positions of probable endogenous mineralization based on the spectral signature of rocks and minerals, specialized processing of satellite images in the multispectral range was carried out.

It is determined that the ring structures and faults have mineragenic significance, which (in the zone of the Uchkuduk thrust) among the brecciated, silicified and ozhelezny dolomitic limestones of the Lower Sillur are more often located on the centers of multispectral ring structures.

As a result of the work performed with the use of cosmostructural studies, 6 promising positions were identified, four of them – new forecast positions, they can be favorable for endogenous mineralization, they represent a halo of spectral brightness anomalies and an anomaly of radio brightness temperatures above the forecast positions.