Acidity and geochemistry of coarse-grained acid sulfate soil materials in western Finland

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Discharge from fine-grained acid sulfate (a.s.) soils with total sulfur > 0.2% is commonly associated with acidic metal-rich runoff, with metal-loads exceeding the Finnish mining environments and the combined Finnish industry. These soils currently pose one of the largest threats to water-bodies in the coastal areas of Finland and it is estimated that over one-third of the coastal waters are negatively affected by a.s. soil runoff. It has previously been considered that a.s. soils in Finland were limited to fine-grained soil materials, capable of producing large amounts of acidity and a low pH (< 4.0) if oxidized. Recently it has been found, that some coarse-grained materials ($d_{50\%}$>63µm) also display severe drops in pH upon oxidation in laboratory conditions. These materials are attractive for sand and gravel excavation which, in some cases, result in sand-pit lakes and discharge with unusually low pH-values (c. 3.5) and high metal concentrations, which may pose a threat to the groundwater and drinking water supplies.

In the current study we show that even though the acidity and sulfur content (0.01–0.1%) is low, the coarse-grained soil materials are still capable of lowering the pH below 4.0 (values as low as 2.0 have previously been recorded) upon oxidation, due to poor buffering capacity. The titratable incubation acidity of the soil samples correlate directly with the sulfur content, which suggest that sulfide oxidation is the main cause for the acidity. The origin of the sulfides is not clear, but it is suggested that they have formed in situ, due to reduction of sulfate in the beach sand deposits.