Mineralogical and geochemical characteristics of tailings and waste rocks from a gold mine in northeastern Thailand

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Extended Abstract

Gold mining activities have raised several environmental and health concerns in the local communities in northeastern Thailand. Despite a long history of gold mining activities, there is still a lack of thorough investigation of mining wastes and their potential to produce acid mine drainage (AMD). The study area located in Wang Saphung, Loei province is covered by Permian Pha Dua Formation including siltstone, sandstone and intruded by Triassic granodiorite (Figure 1). Massive sulfide rocks are found; therefore, they may generate AMD. The AMD, which usually contains a high amount of hazardous materials such as arsenic, lead, zinc, cadmium and cyanide, is a serious threat to water resources and natural habitat. This study thus aims to characterize the mineralogy and geochemistry of tailings and waste rocks from the gold mine in northeastern Thailand by using advanced analytical techniques (EPMA, XRF and ICP-MS). The total digestion method using mixed acid of HF-HClO4-HNO3 was applied for ICP-MS analysis.

The tailing storage facility contains upper gray tailings (top) and lower ocher tailings (bottom) (Figure 2). The upper gray tailings mainly contain sulfide minerals (40%), particularly pyrrhotite, pyrite and chalcopyrite, and silicate minerals. In contrast, the lower ocher tailings mainly contain goethite, quartz, chlorite, muscovite, calcite, hematite and some pyrrhotite, with a high concentration of arsenic, copper, and lead. Based on acid/base accounting (ABA) method, the upper gray tailings can be categorized as potentially acid forming (PAF) whereas the lower ocher tailings are classified as non-acid forming (NAF). In addition, precious metal-barren rocks or waste rocks are investigated and can be characterized into sandstone, siltstone, gossan, skarn, skarn-sulfide, massive sulfide, diorite, and limestone/marble. Gossan rocks contain a great amount of toxic elements such as arsenic (334–810 mg/kg), copper (500–7500 mg/kg), and zinc (45–350 mg/kg) while massive sulfide and skarn-sulfide rocks contain a large volume of sulfide minerals, particularly pyrrhotite, pyrite, arsenopyrite, and chalcopyrite.

Both the upper gray tailings and the massive sulfide/skarn-sulfide rocks contain substantial volumes of sulfide minerals and potentially are the most relevant source of the AMD development. The lower ocher tailings and gossan waste rocks contain similar toxic elements, which can leak into the environment and lead to contamination problems.

To prevent the contamination, a proper storage of tailings and waste rocks is necessary and recommended for managing mining wastes. The dumping sites of waste rocks and the tailing storage that contain sulfide minerals should also be covered with compacted clay and soil layers during the mine closure process.

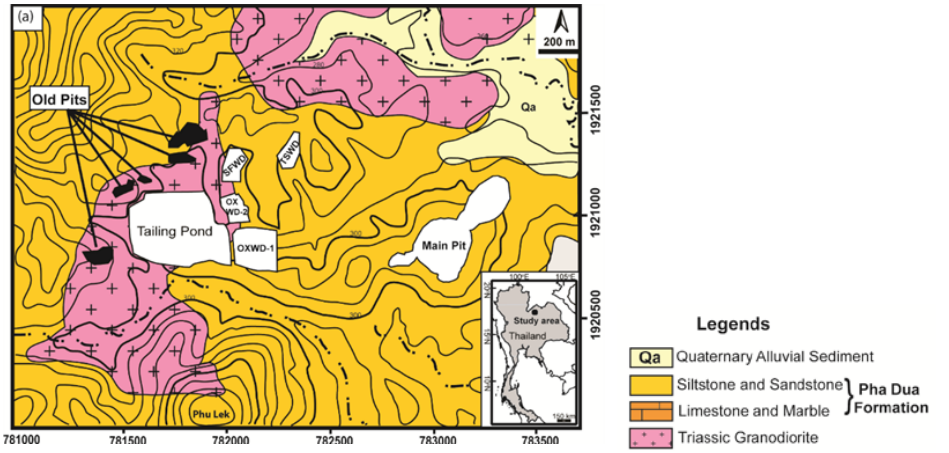

Figure 1 *Geological map of the study area in northeastern Thailand modified from Rodmanee (2000) and Assawincharoenkij et al.. (2017).*

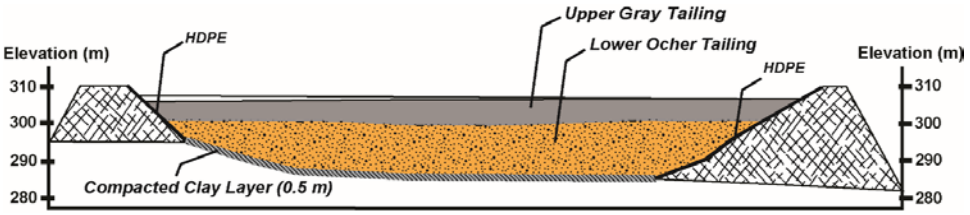

Figure 2 *Cross section showing the outline of tailing pond (Assawincharoenkij et al.. 2017).*

Keywords Tailing, Waste rock, Gold mine, Toxic element, Acid mine drainage

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