A laboratory study of pyrite oxidation in acid sulfate soils

ABSTRACT

Acid sulfate soils cover an estimated 13 million hectares (ha) worldwide, the largest concentration (6.7 million ha) being in the coastal lowlands of Southeast Asia. In Malaysia, they occur mainly along the coastal plains of Peninsular Malaysia and Sarawak. Soils that have been drained are characterized by very low pH and high amounts of exchangeable aluminum (Al), both resulting from the oxidation of pyrite. This article explains the transformation of pyrite when pyrite-bearing sediments present in acid sulfate soils undergo weathering. Soil samples containing pyrite from Cg-horizons of selected acid sulfate soils in Peninsular Malaysia were incubated in the laboratory. Some samples were treated with peat, superphosphate, calcium silicate, or dolomite so as to reduce the oxidation of pyrite. Some were left unamended as a control. Changes in pyrite morphology were studied by scanning electron microscopy-energy dispersive x-ray (SEM-EDX). At the end of incubation period, water-soluble metals were determined. Pyrite in the unoxidized state has iron (Fe) to sulfur (S) ratio of 1:2, indicating the absence of heavy metal contamination in the pyrite structure. This suggests that when pyrite dissolves, there is little risk of pollution with respect to heavy metals. Pyrite dissolved quickly to form jarosite as its disintegration proceeded. The amounts of aluminum and iron in the water-soluble form were large, possibly reaching plant and aquatic life toxic levels. The application of superphosphate slowed down pyrite oxidation.

Keyword: Acid sulfate soil; Jarosite; Oxidation; Pyrite