



## Classification of Finnish and Swedish acid sulfate soil materials

Anton Boman (1), Gustav Sohlenius (2), Stefan Mattbäck (1,3), Marina Becher (2), Pauliina Liwata-Kenttälä (1), Christian Öhrling (2), Jaakko Auri (1), and Peter Edén (4)

(1) Geological Survey of Finland (first name.last name@gtk.fi), (2) Geological Survey of Sweden, Uppsala, Sweden (first name.last name@sgu.se), (3) Åbo Akademi University, Åbo, Finland (stefan.mattback@abo.fi), (4) Retired from the Geological Survey of Finland (peter.eden@netikka.fi)

In Finland, nationwide mapping of acid sulfate soils (ASS) has been done since 2009 by the Geological Survey of Finland (GTK). In Sweden, regional ASS mapping has been done since 2012 by the Geological Survey of Sweden (SGU). GTK and SGU have collaborated in two EU-funded projects in order to unify the methods for classification, characterization and mapping of ASS. The definitions, diagnostic criteria and terminology for ASS set by the International Acid Sulfate Soils Working Group in 2008 have been adopted for ASS in Finland and Sweden, however with some minor modifications for characterization of hypersulfidic materials in organic soil materials and introduction of new diagnostic criteria and terminology for soil materials that are close to being classified as ASS materials but which are not completely fulfilling the diagnostic criteria. When applicable, the ASS materials are also classified according to the most recent version of the World Reference Base for Soil Resources (WRB).

ASS are in Finland and Sweden defined as soils, sediments (incl. glacial till) and organic materials (e.g. peat) containing hypersulfidic materials which upon natural oxidation in the field or during incubation in the laboratory form sulfuric acid that lowers soil-pH to <4.0 for mineral soil materials or <3.0 for organic soil materials. Because organic acids can lower soil-pH to around 3.5–4.0, we have chosen to use a lower pH-limit for organic soil materials in order to distinguish between acidity formed from sulfide oxidation and that originating from organic acids.

An important issue to consider during classification of ASS is how to handle soil materials where the pH due to sulfide oxidation drops considerably (e.g.  $\geq 1$  pH unit) during incubation, or during field conditions, to values close to, but not triggering, the diagnostic criteria for classification as ASS. With current international classification systems such soils are considered non-ASS even though the possible environmental impact, e.g. release of acidity and metals due to sulfide oxidation, can potentially be very high. Mapping of ASS in Finland and Sweden have shown that areas with this type of soils can be quite large. We have therefore introduced the prefix “pseudo” (i.e. pseudo acid sulfate soil), which here can be described as “close to” or “almost”, in order to describe a soil not fulfilling the ASS criteria but which may have a considerable environmental impact due to sulfide oxidation.

In order to enable classification of pseudo ASS, we have also introduced the terms “pseudo sulfuric material” and “pseudo hypersulfidic material”. Pseudo sulfuric material is used only for mineral soil materials and is characterized by a pH of 4.0–4.5 in the oxidised horizon. This material is important in Finnish and Swedish soils as they often contain soluble aluminium that leach out from the soil, occasionally causing severe problems for fish in recipient waters, at pH-levels around 4.5. Pseudo hypersulfidic materials display a pH-drop of  $\geq 1$  unit to values between 4.0–4.5 and 3.0–3.5, in mineral and organic soil materials, respectively.