Plants used in Phytoremediation of AMD in mine tailings

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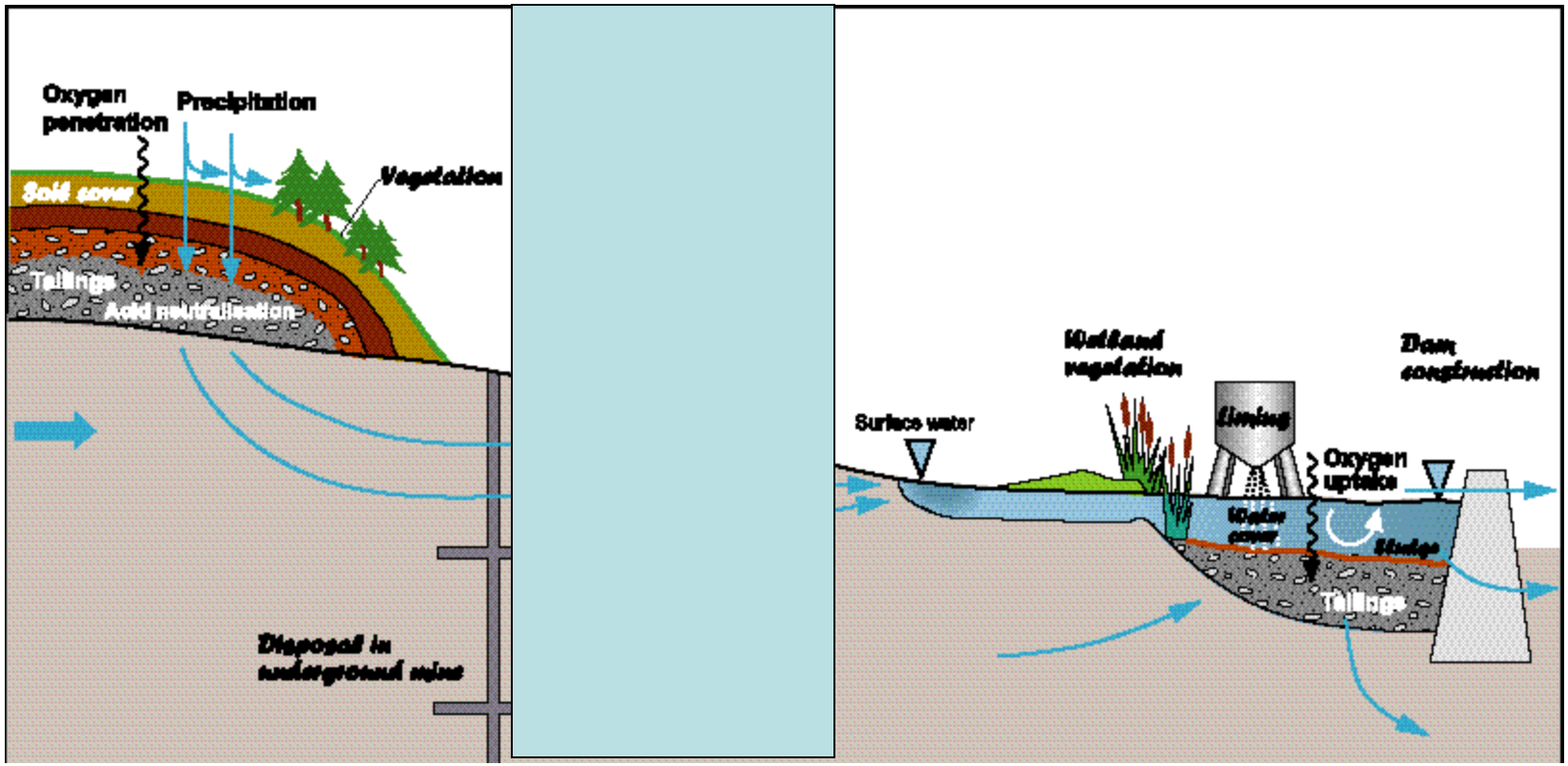
The problem
Formation of AMD (acid mine drainage)

Dry cover

Wet cover

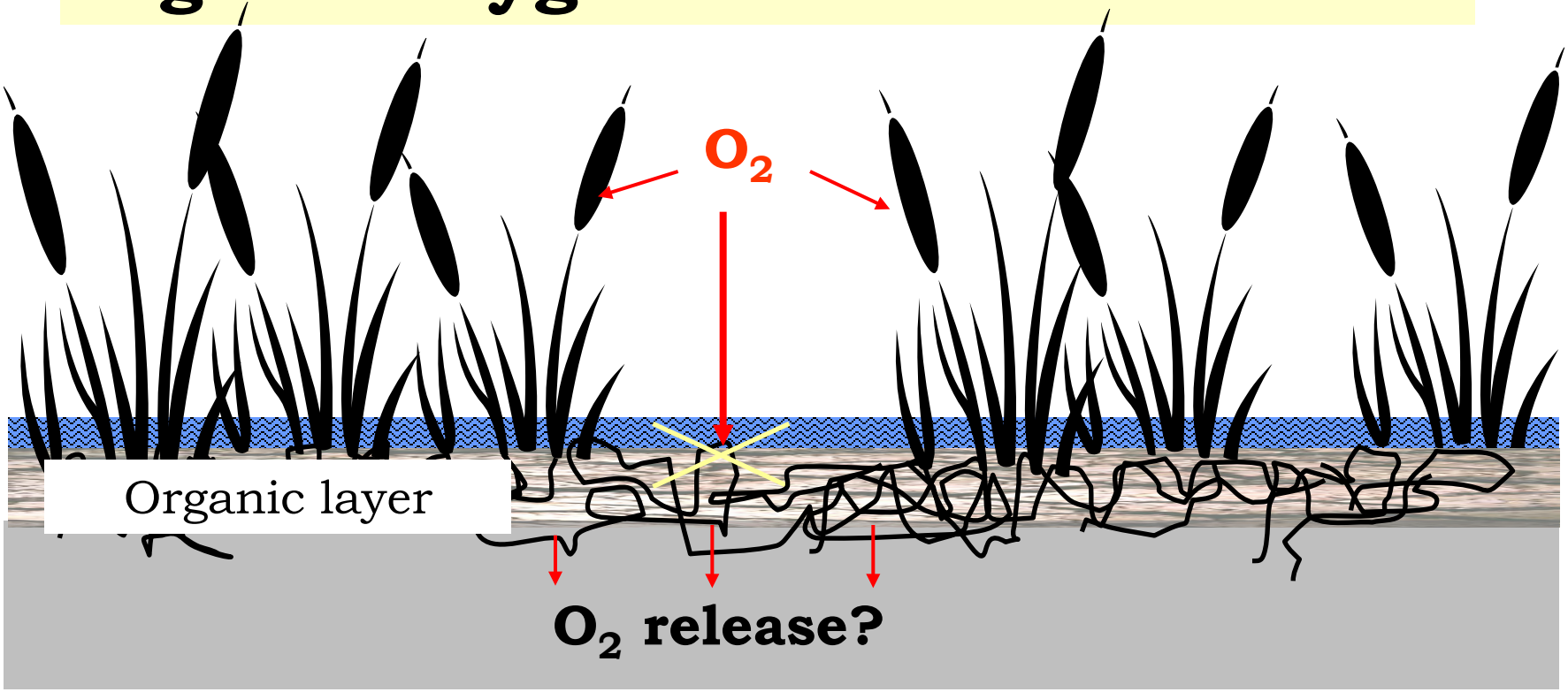


Wet cover

Establishment of wetland vegetation on water covered tailings.

Prevent formation of AMD

Plant establishment on water covered mine wastes might reduce the oxidation of sulphide minerals due to the production of an organic oxygen barrier



Aims:

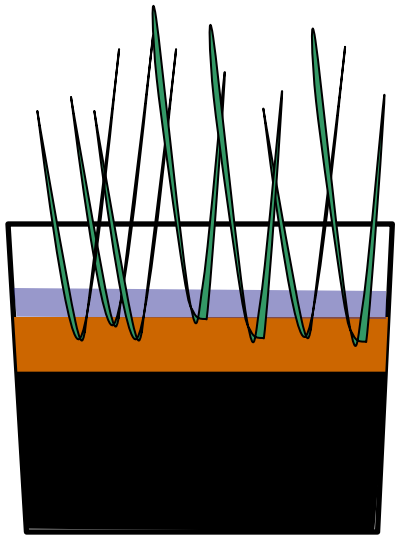
1. To find suitable low-cost amendments for plant establishment
2. To find the effects of plant establishment on metal release, pH and SO_4

Amendments for plant establishment

Plant growth on different waste products was investigated

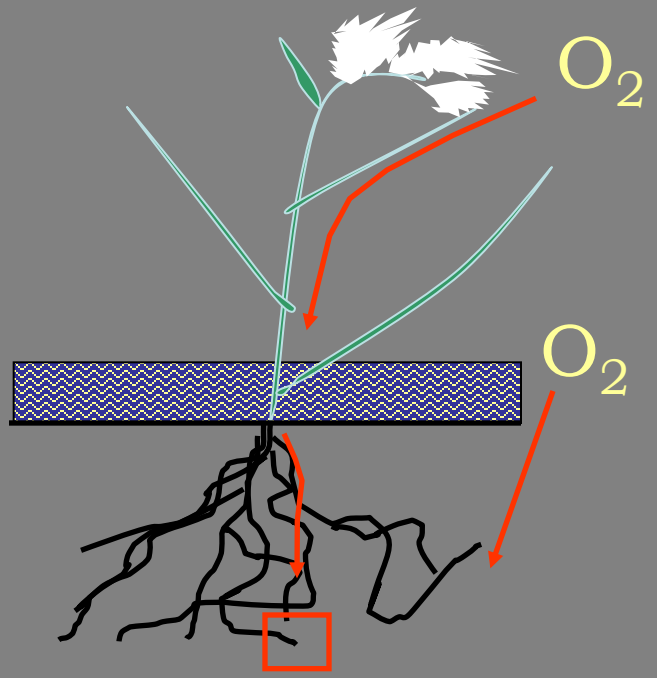
- Sewage sludge
- Bio sludge
- Ash
- Green liquor dregs
- Peat

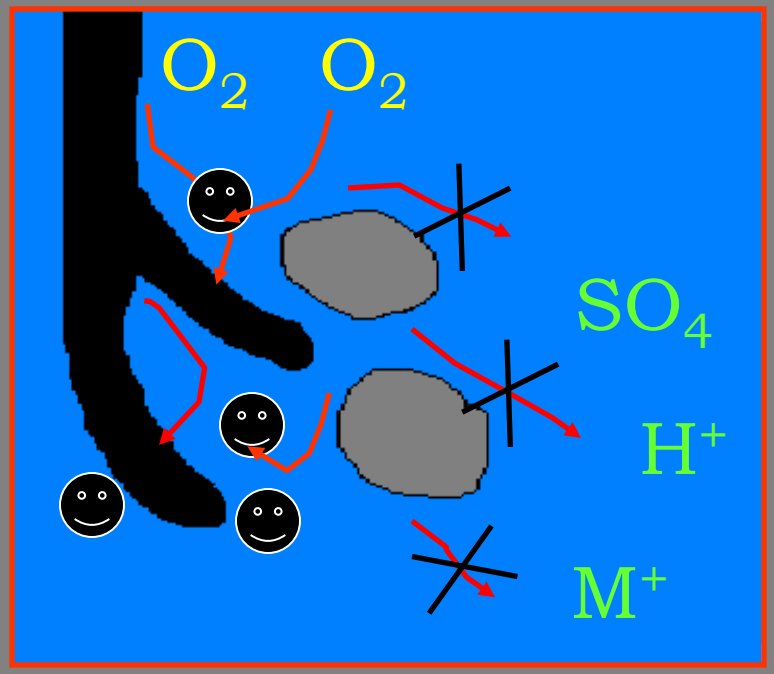
- Sewage sludge + ash
- Sewage sludge + ash + peat



Phragmites australis (Reed) and *Eriophorum angustifolium* (Common cottongrass)

Effects of wetland-plant growth





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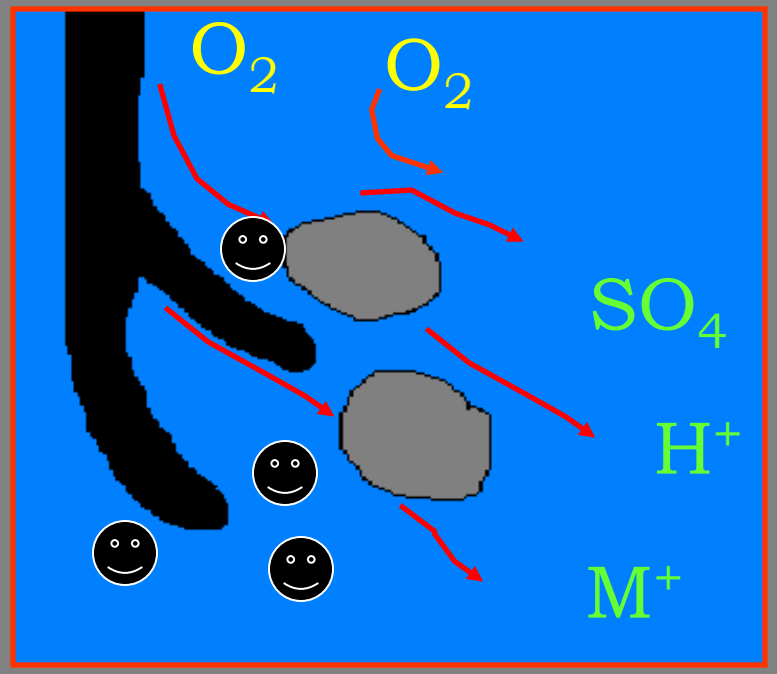


Plant species studied

Eriophorum angustifolium (Common Cotton grass)

Levels[1] in drainage water from tailings with different treatments

	pH	SO_4 (mg l^{-1})	Cd (µg l^{-1})	Cu (µg ml^{-1})	Pb (µg l^{-1})	Zn (µg ml^{-1})
Control	2.6 b	1137 a	435 a	3.21 a	8134 a	123 a
Sewage sludge	2.8 b	394 b	29 b	0.30 b	5864 a	5 b
E. angustifolium + sewage sludge	5.9 a	608 b	6 b	0.04 b	92 b	6 b

[1]Different letters (a and b) indicate significant difference between the various treatments

Effects of *Eriophorum angustifolium* on drainage water from water covered wastes amended with sewage sludge compared with controls

Metal content:	decreased	95-99%
pH:	increased (plants:~5.7, control:~2.6)	100%
SO_4:	decreased	33-47%

Plant species used in the test field and on other type of tailings, from the left:

Carex rostrata (Bottle sedge)

Eriophorum angustifolium (Common cottongrass)

Phragmites australis (Reed)

Submerged plants treatment of AMD

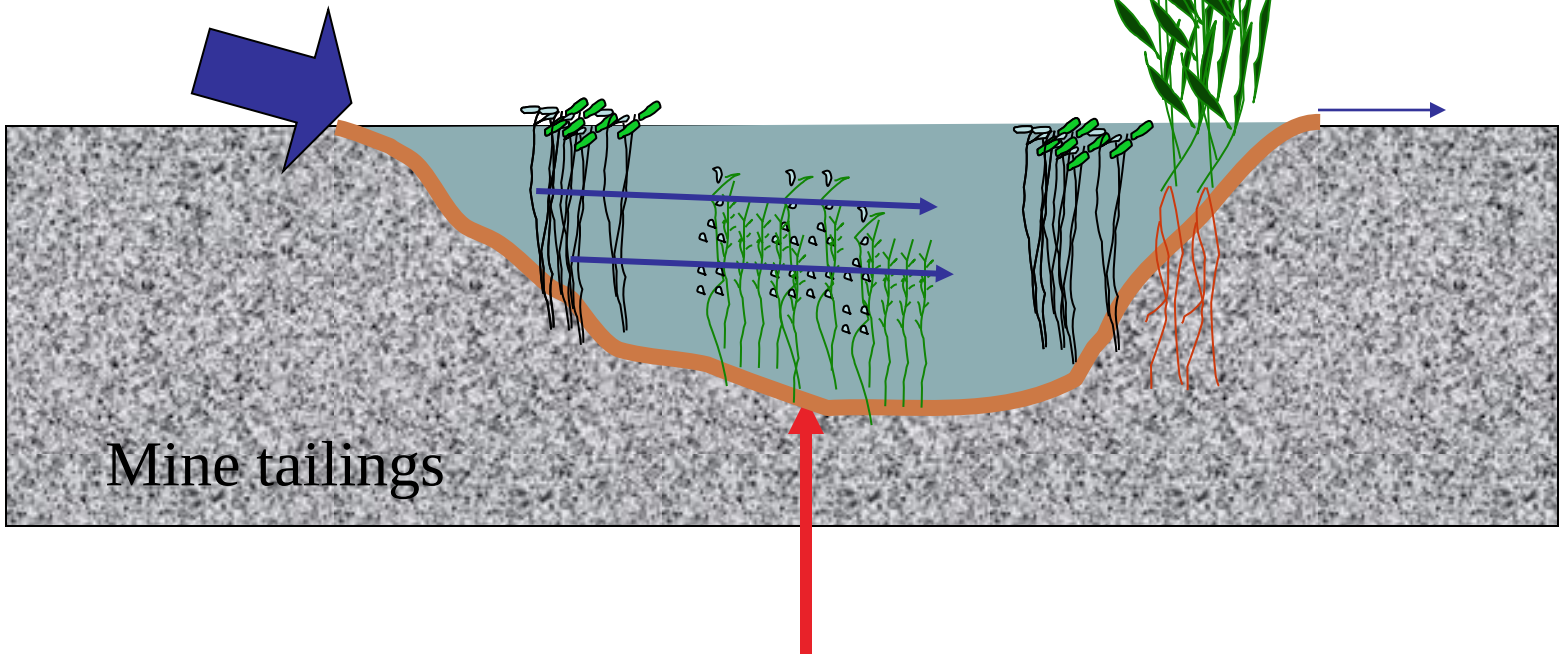
To prevent formation of AMD and increase pH and remove water from metals

Surface water in

Surface water out

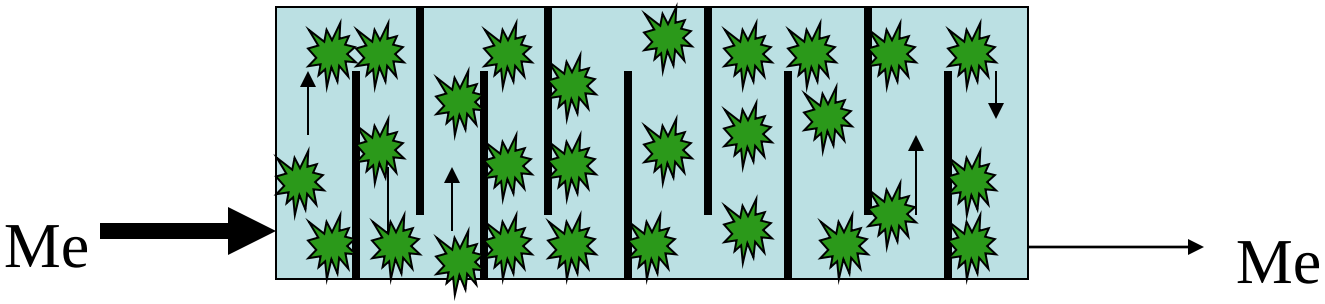
Higher pH?
Lower
metal level?

pH = 2.7
High metal level



Prevention of AMD formation?

Use of *Elodea canadensis* to remove metals from water



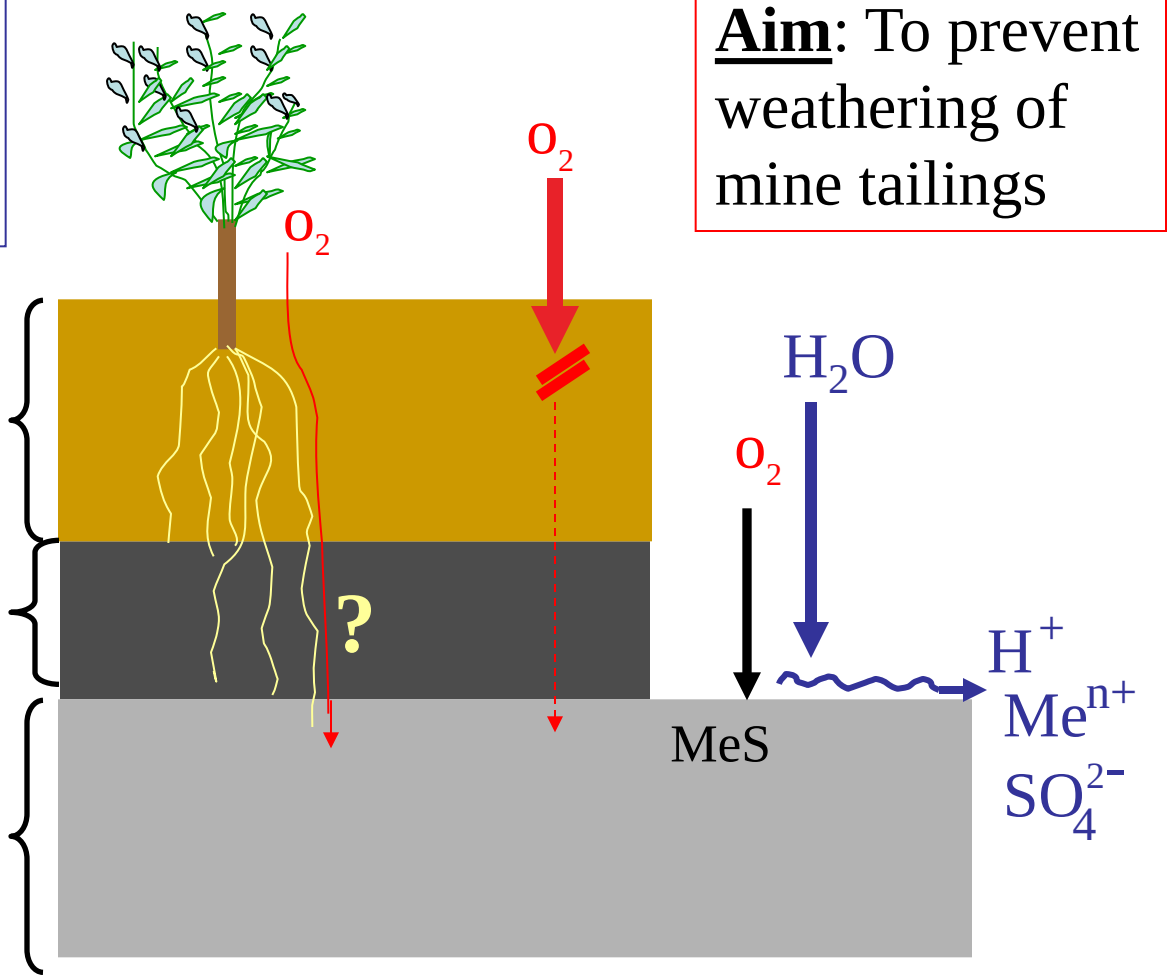
Metal	Total removal, %	Removal by plant,%
Zn	76	48
Cu	75	71
Pb	92	30
Cd	45	45

Dry cover

Use of ash and sewage sludge to cover sulphidic mine tailings and establish vegetation

Prevention of root penetration **?**
Plant establishment in sewage sludge **?**

Aim: To prevent weathering of mine tailings

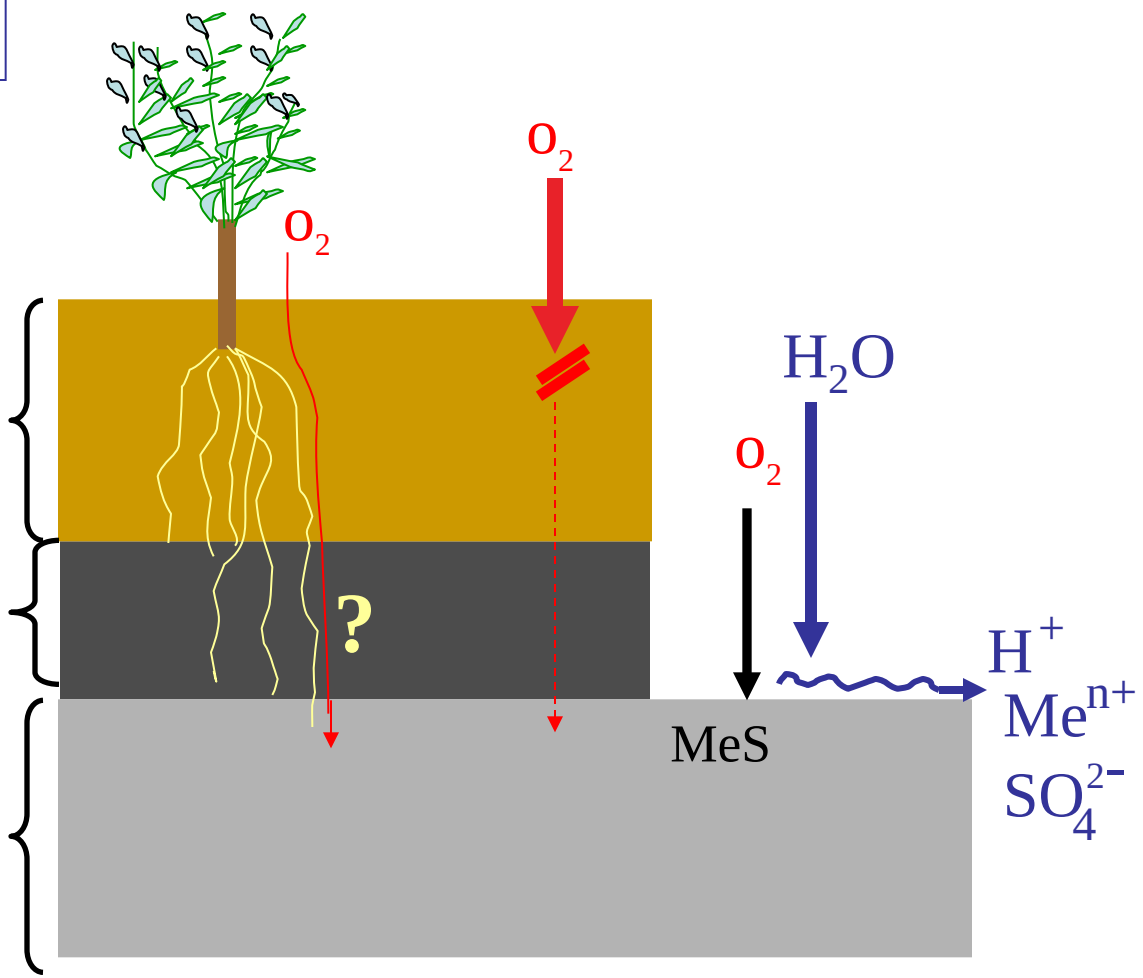


Establishment of vegetation on mine tailings

Plant nutrients necessary

Use of sewage sludge to establish vegetation

Plant establishment in sewage sludge ***?***



Cover layer of sewage sludge on mine tailings

May 2002

Sewage sludge 0.5 m
Seeds of grasses and lupine

August 2002

Picture taken

AIMS:

Plants abundantly growing in sewage sludge with high root biomass and low accumulation of metals in the shoot.

No leakage of nutrients, metals etc. to the surface water from the sludge.

Stabilisation of metals

Aesthetically

Organic material preventing oxygen penetration by using it.

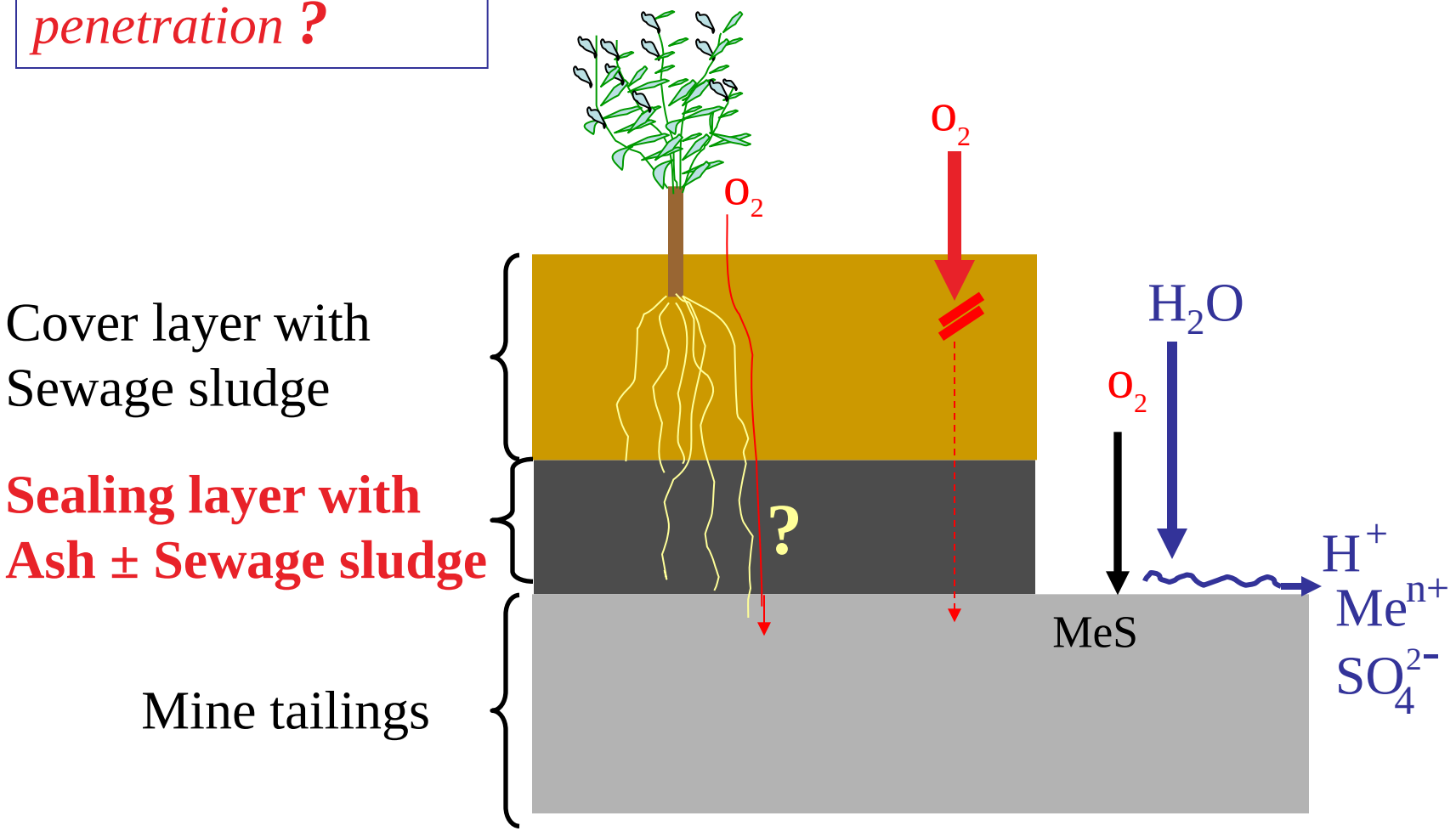
Sustainable

Established vegetation on dry cover.

Risk of root penetration of the sealing layer.

Use of ash and sewage sludge to cover sulphidic mine tailings

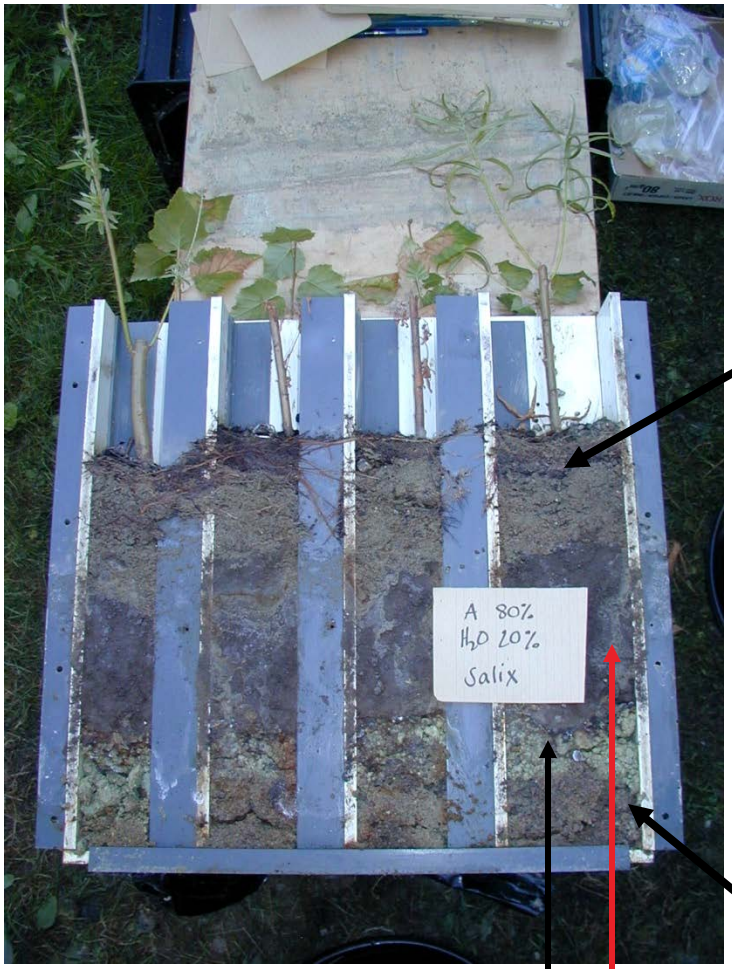
Prevention of root penetration ***?***



Salix viminalis

Ash

Ash 10% + 90% Sludge



Till

Sand

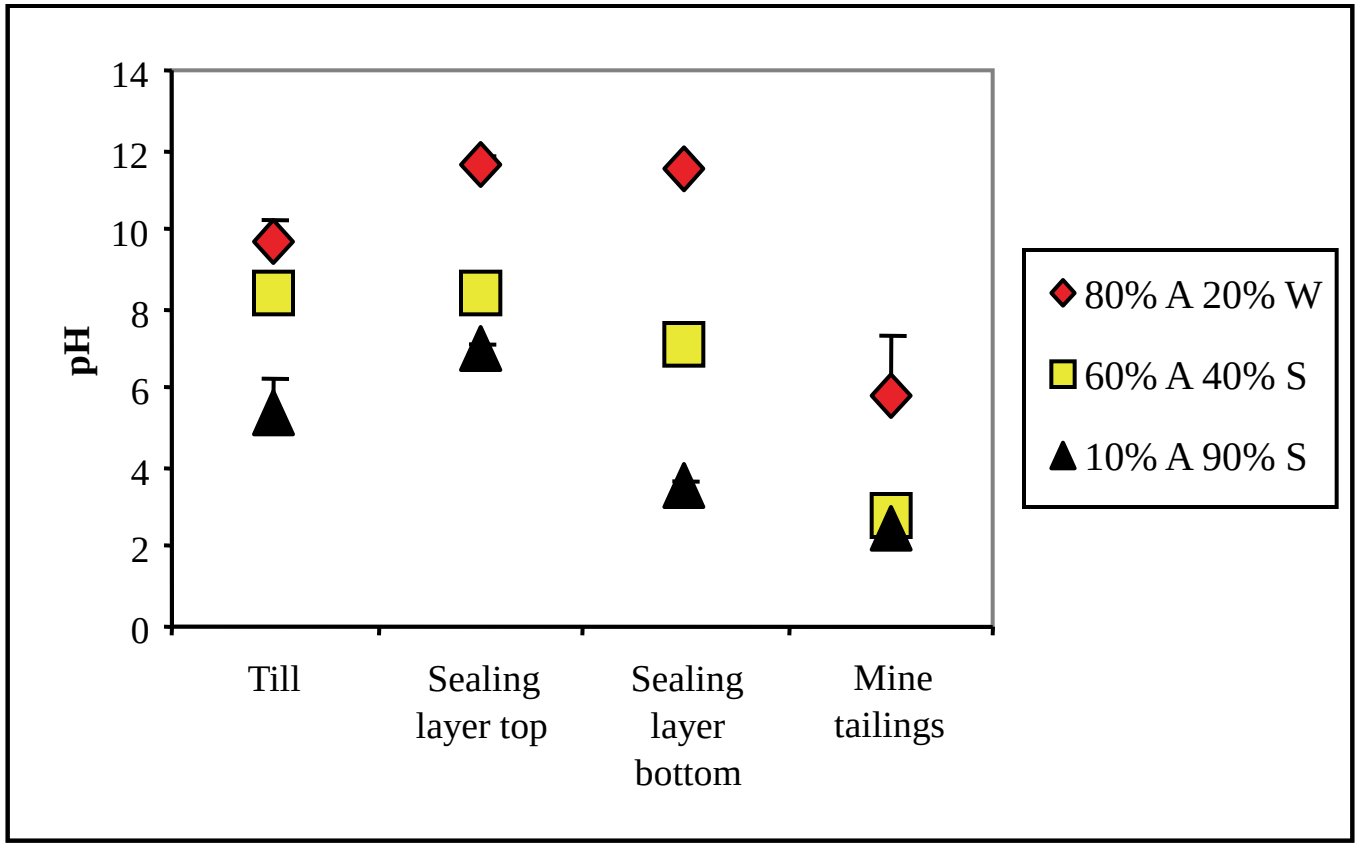
Ash

Mine tailings

Root mass (DW) of *Salix viminalis* in different substrate layers. The sealing layer is varied according to the three head columns. n=4 ± SE

	80 % ash + 20 % H_2O	60 % ash + 40 % sewage sludge	10 % ash + 90 % sewage sludge
Till	0.06±0.04	0.37 ±0.21	1.00 ±0.49
Sealing layer top	0	0.35 ±0.11	1.33 ±0.42
Sealing layer bottom	0	0	0.57 ±0.32
Mine tailings	0	0	0

pH in different layers. A= fly ash, S= sewage sludge and W= water. n=4, ±SE



PhD-students working in this project

Eva Stoltz — (Emerged plants, root penetration)
Clara Neuschütz — (Dry cover, root penetration)
Johanna Nyquist — (Submersed plants and AMD treatment)

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Ash and sewage sludge producers