REVIEW

of the national scientific consultant Marina A. Mizernaya on the doctoral dissertation of **Yertay Talgatovich Eskaliyev**, PhD candidate of D. Serikbayev East Kazakhstan Technical University

Dissertation title: "Methodology for Prospecting Gold-Bearing Deposits Using Modern Satellite Technologies: A Case Study of the West Kalba Gold Belt"

Educational program: 8D07201 – Geology and Exploration of Mineral Deposits

The present dissertation was carried out by the doctoral candidate during his PhD studies in the EP **8D07201 – Geology and Exploration of Mineral Deposits** at the Non-Profit Joint-Stock Company D. Serikbayev East Kazakhstan Technical University.

The dissertation is devoted to the development of a remote sensing–based methodology for gold exploration in the West Kalba gold belt (Eastern Kazakhstan), aimed at mapping hydrothermal alteration halos and delineating prospective zones.

The dissertation addresses the pressing scientific and practical problem of forecasting gold ore deposits in Western Kalba based on Earth remote sensing data.

In the course of the research, the author formulated and solved the following objectives:

1) Identify and justify a set of key indicators of hydrothermal alteration in the gold-ore systems of the West Kalba gold belt that reflect the staged nature of ore formation and are suitable for interpreting Earth remote sensing data; then assess their diagnostic value and limitations for prospective delineation of promising gold-ore sites.;

2) Build a mineral targeting framework that maps alteration minerals and diagnostic absorbers using regional geological sources and reference laboratory spectra.

3) Develop a reproducible processing pipeline for ASTER multispectral data, including alignment, NDVI masking, band ratios, false color composite generation, and multi-scene mosaicking.

4) Validate alteration mapping results using independent object-based comparison and hyperspectral EnMAP spectra where coverage is available.

5) Produce regional alteration composites and identify prospective zones for follow-up work.

The dissertation is based on materials from previous geological mapping, geophysical, prospecting, and exploration works conducted within the West Kalba metallogenic zone, as well as on the results of research projects funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan, in which the doctoral candidate participated directly. A substantial body of recent published scientific literature was also used.

The dissertation substantiates the theoretical foundations and develops a methodological approach to the application of remote sensing in geological research, with a focus on hydrothermal alteration mapping and mineral exploration. The material is presented in a logical and consistent manner, ranging from the physical principles of electromagnetic radiation and spectral properties of geological materials to data processing methods, spectral transformations, and validation techniques. The final part of the work is devoted to confirming spectral signatures using hyperspectral data, providing a reliable basis for applying the proposed methodology to gold-bearing systems of Eastern Kalba.

The dissertation consists of six scientifically grounded and logically interconnected chapters that fully correspond to the stated objectives and comprehensively substantiate the defended research statements.

The author has substantiated a set of key hydrothermal alteration types that form diagnostic spectral signatures and reflect the stage-wise evolution and spatial architecture of ore-forming systems.

It is demonstrated that the zonal structure of hydrothermal alteration halos identified from ASTER multispectral data enables effective delineation of prospective gold-bearing areas at the regional scale.

The reliability of the obtained results is confirmed by spatial correlation with known gold deposits and by hyperspectral validation using EnMAP data.

The results obtained in the dissertation are relevant, scientifically novel, and of practical significance, and they can be applied in regional geological exploration programs. The dissertation was completed independently and represents a fully accomplished, high-level scientific study.

Scientific and practical recommendations for further geological exploration, developed during the course of the research, have been implemented in the production activities of **LLP "GEOSAT"**, and an official act confirming implementation in the educational process is available.

A major strength of the dissertation is its high scientific merit and practical value, which lies in the development of a remote sensing–based methodology for the preliminary forecasting of new prospective gold-bearing objects within the West Kalba metallogenic zone.

Based on the presented scientific results and their significance, the dissertation of **Y.T. Eskaliyev** constitutes a complete and independent scientific work, meets the requirements of the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, and is recommended for defense.

The author of the dissertation, **Yertay Talgatovich Eskaliyev**, deserves to be awarded the degree of **Doctor of Philosophy (PhD)** in the EP **8D07201 – Geology and Exploration of Mineral Deposits**.

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