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Intelligent search technology for Jiaodong gold mines based on large models and GraphRAG

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Abstract

The Jiaodong gold deposit is a major concentration area of gold resources in eastern China, characterized by complex geological information and an extensive knowledge system. Traditional information retrieval methods struggle to meet the advanced demands of semantic understanding and knowledge reasoning in mineral exploration. To enhance geological knowledge service efficiency, this study develops an intelligent question-answering system for the Jiaodong gold deposit domain based on GraphRAG (Graph-enhanced Retrieval-Augmented Generation) technology. The research utilizes academic papers from CNKI as the corpus, employs OCR and large language models (LLMs) for text parsing and semantic standardization to establish an ontological knowledge system covering core concepts such as mineralization types, ore-controlling structures, and mineral assemblages. The system uses prompt engineering-driven LLMs to automatically extract entities and relationships, constructing a structured knowledge graph integrated into Neo4j. Furthermore, by combining semantic embedding with community clustering algorithms, a knowledge indexing network enables natural language question answering, semantic query expansion, and knowledge provenance. Evaluation results

demonstrate the system's superiority over traditional RAG and general models (e.g., ChatGPT-4o) in answer accuracy, contextual precision, and knowledge interpretability, exhibiting enhanced professional adaptability and reasoning capabilities. The findings provide a novel technical pathway for intelligent information services in gold deposits and theoretical support for knowledge of graph-enhanced language models in geoscience knowledge management. © 2025, Science Frontiers editorial department. All rights reserved.

Author keywords

Graph RAG; Jiaodong gold deposit; knowledge graph; knowledge question answering; large language mode

Indexed keywords

Engineering controlled terms

Clustering algorithms; Economic geology; Gold mines; Information retrieval; Knowledge graph; Knowledge organization; Mineral exploration; Ontology; Query processing; Question answering; Search engines; Semantic Web; Semantics

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