Research aims to prevent deadly environmental disasters involving mine waste

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New research will help mining companies better understand the negative societal and environmental impacts of mine-waste disasters, known as tailings flows, and hopefully avoid them.

Researchers created a database as part of a study that presents the first global picture of the occurrence rates, behaviors and physical impacts of tailings flows, which are rapid downstream movements of mine waste following failures of tailings dams.

The study, led by the University of Waterloo, involves researchers in three provinces and reports detailed information on 63 tailings flows that

have occurred worldwide since 1928. Catastrophic tailings flows have happened once every two to three years on average since 1965, causing death, long-lasting environmental contamination and severe infrastructure damage over distances that can span tens of kilometers. Hazardous weather and inadequate drainage systems have been the most frequent triggers for tailings flow since 1996.

"Despite the strict engineering requirements, tailings dams can fail, sometimes catastrophically, so our research raises awareness of the potential downstream effects for public safety purposes," said Nahyan Rana, a Ph.D. student of earth and environmental sciences at Waterloo, and lead researcher on this project. "This study is especially relevant when we consider the global rise in mining activity."

The database will help mining engineers compare the conditions before previous incidents to those of existing sites. The researchers used satellite imagery to map dozens of cases of tailings flow and make the case to support more assessments of these dams.

By analyzing the satellite imagery and historical data, the researchers found that the behavior of tailings flows primarily depends on a high ratio of water to solids in the tailings and the nature of the downstream terrain. Having excess stored water increases the fluidity of released tailings.

Some tailings flows have attained maximum speeds of 100 kilometers per hour when traveling along semi-dry, narrow channels. The result is mass casualties and the destruction of communities and the natural environment. Some tailings flows have occurred along active rivers, leading to slower speeds but longer travel distances exceeding 10 kilometers. Tailings flows on near-flat terrains have traveled shorter distances but caused widespread flooding with maximum speeds of 22 to 50 kilometers per hour.

"Since 2014, there have been three high-profile events—two in Brazil and one right here in Canada," said Stephen Evans, a professor of geological engineering and co-author of this study. "While much progress has been made in terms of regulation and oversight, studying past tailings flows enables better prediction of what could happen should a major tailings dam failure occur."

The study, Catastrophic mass flows resulting from tailings impoundment failures, was recently published in the journal Engineering Geology. The database, A Comprehensive Global Database of Tailings Flows, can be accessed through Scholars Portal Dataverse.

More information: Nahyan M. Rana et al, Catastrophic mass flows resulting from tailings impoundment failures, *Engineering Geology* (2021). DOI: 10.1016/j.enggeo.2021.106262

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