REVIEW

of the national scientific consultant Marzhan Ye. Rakhymberdina on the doctoral dissertation of **Yeskaliyev Yertay Talgatovich,** PhD candidate of D. Serikbayev East Kazakhstan Technical University

Dissertation title: «Methodology for prospecting of gold-bearing deposits using modern satellite technologies, case study of the West Kalba gold belt»
Educational program: 8D07201 «Geology and Exploration of Mineral Deposits»

This dissertation research was carried out by the doctoral candidate during PhD studies under the educational program **8D07201 «Geology and Exploration of Mineral Deposits»** at D. Serikbayev East Kazakhstan Technical University.

The dissertation is devoted to the application of Earth remote sensing methods and geological/structural analysis for forecasting and prospecting of gold mineralization within the West Kalba gold belt (Eastern Kazakhstan). The study examines spatial regularities of hydrothermal alteration footprints, their relationship to the geological setting and known manifestations of gold mineralization, and substantiates exploration criteria by integrating satellite-derived products with geological information.

The author substantiates a geology driven set of alteration indicators for West Kalba gold systems and implements a multi scene workflow using multispectral ASTER data. The methodology applies consistent preprocessing and spectral transformations, including band ratios and diagnostic indices in the VNIR and SWIR ranges, to generate mineral based maps highlighting key alteration related mineral groups. The mapped patterns are interpreted in relation to structural controls and known mineralization, and are supported by reference spectra and mineralogical rationale, including signatures related to Al OH and Mg Fe OH bearing minerals, carbonates, and ferric iron minerals that commonly accompany gold mineralization. An important strength of the dissertation is validation. The results are tested through spatial correspondence with known deposits and exploration footprints. Where coverage overlap is available, hyperspectral EnMAP data are used for additional spectral confirmation, strengthening mineral interpretation confidence with higher spectral resolution of 224 frequency bands and reducing uncertainty in target delineation.

The dissertation consists of six interconnected chapters that are logically structured and aligned with the stated objectives. The initial chapters provide the regional geological context of the West Kalba belt and review relevant prior research. The methodology chapter describes the processing workflow and product generation in detail. The final chapters present the alteration mapping results, their validation using independent information sources, and the delineation of prospective target zones, followed by discussion of their practical implications for exploration planning.

The methodological basis of the study relies on the integrated use of geological information and satellite-based spectral interpretation. The author employed analysis and synthesis of published materials on regional geology, structure, and metallogeny; multi-scene satellite data processing to generate comparable products across the full study area; spectral analysis, index calculations, and false-color composites to identify hydrothermal alteration signatures; spatial correspondence assessment with known mineralization objects and exploration areas; delineate prospective zones; and independent checking of interpretations using additional available datasets, including spectral confirmation within areas of overlap with hyperspectral observations.

The results obtained in the dissertation are relevant, scientifically novel, and practically significant. The work demonstrates a high level of independence, methodological consistency, and completeness. The generated mapping products and the proposed approach can be used for rapid regional screening and preliminary prioritization of prospective zones, and can provide a

defensible basis for planning subsequent exploration stages, including detailed mapping, sampling, and field traverses.

The scientific novelty of the dissertation lies in developing and substantiating an integrated approach to identifying and interpreting hydrothermal alteration zones through a geology-driven mineral targeting framework, combined with a reproducible multi-scene processing methodology that produces comparable merged products and a two-level validation strategy. The practical value of the study is associated with the applicability of the workflow and maps for accelerated regional screening, reduced uncertainty in target selection, and improved efficiency of field work over large territories under limited resources.

The dissertation of represents a complete piece of scientific work in terms of its results and scientific/practical significance, meets the requirements of the Committee, and is recommended for defense.

The author of the dissertation **Yertay Talgatovich Yeskaliyev**, deserves to be awarded the degree of **Doctor of Philosophy (PhD)** under the educational program **8D07201 «Geology and Exploration of Mineral Deposits»**.

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