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Assessing and Managing the Risk of Inland Acid Sulfate Soil Drainage via Column Leach Tests and 1D Modelling: A Case Study from South East Australia

Authors : Nicolaas Unland, John Webb

Abstract : The acidification and mobilisation of metals during the oxidation of acid sulfate soils exposed during lake bed drying is an increasingly common phenomenon under climate scenarios with reduced rainfall. In order to assess the risk of generating high concentrations of acidity and dissolved metals, chromium suite analysis are fundamental, but sometimes limited in characterising the potential risks they pose. This study combines such fundamental test work, along with incubation tests and 1D modelling to investigate the risks associated with the drying of Third Reedy Lake in South East Australia. Core samples were collected from a variable depth of 0.5 m below the lake bed, at 19 locations across the lake's footprint, using a boat platform. Samples were subjected to a chromium suite of analysis, including titratable actual acidity, chromium reducible sulfur and acid neutralising capacity. Concentrations of reduced sulfur up to 0.08 %S and net acidities up to 0.15 %S indicate that acid sulfate soils have formed on the lake bed during permanent inundation over the last century. A further sub-set of samples were prepared in 7 columns and subject to accelerated heating, drying and wetting over a period of 64 days in laboratory. Results from the incubation trial indicate that while pyrite oxidation proceeded, minimal change to soil pH or the acidity of leachate occurred, suggesting that the internal buffering capacity of lake bed sediments was sufficient to neutralise a large proportion of the acidity produced. A 1D mass balance model was developed to assess potential changes in lake water quality during drying based on the results of chromium suite and incubation tests. Results from the above test work and modelling suggest that acid sulfate soils pose a moderate to low risk to the Third Reedy Lake system. Further, the risks can be effectively managed during the initial stages of lake drying via flushing with available mildly alkaline water. The study finds that while test work such as chromium suite analysis are fundamental in characterizing acid sulfate soil environments, they can the overestimate risks associated with the soils. Subsequent incubation test work may more accurately characterise such soils and lead to better-informed management strategies.

Keywords : acid sulfate soil, incubation, management, model, risk
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