Classification of Finnish and Swedish acid sulfate soil materials

Photography encouraged

Background

The definitions, diagnostic criteria and terminology for acid sulfate soils (ASS) set by the International Acid Sulfate Soils Working Group in 2008 have been adopted for ASS in Finland and Sweden. However, minor modifications for characterization of sulfuric and hyper- and hyposulfidic materials in organic soil materials have been made. Also, the prefix "pseudo" is introduced for describing soil materials not fulfilling the ASS criteria but which may have a considerable environmental impact due to sulfide oxidation.

Definition and criteria of acid sulfate soils

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.

A lower pH limit for organic materials is used in order to distinguish between acidity formed from sulfide oxidation and that originating from organic acids.

In order to classify as an acid sulfate soil the soil need to contain:

- Sulfuric material and/or
- Hypersulfidic material

or

- Pseudo-sulfuric material together with hypersulfidic material

Diagnostic acid sulfate soil materials

Sulfidic material (same def.):

- ≥ 0.01% sulfidic S.

Hyposulfidic material (mod. def.):

- Sulfidic material where pH during incubation does not drop to < 4 in mineral soil materials and < 3 in organic soil materials.

Hypersulfidic material (mod. def.):

- Sulfidic material where pH during incubation drops with ≥ 0.5 pH-units to <4 in mineral soil materials and < 3 in organic soil materials.

Pseudo-hypersulfidic material (new term):

- Sulfidic material where pH during incubation drops with ≥ 1.0 pH-units to 4 - 4.5 for mineral soil materials and to 3-3.5 for organic soil materials.

Monosulfidic material (same def.):

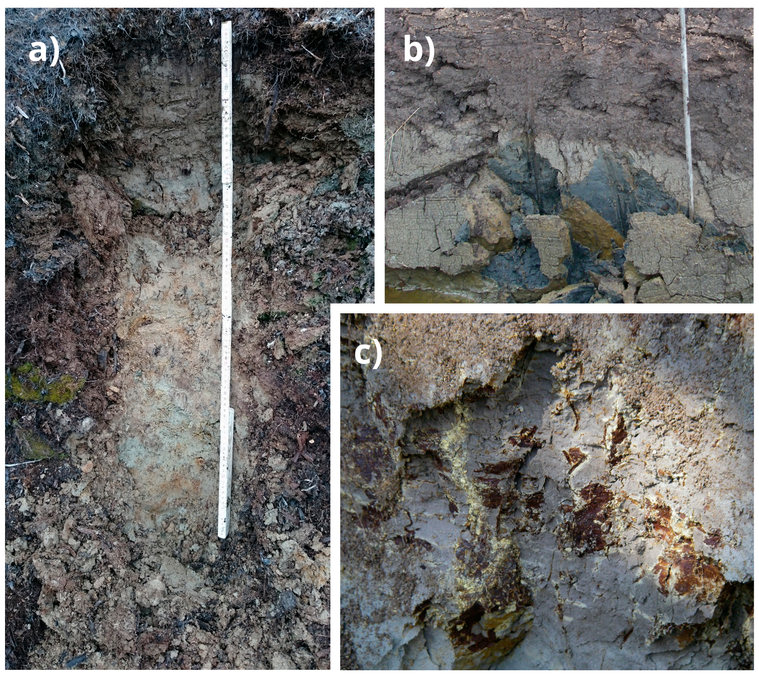
- ≥ 0.01% acid volatile sulfide (AVS).
- Also hypo- and hypermonosulfidic material is possible.

Sulfuric material (mod. def.):

- pH < 4 in mineral soil materials and < 3 in organic soil materials.

Pseudo-sulfuric material (new term):

- pH 4-4.5 in mineral soil materials. Due to Al toxicity! (Not for organic soil materials).
- 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.



Figs. 1 a-c. a) Hyposulfidic peat covering sulfuric glacial till, b) hypersulfidic peat covering hypersulfidic gyttja-bearing massive silt, c) jarosite in sulfuric gyttja-bearing silt (oxidized).

Fig. 2. Typical hyposulfidic clay/silt material with monosulfidic bands. Often classified as pseudo-hypersulfidic material.

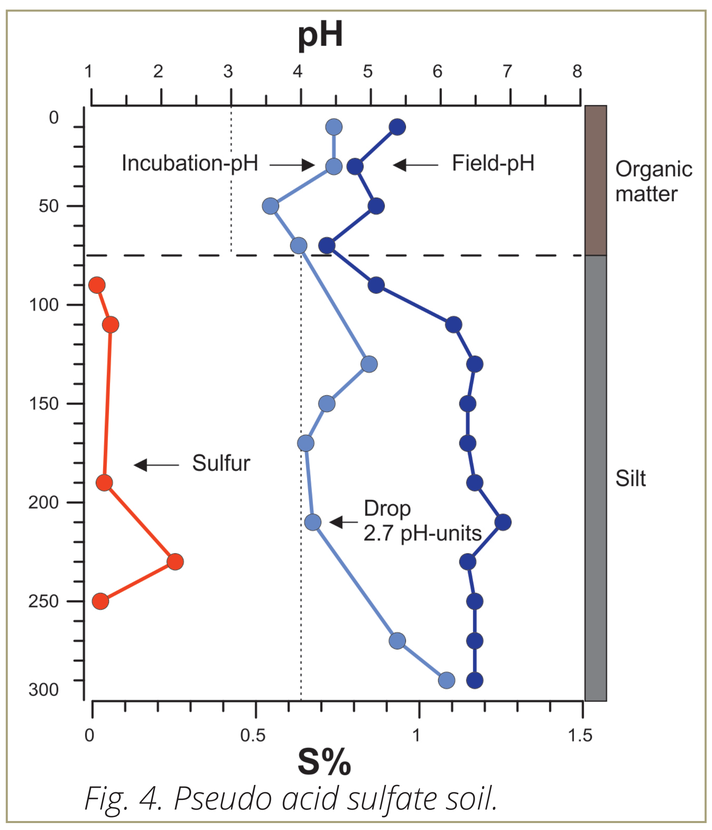


Fig. 4. Pseudo acid sulfate soil.

a) Hypersulfidic sand (right), upper part (left) oxidized.

b) Weakly stratified gyttja-bearing hypermonosulfidic silt.

c) Stratified gyttja-bearing hypersulfidic silt.

d) Gyttja-bearing hypersulfidic silt on top (left) with an erosional contact and a thin sandy layer. Massive gray pseudo-hypersulfidic clay with black monosulfidic bands (right).

e) Sharp erosional contact between gyttja-bearing hypersulfidic silt (left) and grey massive hyposulfidic clay.

f) Massive bluish gray, often pseudo-hypersulfidic, clay with black monosulfidic bands.

Figs. 3 a-f. Examples of various types of sulfidic materials commonly found in Finnish and Swedish acid sulfate soils.

Active and potential acid sulfate soils

- If the soil contain sulfuric and/or pseudo-sulfuric material ontop of hypersulfidic material the soil is considered an "active" acid sulfate soil.
- If the soil contain soley sulfuric material without an underlying hypersulfidic material the soil is still considered an "active" acid sulfate soil.
- If the soil contain only hypersulfidic material, the soil is considered a "potential" acid sulfate soil.

Pseudo acid sulfate soil

- A soil containing solely pseudo-sulfuric and/or pseudo-hypersulfidic material is not classified as an ASS, instead the prefix "pseudo" can be used, i.e. pseudo acid sulfate soil.

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European Regional Development Fund

Geological Survey of Finland

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

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

SGU
Sveriges geologiska undersökning
Geological Survey of Sweden

GTK
gtk.fi

Layout: Viena Arvola