

To Whom It May Concern:

The conclusion of the scientific supervisor on the PhD thesis titled:

“Creation of a GIS database of rare-metal deposits of the Kalba-Narym metallogenic belt”

The PhD thesis presented by **Yerkebulan Bekishev** addresses relevant scientific and applied problems related to the systematization, analysis, and digital representation of geological information on rare-metal deposits of the Kalba–Narym metallogenic belt. The research focuses on the development of a geoinformation database that integrates geological, geophysical, geochemical, and remote sensing data within a unified digital environment.

The work includes the creation of a structured GIS database intended for the storage, visualization, and analysis of spatial geological information. The developed system enables the integration of heterogeneous datasets and provides an effective tool for mineral resource studies and geological exploration.

A significant part of the research is devoted to lithological mapping based on remote sensing data. The author applied modern satellite imagery processing techniques to identify lithological units and geological structures within the study area. In addition, machine learning methods were used to detect pegmatite veins, which are closely associated with rare-metal mineralization. The application of these approaches significantly improves the efficiency and reliability of geological interpretation based on satellite data.

Yerkebulan Bekishev has shown strong analytical thinking, diligence, and the ability to independently solve complex scientific problems.

The defending statements presented in the dissertation clearly reflect the scientific novelty of the research. The obtained results are scientifically substantiated and have practical significance for geological mapping, mineral prospecting, and the development of digital geological information systems.

The PhD dissertation of **Yerkebulan Bekishev**, in terms of the relevance of the research objectives, the scientific novelty of the results obtained, and their practical significance, represents a substantial and well-completed scientific study. The author deserves to be awarded the degree of



Doctor of Philosophy (PhD) in the educational program 8D07201 – Geology and Exploration of Mineral Deposits.

Therefore, the dissertation may be recommended for submission to the evaluation committee and, upon a positive assessment, to the scientific council for the final defense.

Foreign scientific supervisor

A handwritten signature in black ink, appearing to read "E. Levin", is positioned above the printed name.

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