Driving Innovation in Mine Closure Monitoring through Automation and an Integrated Digital Knowledge Base

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# ABSTRACT

Effective mine closure monitoring is crucial for environmental protection, regulatory compliance, and long-term stability of post-mining landscapes. Current techniques and approaches, while robust, often lack integration and automation, leading to inefficiencies and missed opportunities for proactive management. This paper explores how a geospatial digital knowledge base can transform mine closure monitoring by integrating diverse datasets, automating analysis, and providing actionable insights.

The proposed approach includes the automatic ingestion, processing, and visualization of airborne lidar or drone photogrammetry-derived change detection data to identify surface deformation and erosion patterns. Coupling this with satellite-based InSAR data, mine design information, risk assessments, and geological models enhances understanding of site conditions and adherence to closure criteria. Additionally, satellite imagery for vegetation monitoring offers a cost-effective method to assess ecological health and recovery.

Integrating real-time instrumentation data, such as piezometers, shape acceleration arrays, soil moisture sensors, tensiometers, and flow meters alongside climate data, provides a dynamic view of site conditions, enabling early detection of potential risks. Summary dashboards consolidate these datasets and compare them against closure criteria, streamlining reporting processes and facilitating regulatory compliance. Finally, access to historical site information through the knowledge base accelerates root cause analysis in the event of anomalies or failures, saving time and resources while improving decision-making.

This paper highlights the application of innovative monitoring approaches by showcasing how various mine sites and sectors, such as linear infrastructure and community emergency response, utilize these datasets and the Cambio platform. By leveraging the Cambio platform, complex earth science data can be transformed into actionable insights, enabling better decision-making and risk management. For mine closure, this approach provides a holistic, proactive, and cost-effective solution for long-term site management.