International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2021 Vol. 11, pp. 185-191/Shortsman and Nurbek
Research Article

REMOTE SENSING RESEARCHES OF TYUBEGATAN DEPOSIT (SOUTHERN UZBEKISTAN)

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ABSTRACT
This article presents data from remote sensing researches of water influx into potassium salts of Tyubegatan deposit (in integration with geophysical data).

Keywords: *Satellite Images, Tubegatan Deposit, Materials of Remote Sensing (RT), Potash Salt, Geophysics, Fault, Ring Structure, Resistance*

INTRODUCTION.

Tyubegatan potassium salt deposit is located in the Dekhkanabad region of southern Uzbekistan (southwestern spurs of the Gissar range) (Fig. 1). Remote sensing researches on the territory of the deposit were provided in order to clarify the reasons for the water inflow into potassium salts and, as a consequence, their erosion.

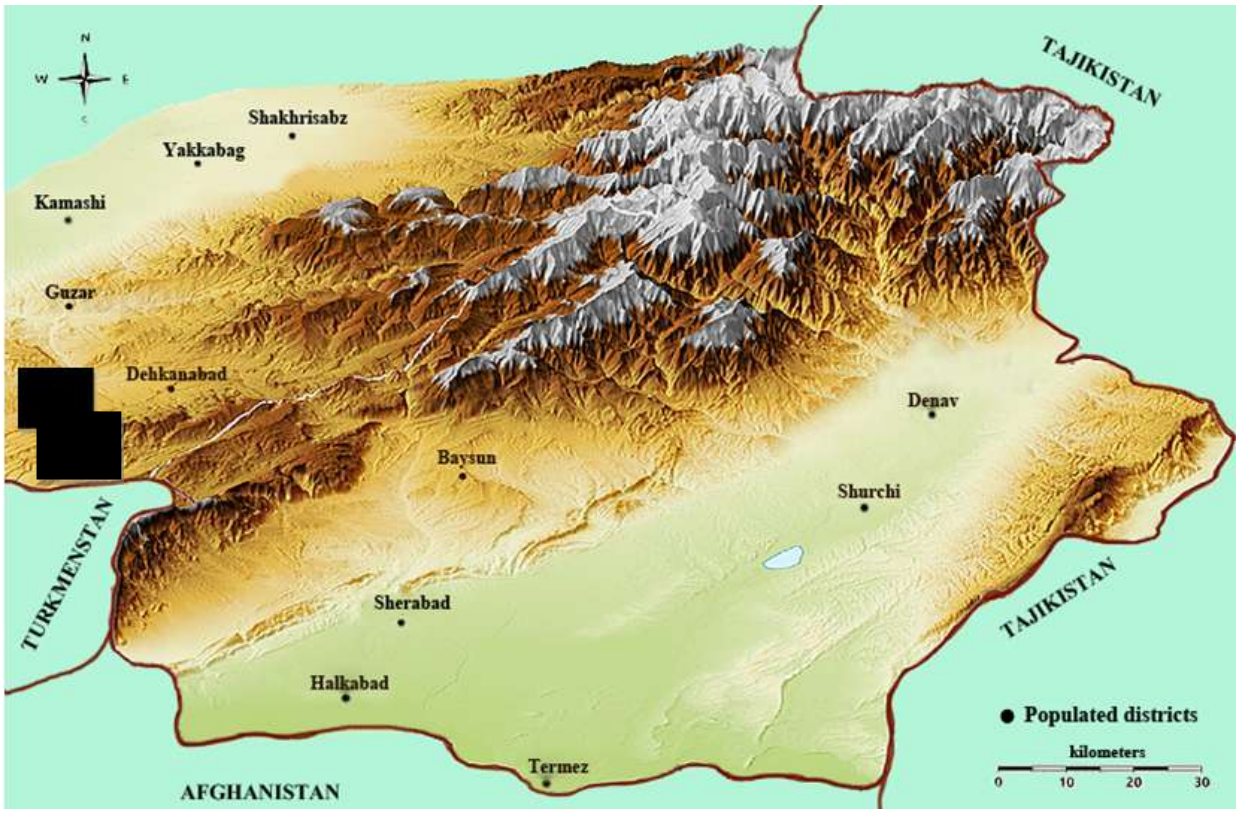

Figure 1: Regional remote sensing geological studies in the territory of Uzbekistan. Black rectangle indicates the situation of study area

MATERIALS AND METHODS

Remote sensing studies were carried out in accordance with the methodological recommendations [1,2] for the implementation of these works in three stages. At the first stage of research in the area of work, geological materials were collected on previously carried out works (including data on previously drilled wells), materials from remote sensing researches and scales were analyzed and prepared. Based on the result of analyzes, multispectral satellite images with additional thematic channels in the RGB system were prepared for geological interpretation (Fig. 2, 3). To map material complexes, the optimal combinations of the R b5 / b1, B b3 / b1, G b5 / b4 channels were used. The received satellite images clearly show the structure of geological strata, the main tectonic, ring and semi-circular structures. An automated decoding of space images was carried out, the analysis of the received signatures and raster images was carried out (*Borisov et al., 1982*).

Based on the results of the analysis, transformed classified vector space images were created with identified structurally interpretable complexes and tectonic structures that have similar mineralogical and geological signs of the same type of rocks on the surface, confirmed by geological interpretation of space images (Fig. 4).

Figure 2: Quick Bird satellite image of the Tyubegatan deposit

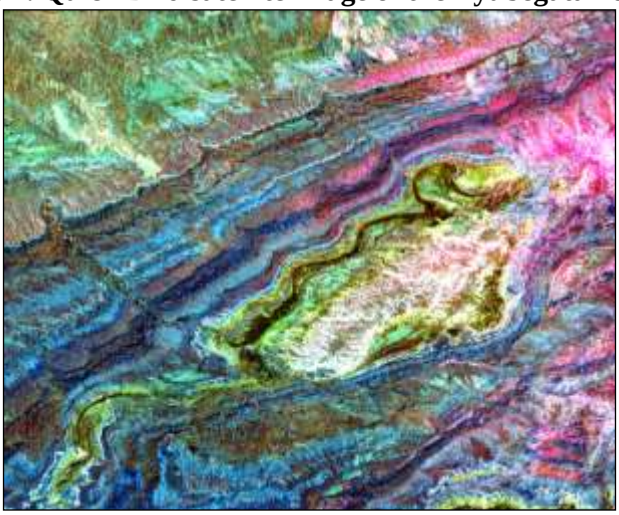

Figure 3: Primarily processed Landsat satellite image in RGB system (channels 4 / 7.3 / 7.2 / 7) of the Tyubegatan deposit.

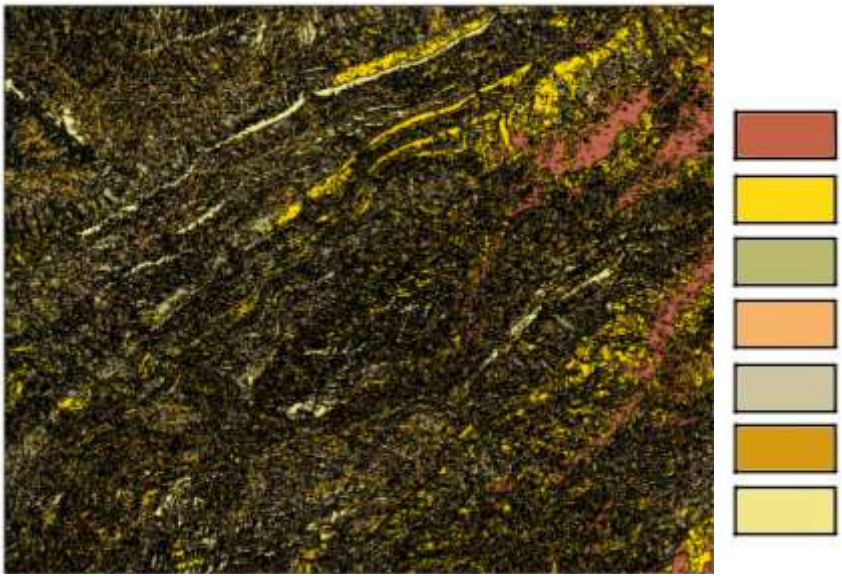

Figure 4: Automated interpretation of the Landsat satellite image by spectral characteristics (7 classes) with the identification of geological strata. Legend bar shows the classes in colors: on top – 1 class, on bottom – 7 class.

The results of automated decryption were used in combination with visual decryption to create the final distance base. In the study area, satellite images were digitally processed using five automated methods: CC (color composition), ACP, Kirsha, ITS and Index IV (*Glukh et al., 2002*).

Digital processing of satellite images by automated methods made it possible to identify the main components of the studied territories, the main formations of rocks, differing in mineralogical composition, different types of rocks regardless of landscape and climatic conditions - metamorphogenic, carbonate and terrigenous types of rocks, structural linearity both in bedrocks and in areas covered by loose formations, which contributes to the mapping of known faults and their tracing in closed areas, as well as the identification of new faults that are not fixed by traditional methods of geological research, the identification of ring and semi-circular structures. As a result of the work, satellite images were created with the identified tectonic and ring structures in the Mesozoic sediments and in areas covered by loose Quaternary formations for their use in interpreting remote sensing materials (Fig. 5).

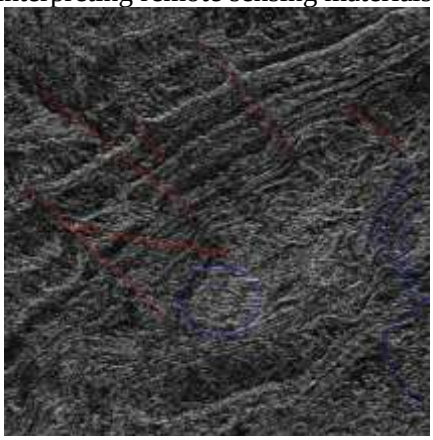

Figure 5. Landsat satellite image for the Tyubegatan deposit, processed by Kirsch method with the identified main linear and ring structures. Red lines indicate faults, blue – ring structures (according to A.R. Asadov).

At the second stage of remote sensing research, preliminary decoding of the space imagery materials from Aster and Quik Bird was carried out using software products for processing these data, such as ArcGIS 9.2, ENVI 4.7, Global Mapper, etc. Second stage includes the following:

-decoding of structural and tectonic elements using modern software products;

-creation of a preliminary version of the sensing scheme;

-decoding of large-scale structural and tectonic elements using the results of geological and geophysical studies.

In geological decoding of the study area, it is important to combine the results of various types of processing of satellite images. In the integration of all digital processing, an important role is played by the calculation and construction of a 3D surface of the relief based on the radar image, on which the tectonics of the area is displayed. Processing of Landsat satellite images contributed to the increase in structural information content. Preliminary remote bases - sensing schemes of decoding of large and medium scales have been created (*Shortsman, 2013*).

On the area of the Tyubegatan deposit and adjacent territories, medium-scale remote sensing materials were interpreted to reveal the general picture of the geological structure of this deposit. When interpreting remote sensing materials, special attention was paid to the tectonic structures of the study area, which can be the cause of water inflow directly into the deposit and, as a consequence, washout of the minerals. Based on the results of decoding, the main structural elements of the study area were identified - ruptured faults, structurally decoding complexes. The main tectonic structures of a regional scale have a northeastern and sub-altitudinal strike and are traced to the southwest and further to the territory of the Republic of Turkmenistan. Fold structures (anticlines and synclines) also occur on the territory of this country. In the process of the formation of folded structures, the development of conjugate ruptured faults of a different order took place. Based on the results of geological interpretation, preliminary remote bases of large and medium scales were created.

RESULTS

The third stage of research is the resultant one. Intermediate versions of the maps were collected in the final cosmogeological scheme. The integration of the results of remote sensing studies with geological and geophysical data into a single digital sensing scheme has been compiled. According to the results of large-scale interpretation, it was revealed that the central part of the study area is highly complicated by tectonic faults of various orders and directions. Basically, the strike of faults is northeastern and sublatitudinal, which affect water production in the deposit.

Figure 6: Identification of tectonic structures in the field

At the third stage of remote sensing studies, field verification work was carried out on the results of preliminary interpretation of space survey materials over the area of the field and adjacent territories in order to establish the geological nature of the identified structures and their effect on water production directly at the deposit.

During the field work, faults were traced, nodes of intersection of tectonic structures of different directions, inter-fault zones of crushing, folded structures, etc., identified during the geological interpretation of space materials for the field (Fig. 6, 7), the spatial location of sensing objects in space images and on the schemes of visual and automated decryption. Particular attention was paid to the springs reaching the surface of the day (Fig. 10), wells (depths of water mirrors in wells), which are located at different altitude horizons and affect the water influx into potash salts.

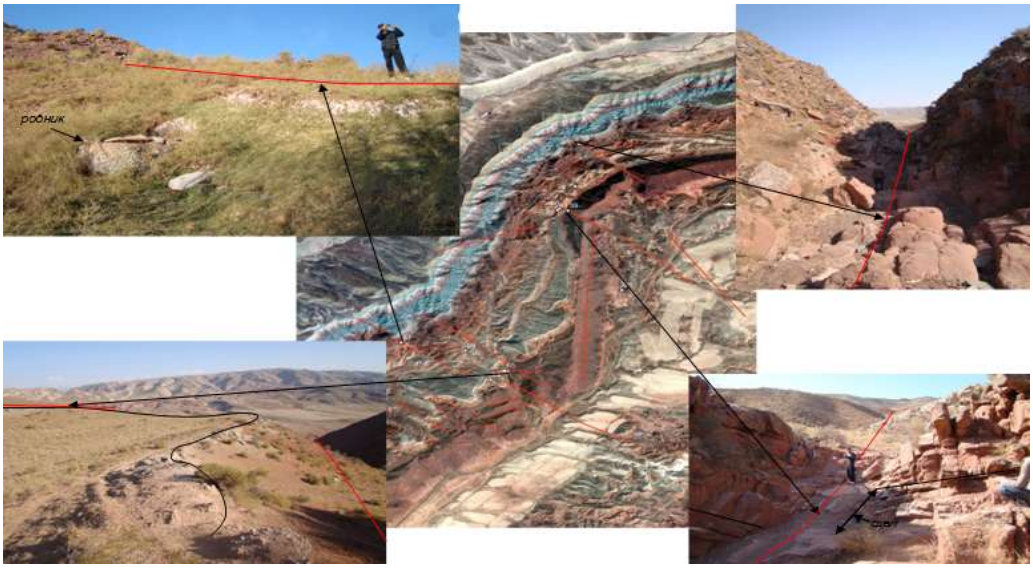

Figure 7: Comparing of identified faults in the field with Quick Bird space imagery.

A large-scale tectonic fault density map was constructed [6], on which faults of a lower order are observed: their density in the area of the potash salt deposit is quite high - areas with a high density of tectonic disturbance in the Tyubegatan potassium salts (Fig. 8).

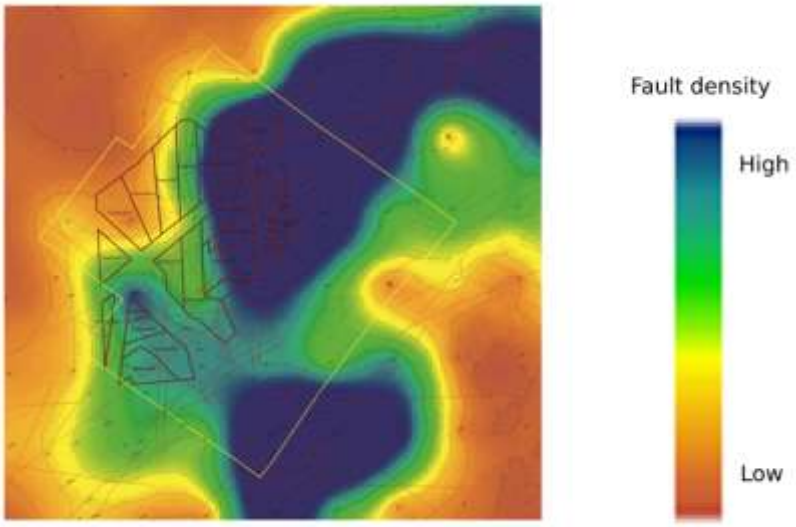

Figure 8: Tectonic faults density of Tyubegatan deposit

During geophysical studies, specialists of the State Enterprise "Central GGE" identified zones of low resistivity on the territory of the deposit, which explains the increased moisture content of the rocks. When comparing the density map of tectonic disturbance with the geophysical map for the Tyubegatan deposit with the identified zones of low resistivity, it was revealed that zones of low resistivity are manifested in more highly tectonized rock strata (Fig. 9).

Figure 9: Resistivity map with revealed low resistivity zones of Tyubegatan deposit (Makarov, 2014).

As a result, a large-scale remote sensing base was created for the central part of the field with geophysical data on the water cut of territories, tectonic structures, identified by geological-geophysical research methods (*Shortsman et al., 2020*).

CONCLUSION

Water influx into potassium salts is observed in intensely tectonized rocks identified by cosmogeological studies (according to the data of previously drilled wells, the fault zones were opened in the depth intervals of 532-577 m) and along the contours of resistivity (ρ=0-15 om/m). The contour of the identified water-saturated zone, according to geophysical data, also coincides with the area of increased moisture content identified by remote sensing studies, which increases their reliability.

In intensely tectonized rocks, sedimentary moisture seeps into deep layers, their accumulation in underground reservoirs, and under favorable conditions, moisture penetrates through cracks and cleats into layers of potassium salts in the form of water inflow. In this regard, it is recommended to investigate the main direction of the fault cleavage on the territory of the field, which will provide information on the direction of water seepage into the deep horizons.

According to the data of remote sensing studies, areas with the lowest density of tectonic disturbances are recommended for conducting geophysical studies, detailed geological prospecting and hydrogeological works in order to clarify the tectonics of the area and the presence of aquifers, both for promising potash salts.

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