

ACID DRAINAGE FROM SULPHIDIC MINE WASTES: COMPARING CONTINENTAL CLIMATE MAINLAND AND TROPICAL CLIMATE SEA DEPOSITION SETTINGS

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Acid mine drainage (AMD) generation has always been abreast during mining activities and even after the deposition of the waste products. In general, it occurs upon oxidation of sulphide-rich materials (e.g., rocks, coarse- or fine-grained waste) producing sulphuric acid and dissolved iron along with other heavy metals. The series of chemical reactions in the oxidation process of sulphides are moderately exothermic which are characterized by high concentrations of oxygen, high temperature, low pH and bacterial activity (VILA *et al.*, 2008). Thus, the difference in these factors will directly influence the rate of AMD generation.

Following these theories, the AMD generation can greatly vary in different depositional environments. Examples of such cases are the AMD generation in the Calancan mine tailings causeway (CMC), Marinduque in the Philippines, a tropical monsoon climate sea deposition setting (Am, BECK *et al.*, 2018) and the Bányabérc waste dump in Hungary, a humid continental climate mainland deposition setting (Dfa, BECK *et al.*, 2018). The climate conditions of the two depositional environments greatly differ in such as the amount of average annual precipitation (965–4064 mm and 750 mm), average annual temperature (26.6 °C and 9.7 °C), seasonal cycle (2 vs. 4 seasons) and weather disturbances (Philippines are prone to tropical typhoon). Even the method of deposition differs greatly: sea deposition setting tends to maintain a reduced environment more than the mainland dumping.

This study focuses on the comparison of acid mine drainage generation in different depositional environments (tropical monsoon climate sea deposition and humid continental climate mainland settings). The samples collected in CMC were analyzed using mineralogical methods, then compared to the secondary data in the Bányabérc waste dump.

Macroscopic observation of Calancan mine tailings causeway (CMC) identified active oxidation visible only in the redeposited materials (tombolo) from the original 1990 causeway. The yellow precipitate, an oxidation indication is only found in patches ranging from 6 m² to 1400 m² and exclusive to the upper 1 cm surface of the materials. This is different from the Bányabérc waste dump in Hungary, where there was wide evidence of active oxidation and deposited materials were characterized by a layer of yellow, brown and red precipitates (FARKAS *et al.*, 2009). The level of alteration in CMC differs in depth and location of the

materials while at the Bányabérc waste dump it varied only in depth. This indicates that the change in deposition setting of the material in CMC causes the formation of secondary minerals. The range and rate of alteration could be the result of difference in agitation settings and intrusion of sea water in most part of the causeway, inhibiting the formation of weathering products and/or dissolution of already formed precipitates.

Laboratory analysis (stereomicroscopy, XRD, SEM+EDX, Raman spectroscopy) of the samples from the two study areas shows alteration of the original sulphide minerals (e.g., pyrite). Secondary minerals such as jarosite and iron oxyhydroxides are identified in both depositional settings. The jarosite found in both study areas have composition mostly in K-H₃O jarosite solid-solution series. The substitution of H₃O⁺ suggests progressive oxidation process (FARKAS *et al.*, 2009), which should be taken into careful account since it is less stable compared to abundant and less soluble K end-member jarosite (the first to precipitate). The absence of Na-substitution in CMC, at least occasionally intruded by the (Na-rich) sea water, could be explained by the significantly lower solubility of the K end member, or alternatively, by the fact that in the Na⁺-rich seawater itself, the presence of Cl⁻ inhibits the precipitation of Na-jarosite (BASCIANO & PETERSON, 2008).

This study will help us to better understand the AMD generation in the two different depositional settings and how the prevailing environmental conditions influence the formation of secondary minerals.

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