

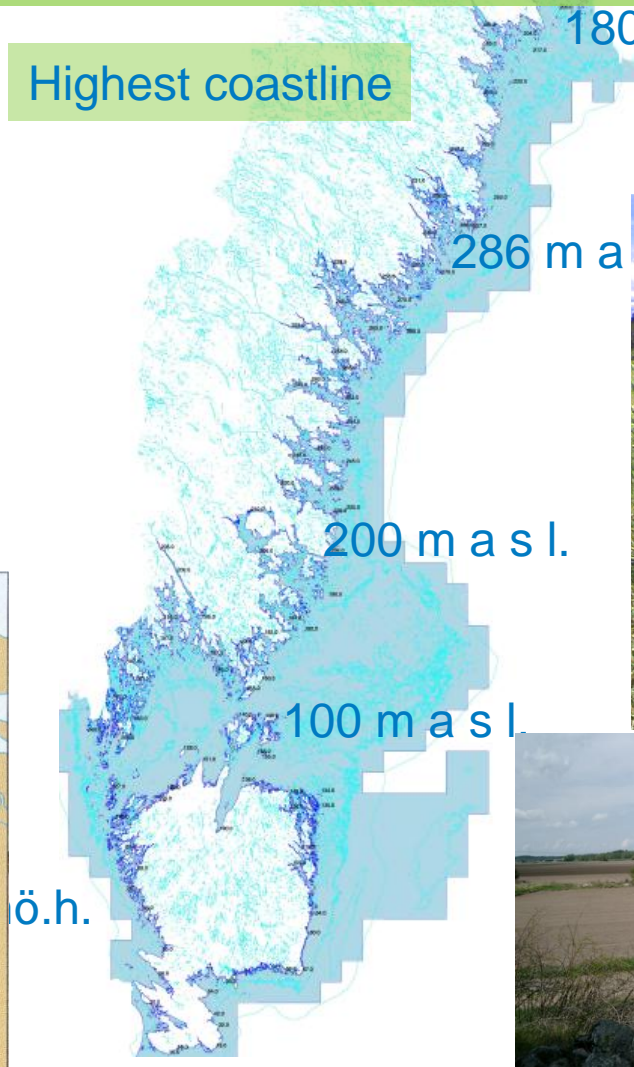
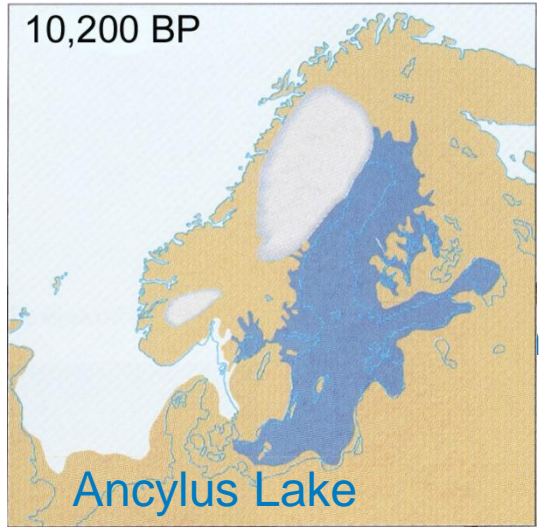
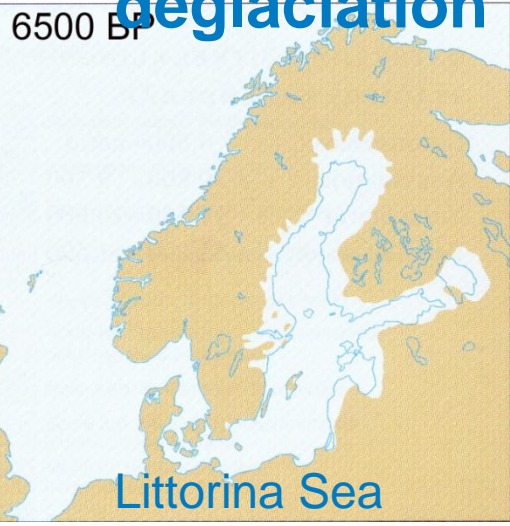
Sulfidic sediments and acid sulfate soils in Sweden

Gustav Sohlenius, Kaj Lax, Lena Persson,
Merdad Bastani, Nelly Aroka, Hanna Wåhlén &
Jo Uhlbäck

Geological Survey of Sweden



Most sulfidic sediments are found in area that haven been covered by brackish/saline water after the latest deglaciation



Depositional environments for sulfidic sediments

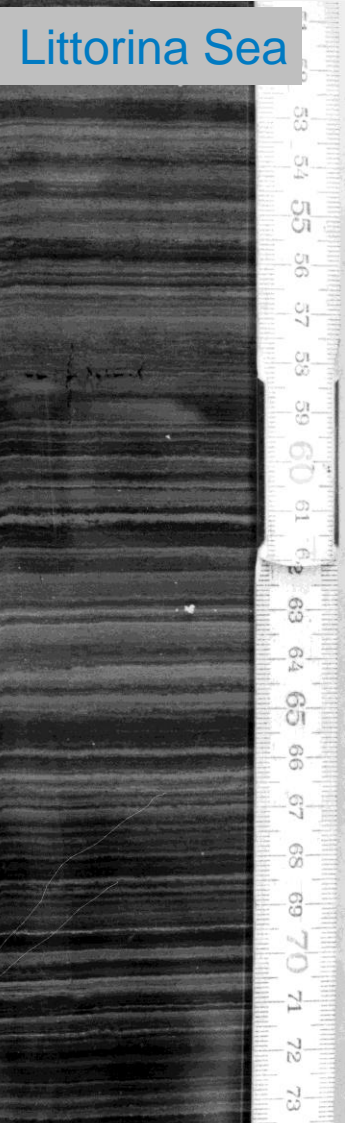


Shallow sheltered bays



The deepest parts of the Baltic Sea

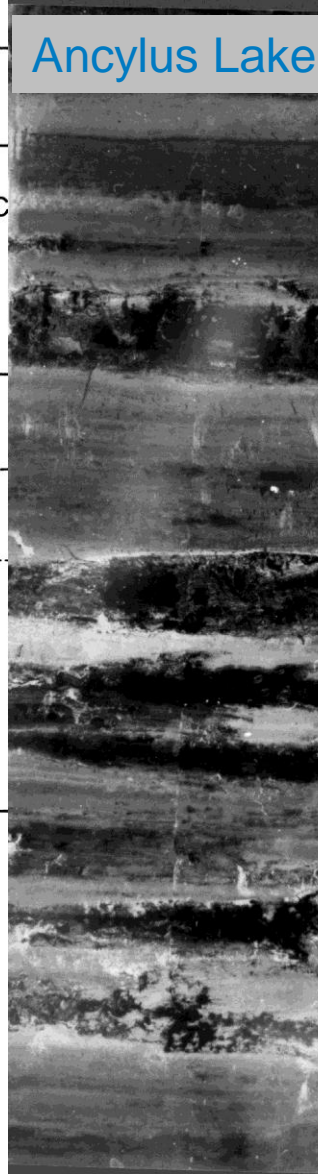
Stratigraphy of glacial and postglacial fine grained sediments from the Baltic Sea



Littorina Sea

DEPOSIT	THE BALTIC SEA		STAGE
	S CENTRAL BALTIC PROPER	N GULF OF BOTHNIA	
Recent mud	BLACK SULPHIDE MUD		PRESENT BALTIC
Postglacial gyttja clay	HOMOGENEOUS or STRATIFIED		
	LAMINATED MUD		LITTORINA SEA
Transition clay	HOMOGENEOUS CLAY (BLACK)		ANCYLUS LAKE
	SULPHIDE CLAY		YOLDIA SEA
Glacial clay and silt	HOMOGENEOUS CLAY		
	DISTAL VARVES		
	PROXIMAL VARVES TILL OR STRATIFIED DRIFT		

Ancylus Lake

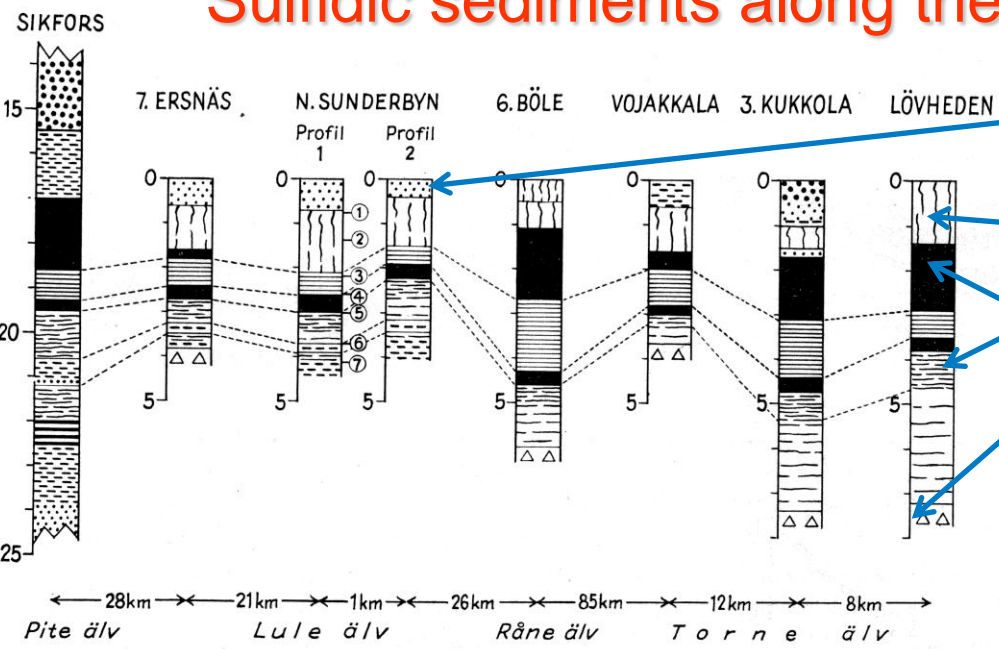


Winterhalter 1981



Sulfidic sediments along the coast of northern Sweden

VERIGES

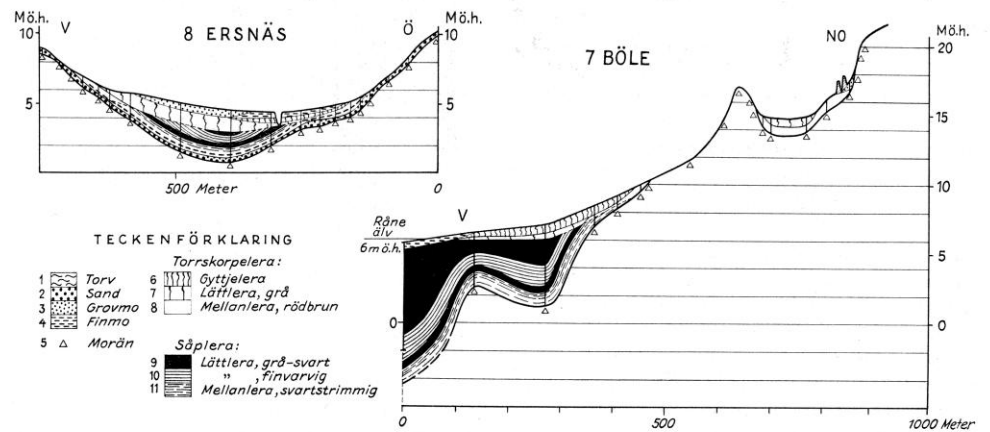
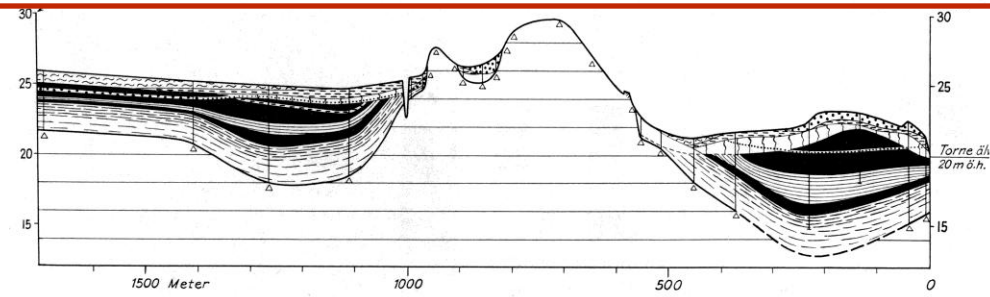
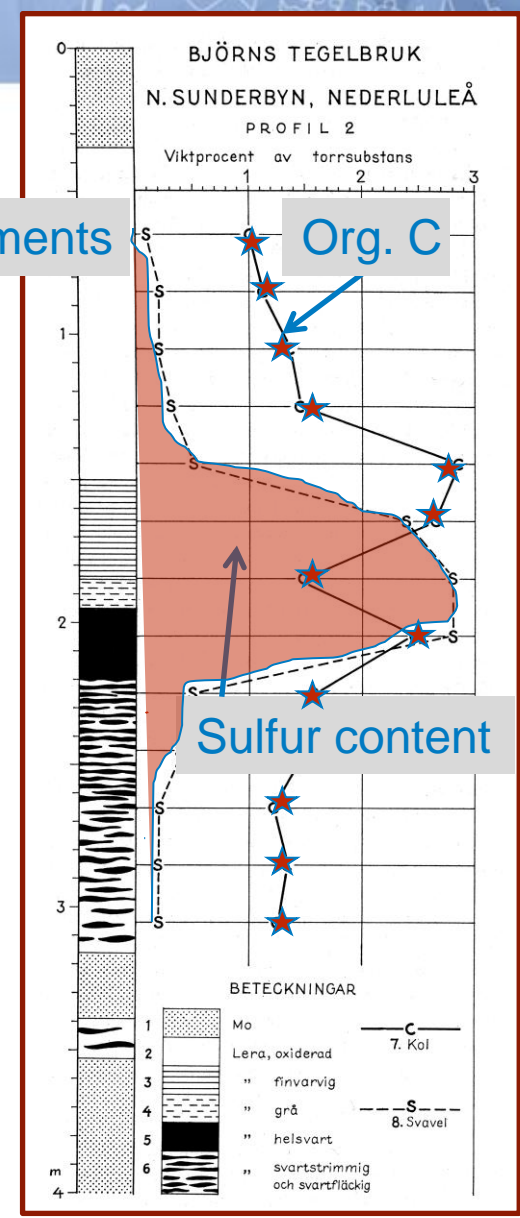


Sand/Silt

AS-soils

Sulfidic sediments

Till



Fromm 1965

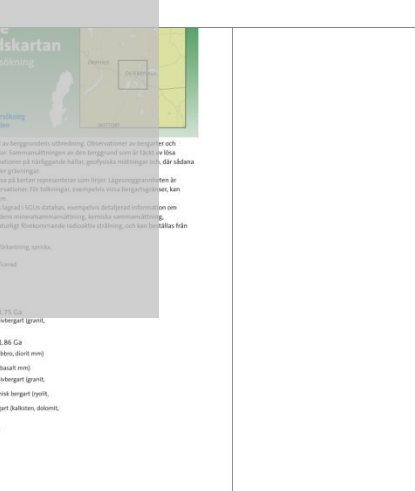
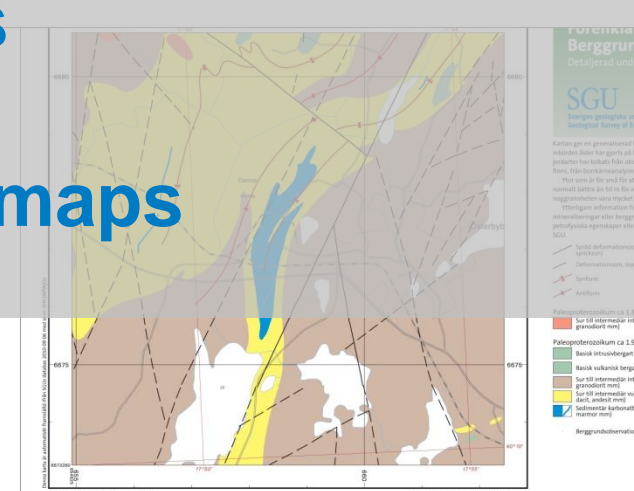
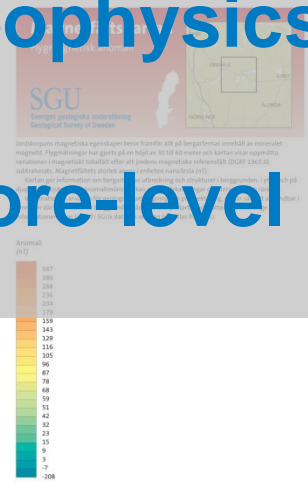
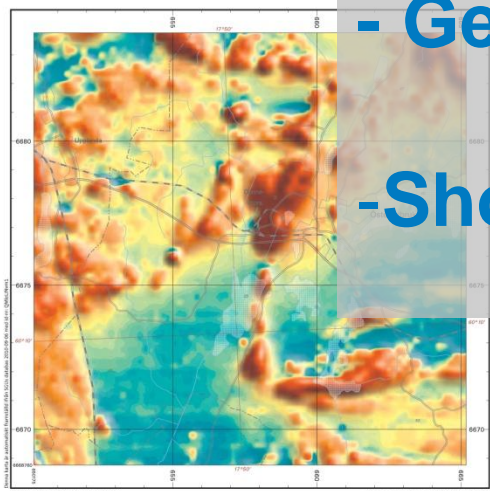
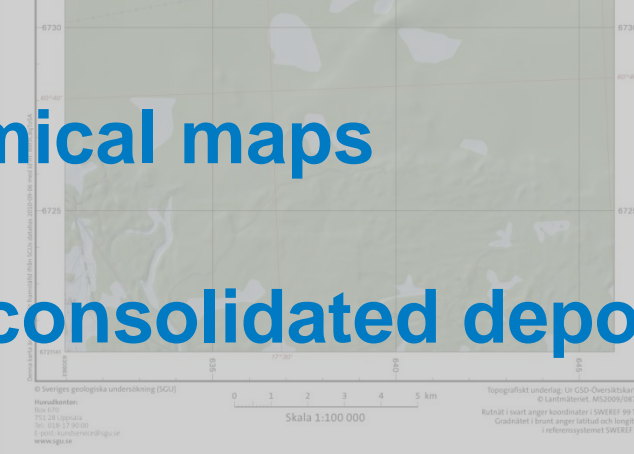
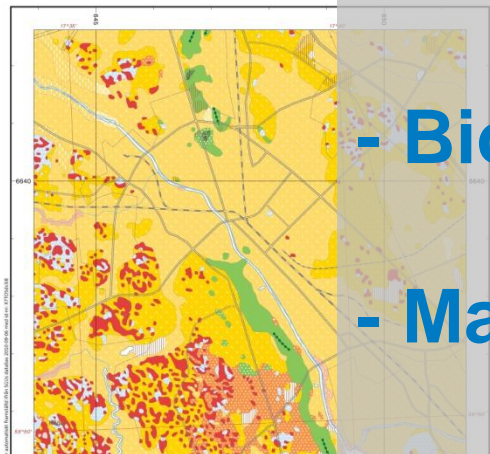
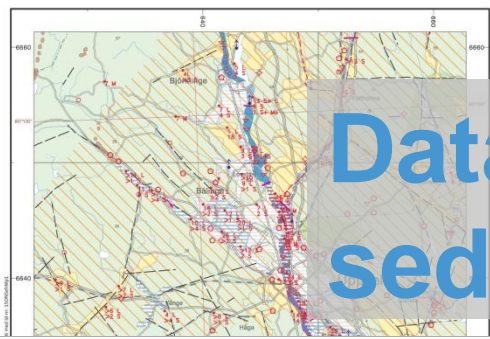
Data used to identify sulfidic sediments and AS soils

- Biogeochemical maps

- Maps of unconsolidated deposits

- Geophysics

- Shore-level maps





Data from the biogeochemical mapping

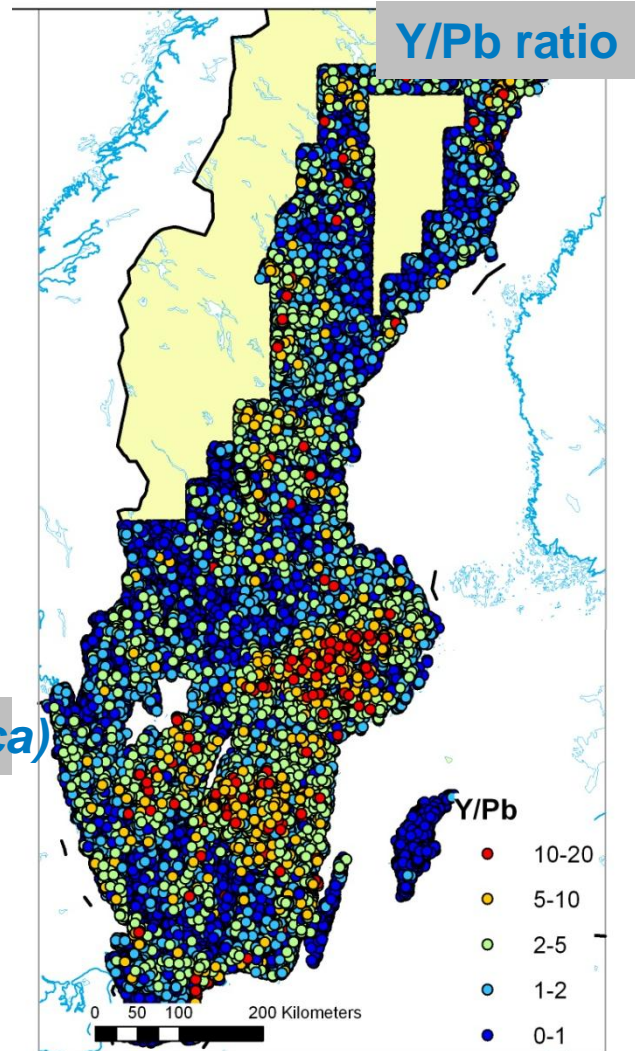


Sedge (*Carex*)

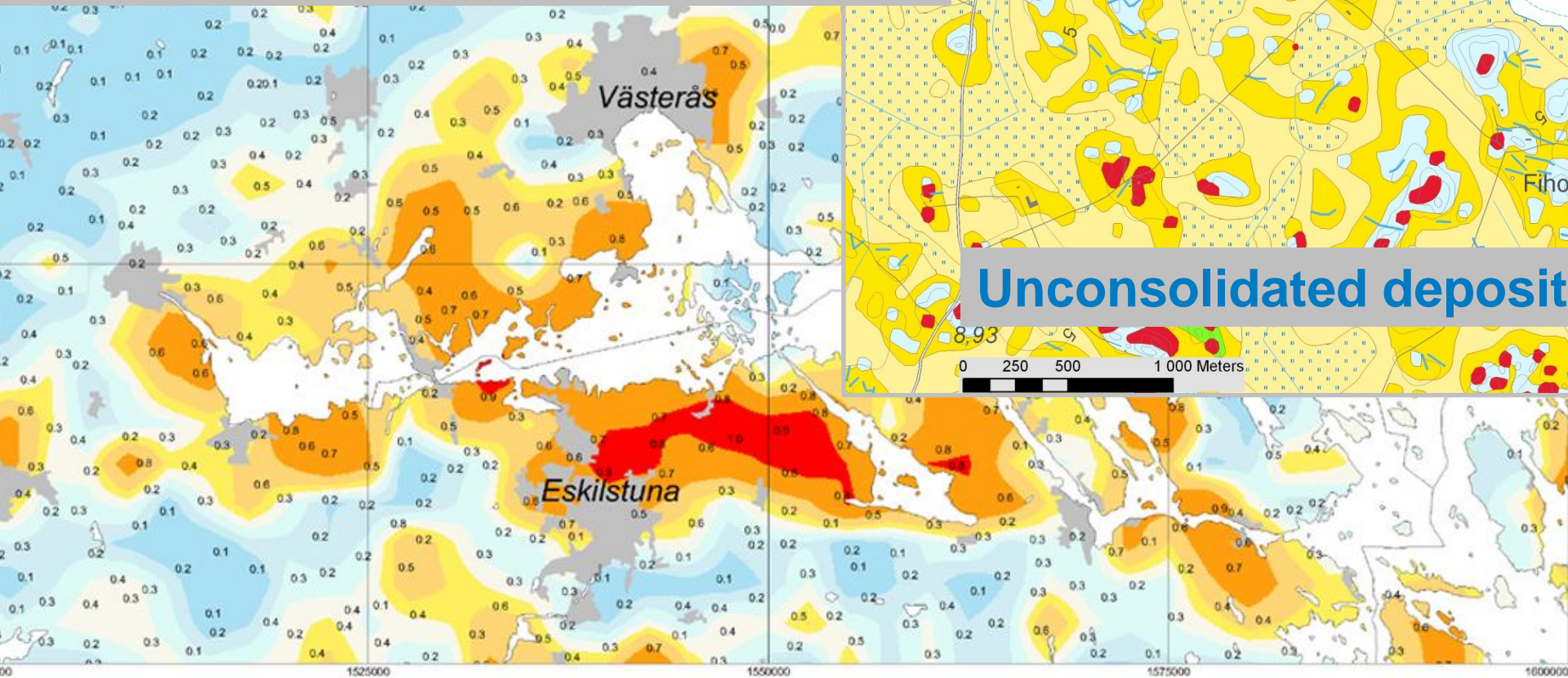
Dropwort (*Filipendula ulmaria*)



Water moss (*Fontinalis antipyretica*)

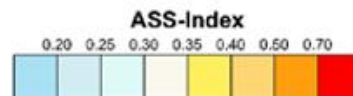


Data from the biogeochemical mapping



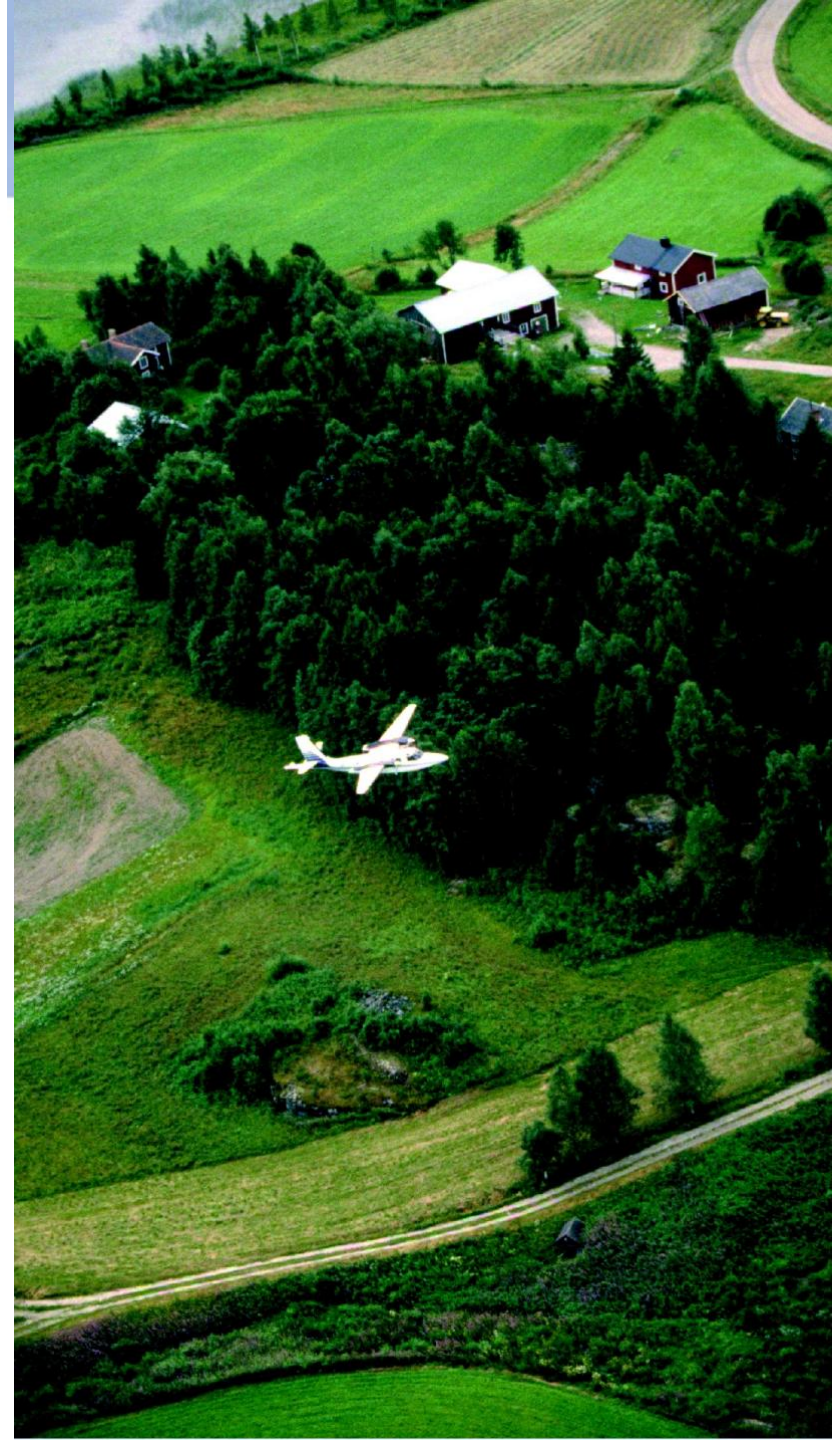
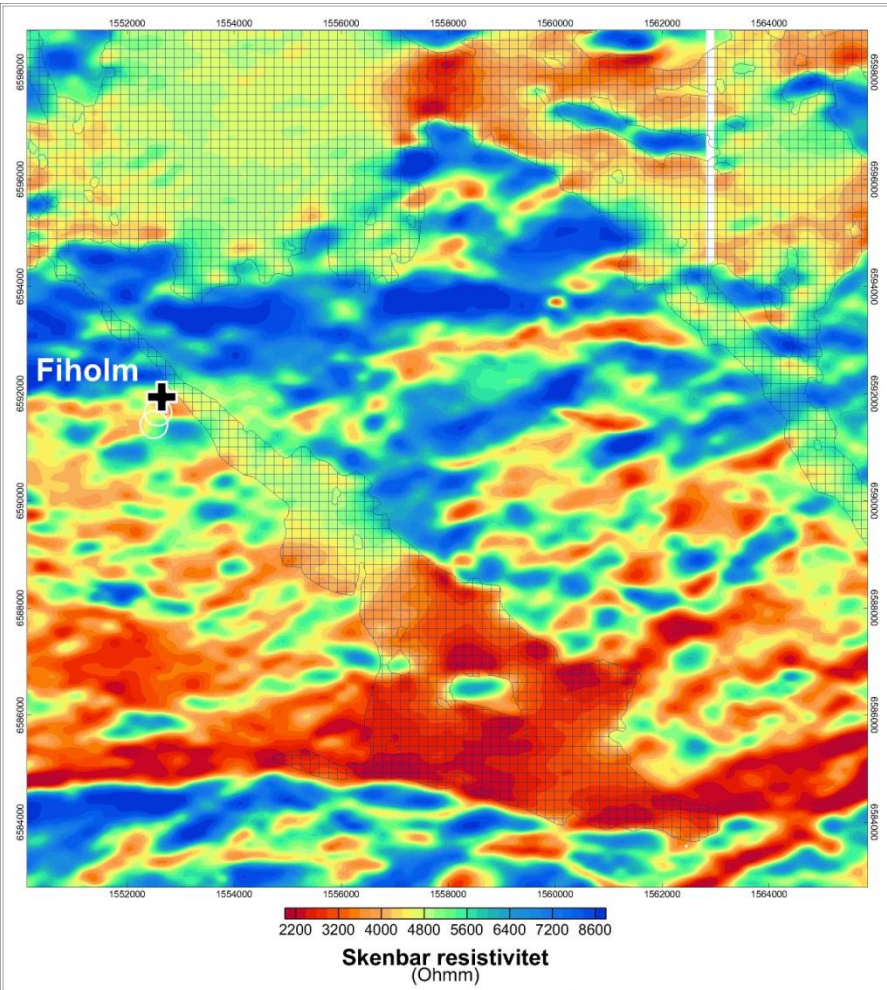
Unconsolidated deposits

5000 0 5000 metres



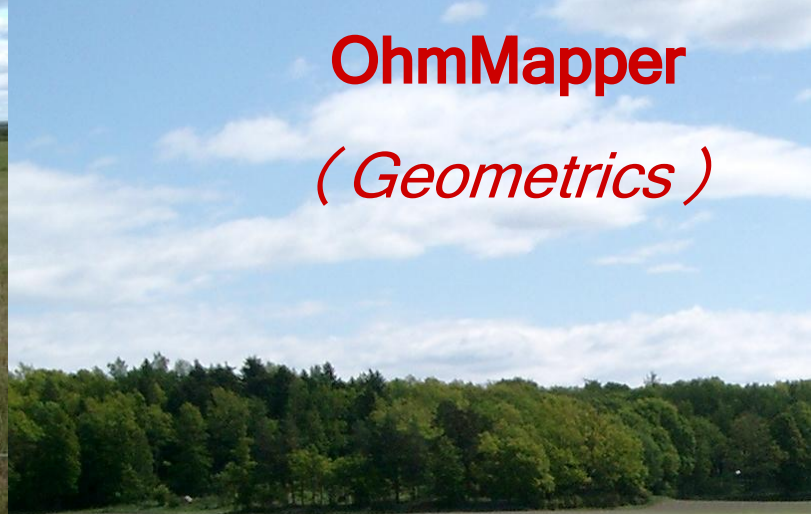
Geophysics

Airborne electromagnetic VLF measurements

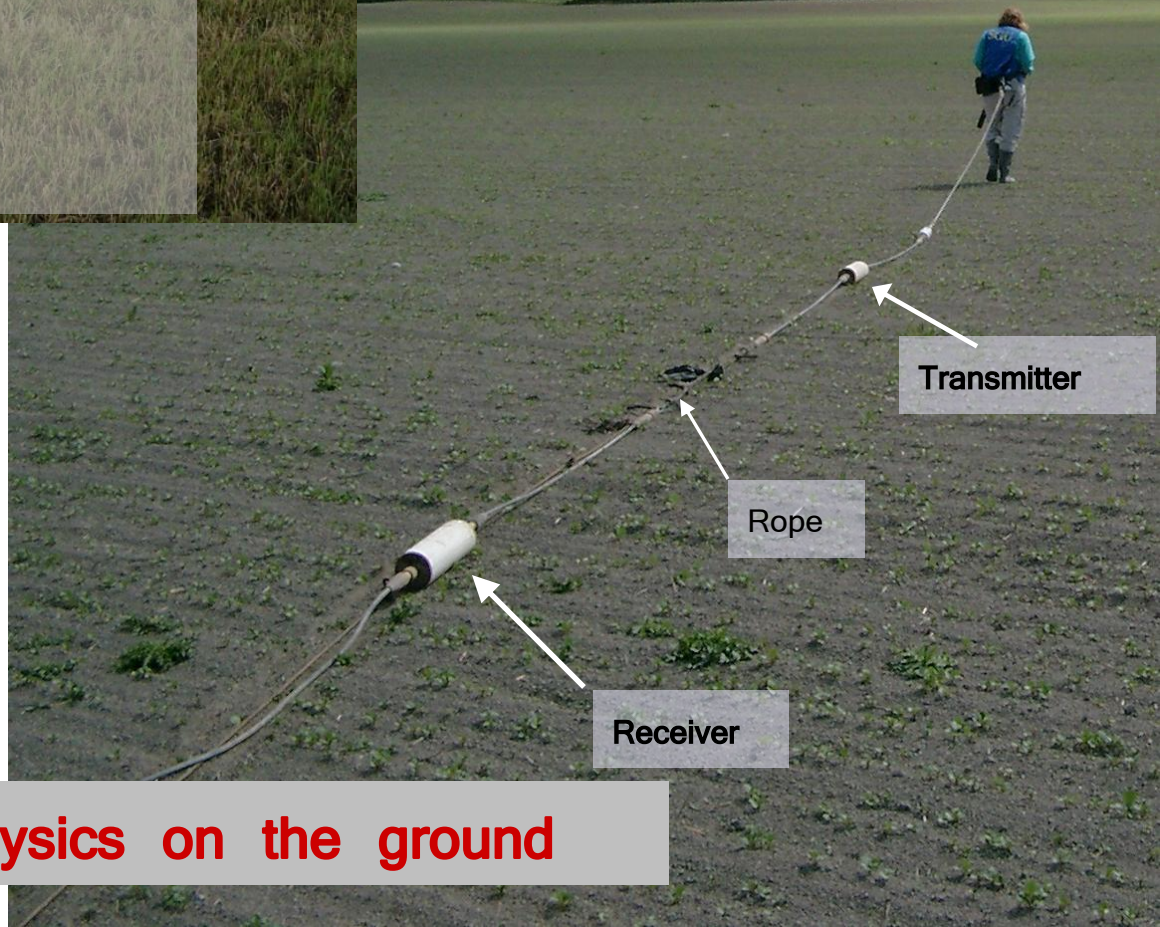
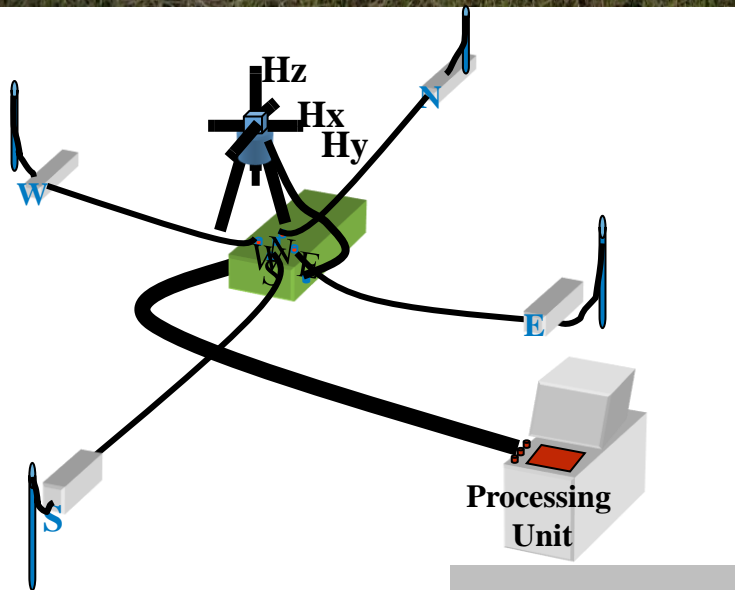




RMT (radiomagnetotelluric)
system



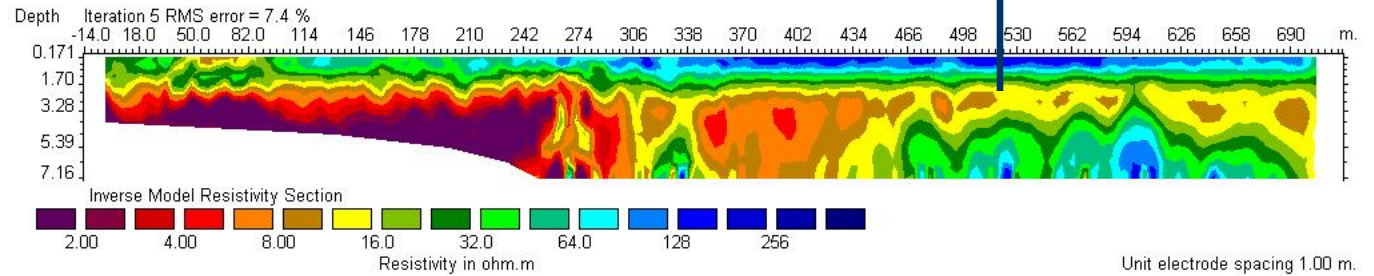
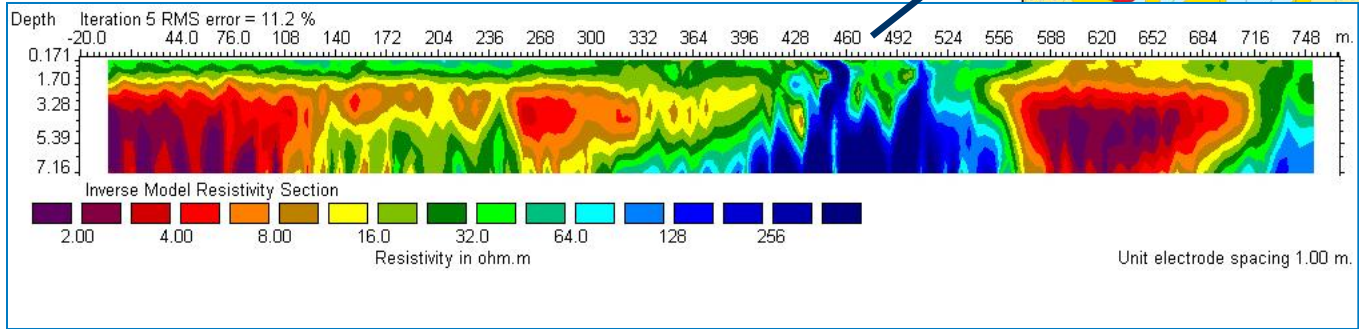
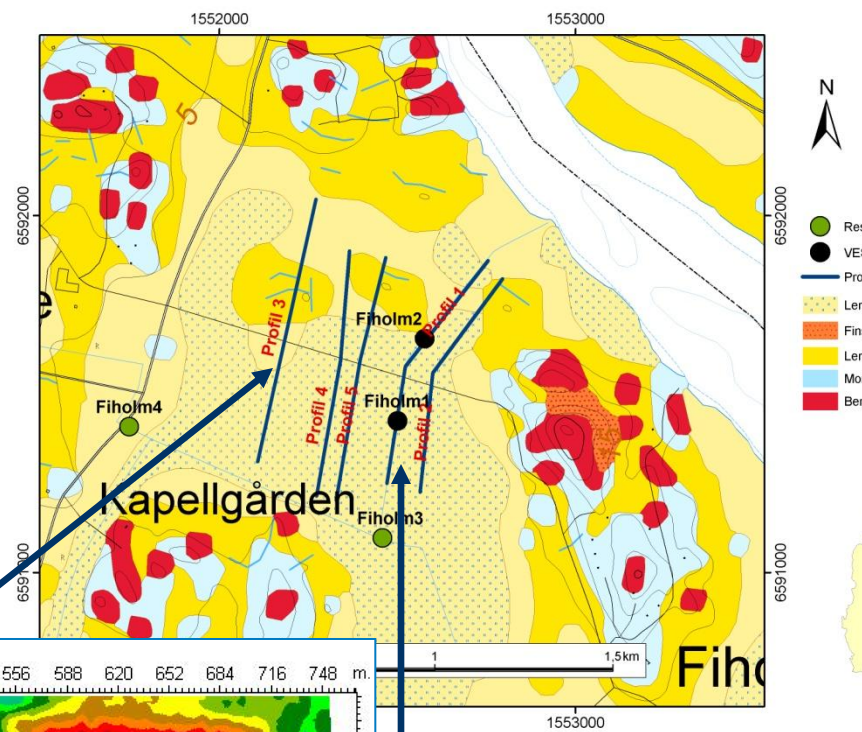
OhmMapper
(*Geometrics*)



Geophysics on the ground

OhmMapper

2D inversion model
(Res2Dinv)

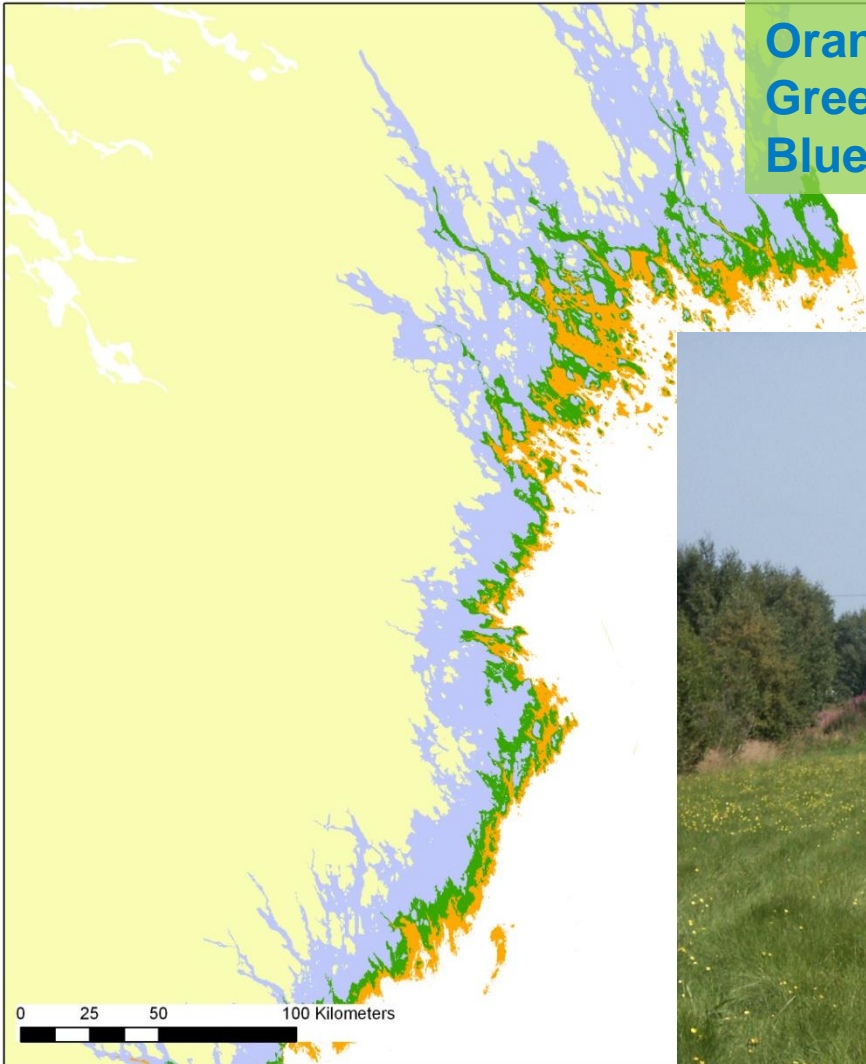


Past shore-levels

Orange 2000 years ago

Green 4000 years ago

Blue maximum area covered by brackish water



Areas with potentially sulfidic sediments along the coast of Norrbotten

Areas that has been land for less than 2000 years

Red = Fine grained sediments

Orange= Fine grained sediments covered by younger sediments

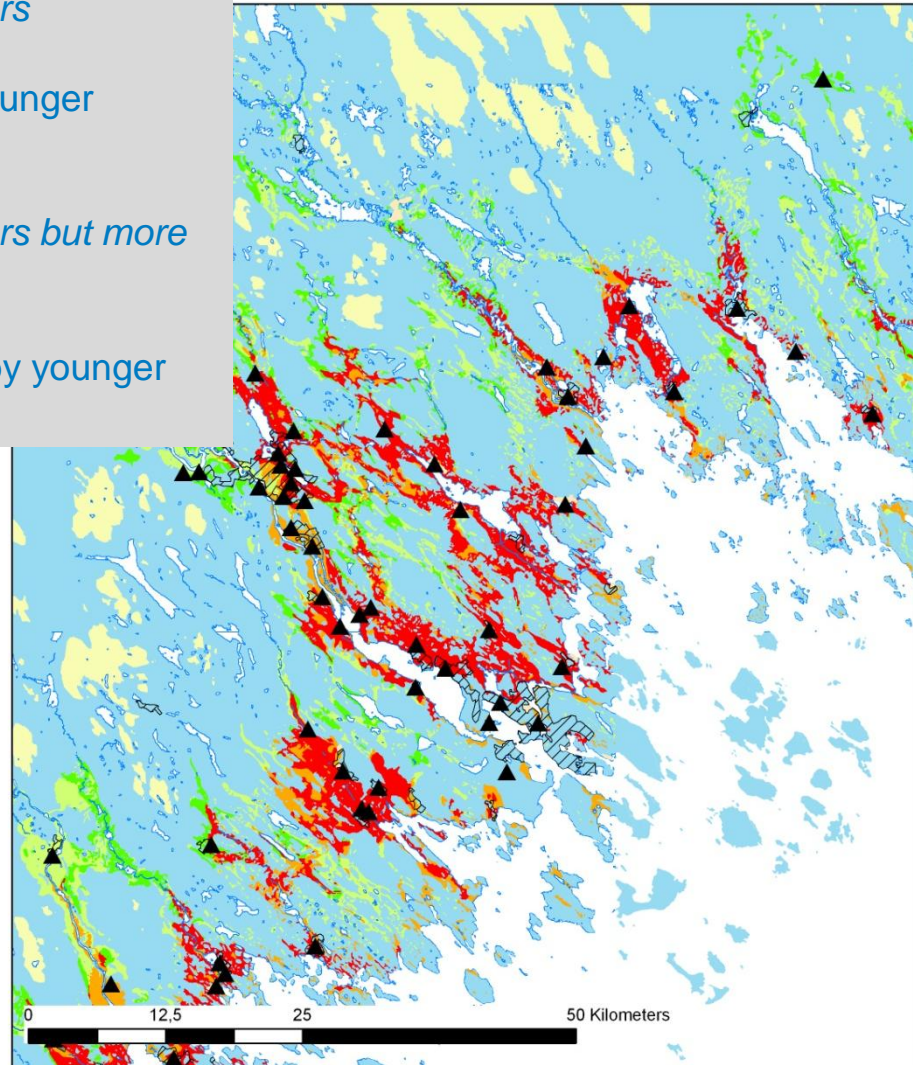
Areas that has been land for less than 4000 years but more than 2000 years

Green = Fine grained sediments

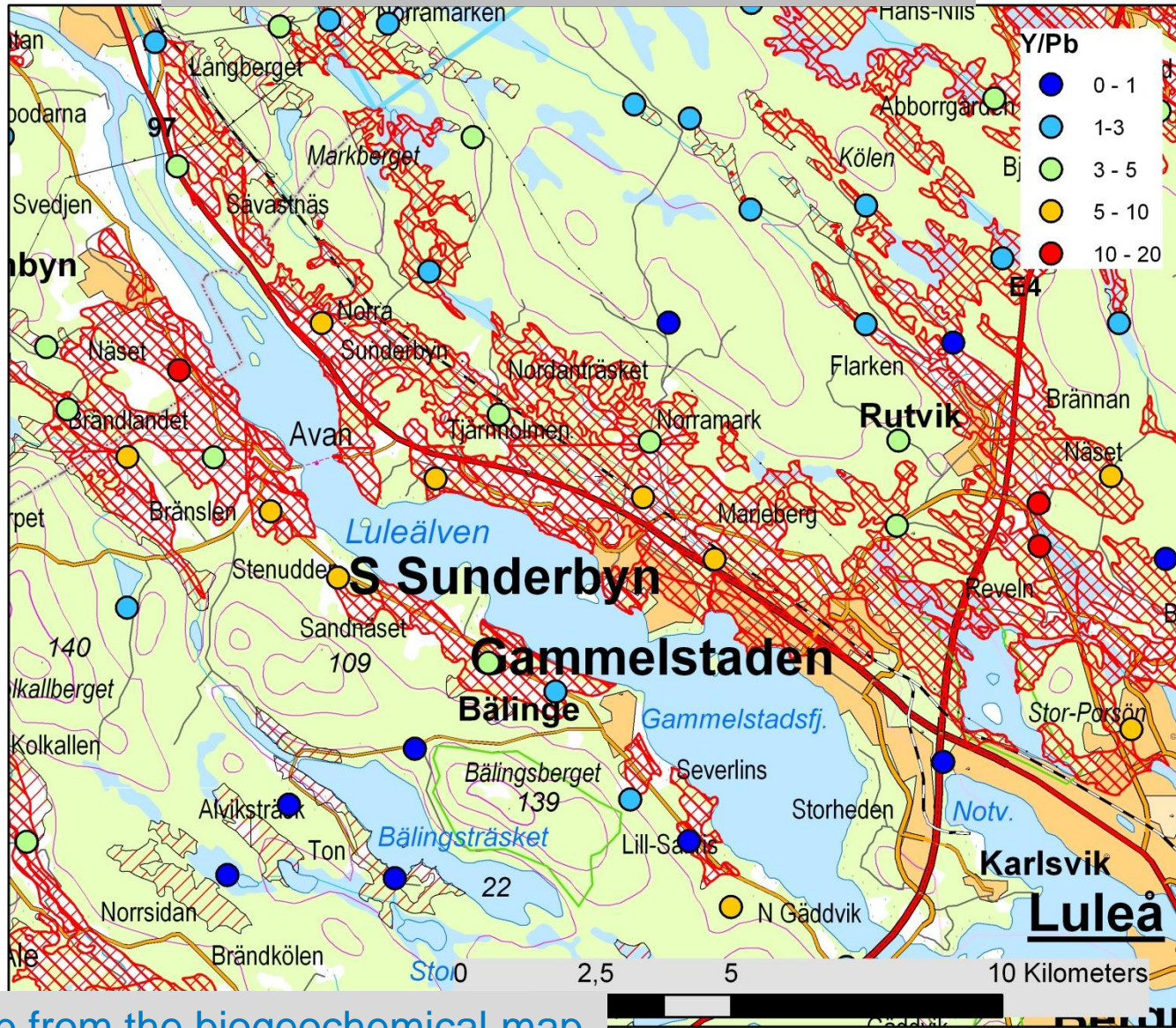
Light green= Fine grained sediments covered by younger sediments

Triangles = sites with sulphidic sediments from:

Ivarsson, H., mfl. 1996 Umeå universitet,
Inst. För ekologi och miljövård.



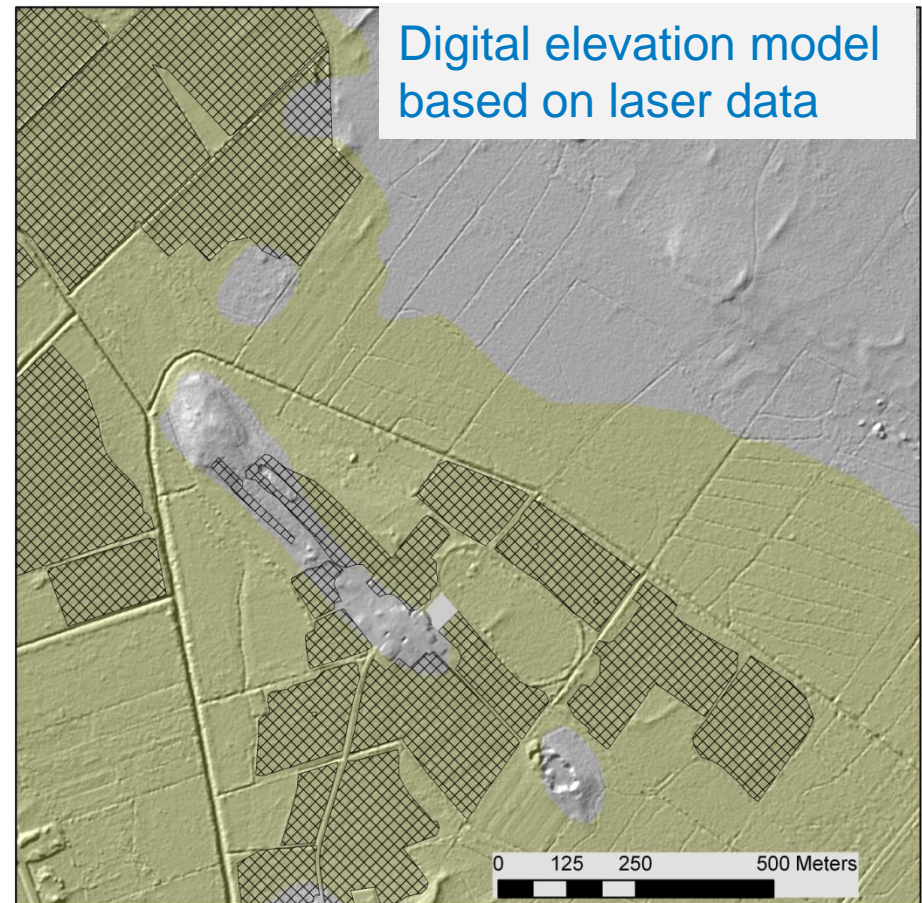
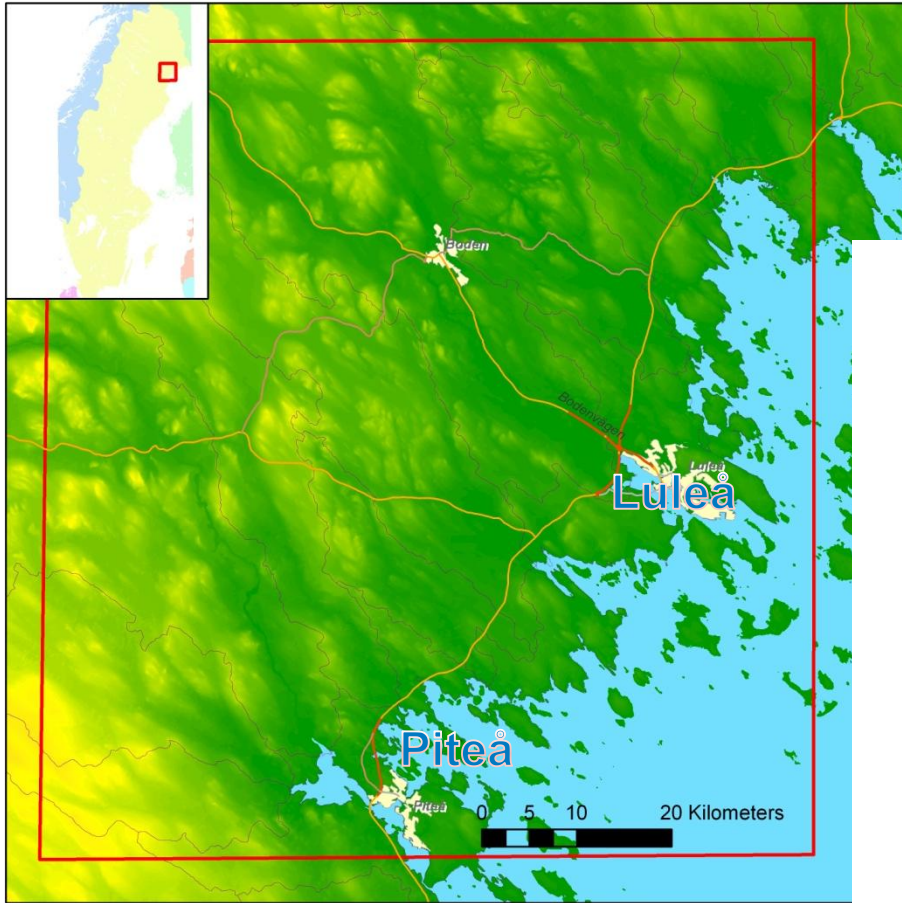
Fine grained deposits in areas less than 2000 years



Y/Pb from the biogeochemical map



Field work 2012





Characterization of AS-soils and sulfidic sediments

in areas with different land use along the coast of northern Sweden

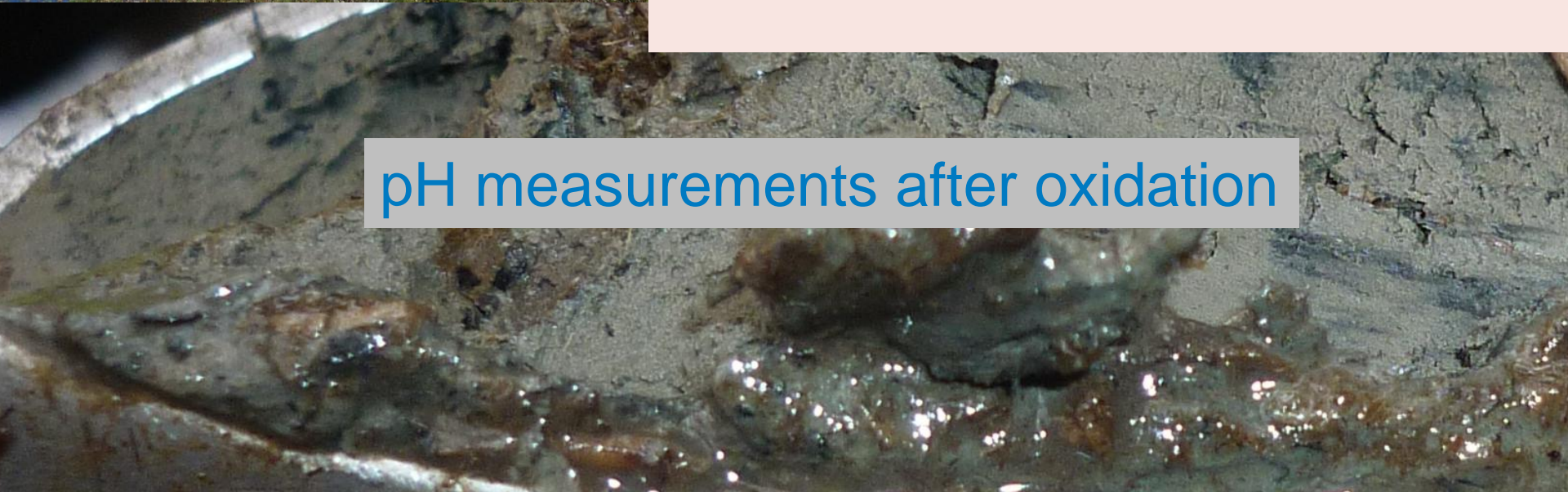
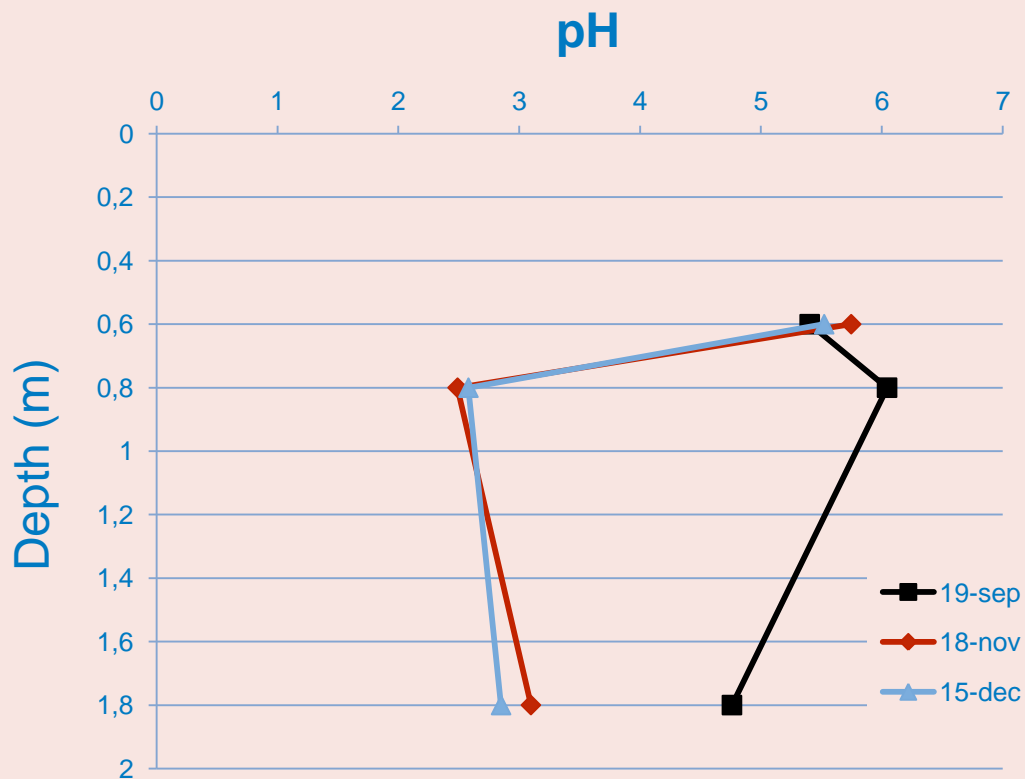


Field characterization



pH measurements in the field





pH measurements after oxidation

7. Identification and Classification of Acid Sulfate Soils in Northern Sweden

Aroka, N¹, Norrlin, J¹, Sohlenius, G¹, Uhlbäck, J¹, Wåhlén, H¹. & Åberg, J².

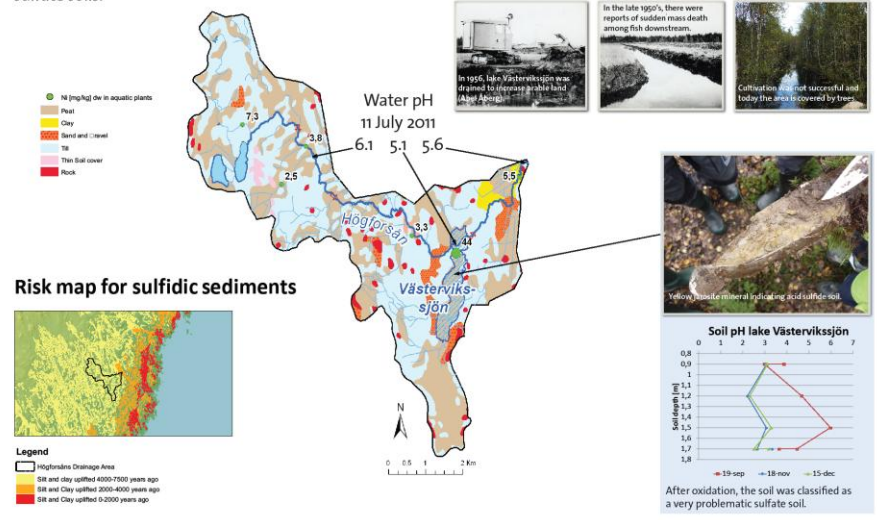
¹ Geological Survey of Sweden, Box 670, 751 28 Uppsala, Sweden
² County Administrative Board of Västerbotten, 901 86 Umeå, Sweden

Substantial areas along the coast of northern Sweden are covered by sulfide-rich sediments. If subjected to oxidation due to lowering of the ground water table, these sediments may develop into acid sulfate soils. Acid sulfate soils have been shown to negatively affect the water quality of some watercourses through acidification and leaching of heavy

metals such as nickel. The Geological Survey of Sweden (SGU) is currently conducting a study on identifying and classifying acid sulfate soils. By combining geological data the study aims to gather a better understanding of the location of these deposits.

Creek Högforsån catchment area

In 2011, SGU and the County Board of Västerbotten conducted a field study in the catchment area of the creek Högforsån in northern Sweden. Water chemistry downstream the drained lake Västerviks-sjön is notably affected by the acid sulfate soils.



Identifying acid sulfate soils

A map of potential risk areas for sulfidic sediments was derived by combining data from SGU's shoreline displacement and maps of Quaternary deposit. Typical risk areas are the most recently uplifted clay and silt sediments. In 2011, soil samples were collected from sites of interest to assess the accuracy and improve the risk map. Further field studies will be conducted during 2012.

Classifying acid sulfate soils

Collected soil samples were oxidized over a period of 3 months in lab, during which pH was measured. After oxidation the soils were classified based on acidity, namely:

- Class I, pH < 3.5 very problematic sulfate soil
- Class II, pH < 4 problematic sulfate soil
- Class III, pH < 4.5 potentially problematic sulfate soil
- Class IV, pH > 4.5 no risk of sulfate soil