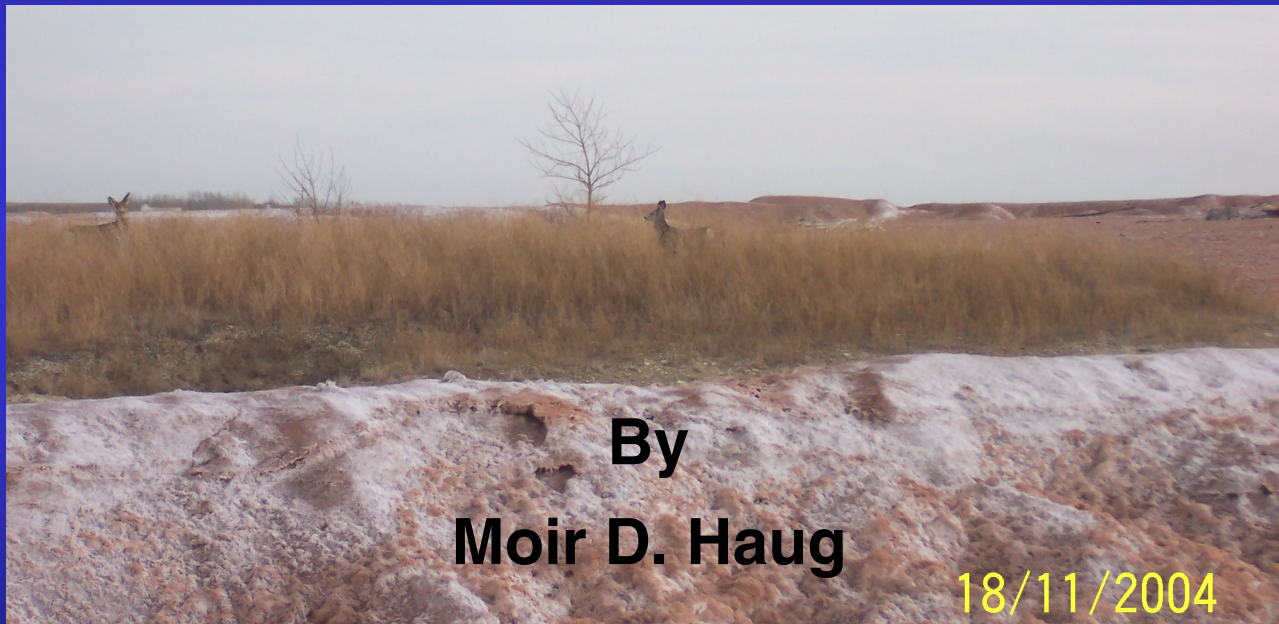


Applications of Alternative Covers For Potash Mining



December 2, 2004

Introduction



Subject

**Search for suitable cover materials for potash
(salt) tailings**

Need

To find a suitable cover decommission option

To find a suitable material to cover salt

To demonstrate the effectiveness of covers on salt tailings

Limit size of environmental bonds

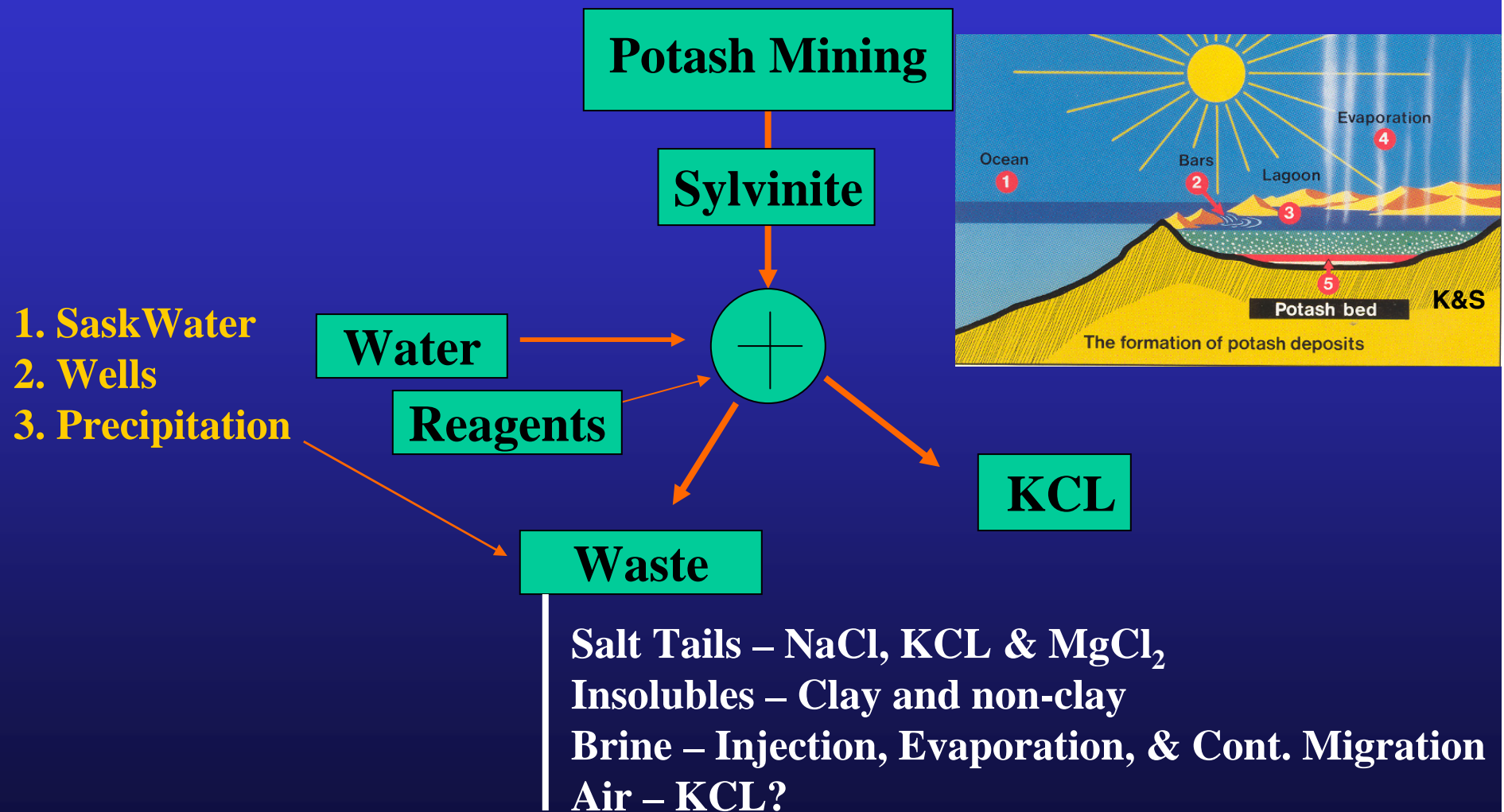
Objective

To examine potash mining and waste production

To examine cover materials used for other applications

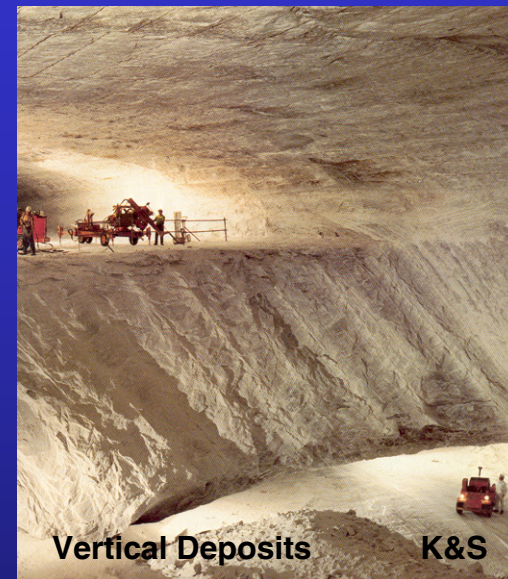
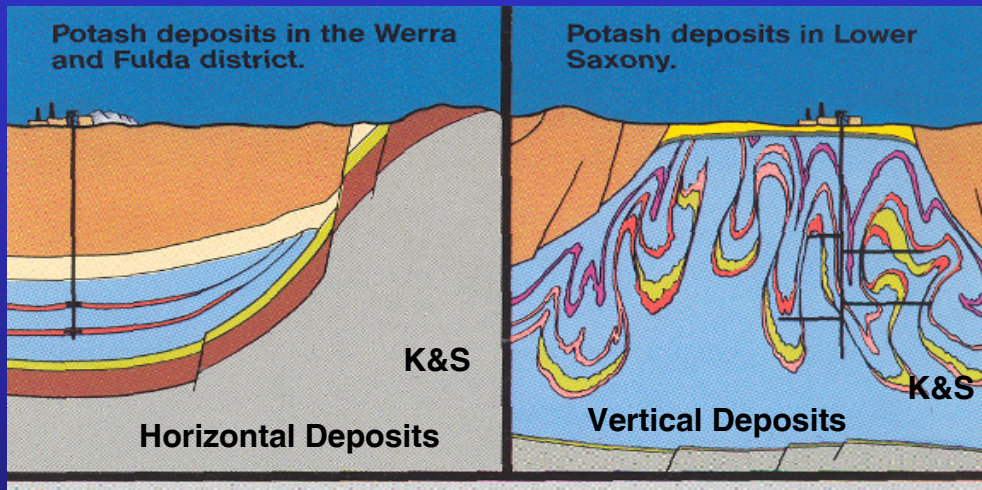
To examine potash test cover experience

Potash Mining



Potash Mining

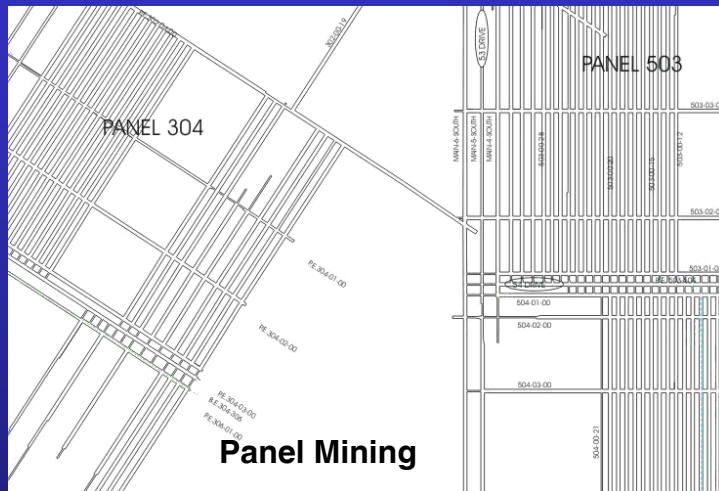
POTASH MINING



Potash Mining

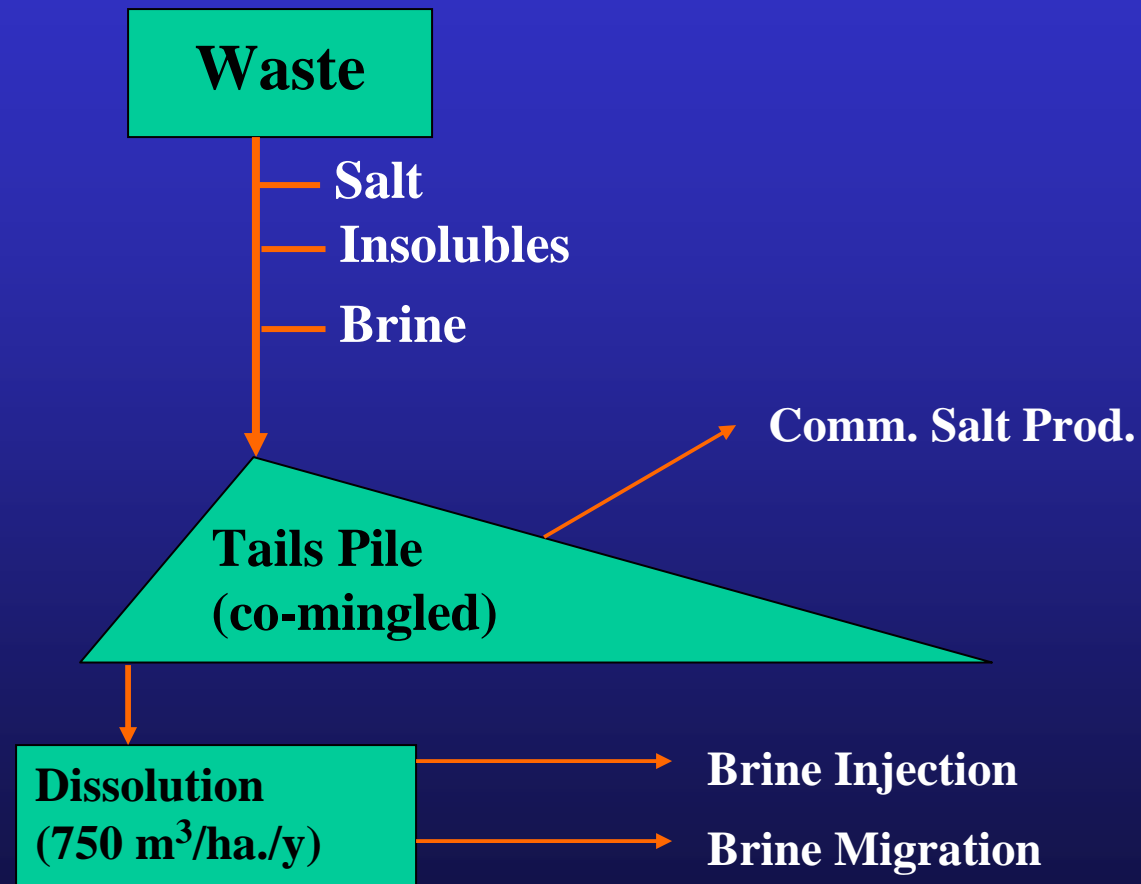


Horizontal Deposit Mining



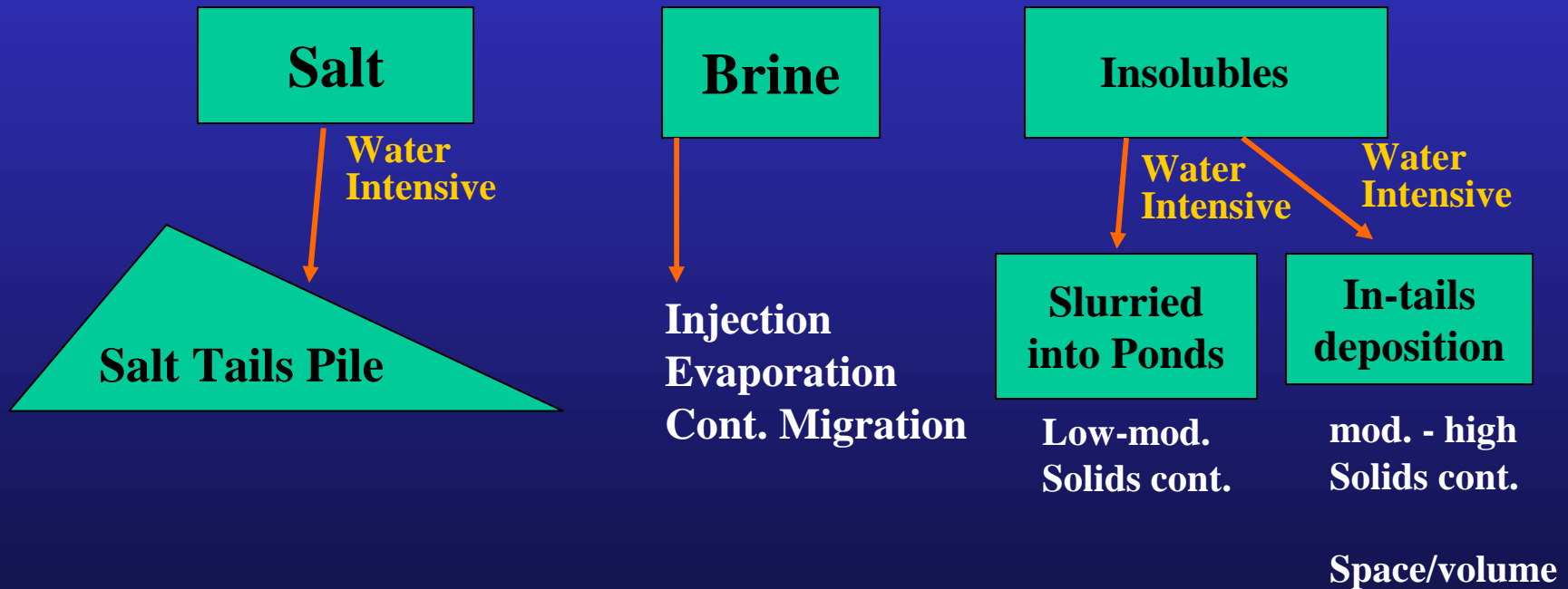
Potash Mining

Potash Mining Wastes



Potash Mining

Current Practice



Potash Mining

Potash Mining Wastes (co-mingled)

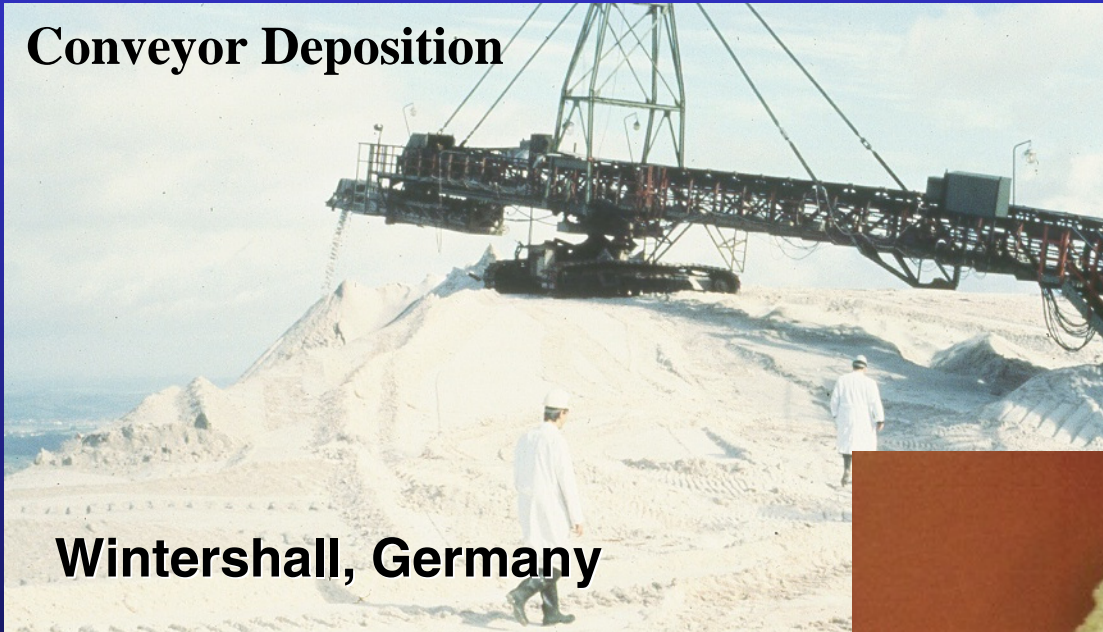
Salt
Brine
Slimes
(insolubles)



Potash Mining

Potash Mining Wastes

Conveyor Deposition



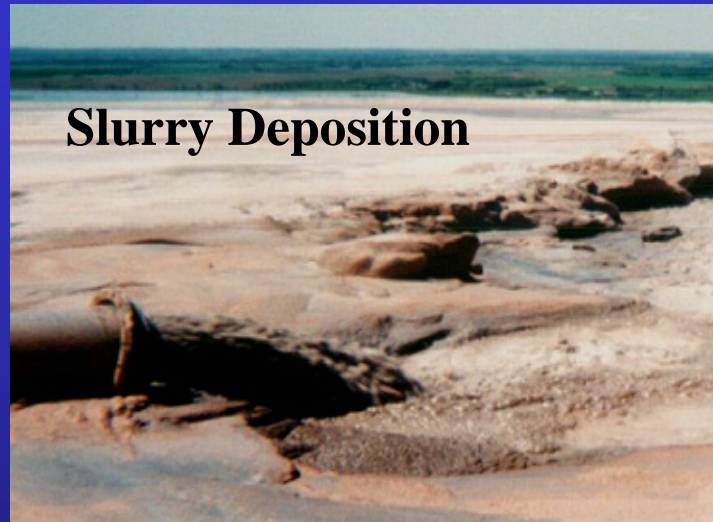
Wintershall, Germany



Potash Mining

Potash Mining Wastes

NaCl (Salt)



Potash Mining



Potash Mining Wastes

Slimes /insolubles
(with brine and fine salt)



10/21/2004

Insolubles Deposition



Soft Tailings

27/10/2004

Insoluble Composition (after Haug, 1988)

MINERAL PROPORTION (%)

Quartz	10.8
Sylvinite	19.9
Dolomite	27.4
Halite	21.3
Anhydrite	12.5
Kaolinite	6.2
Illite	1.9

Potash Mining

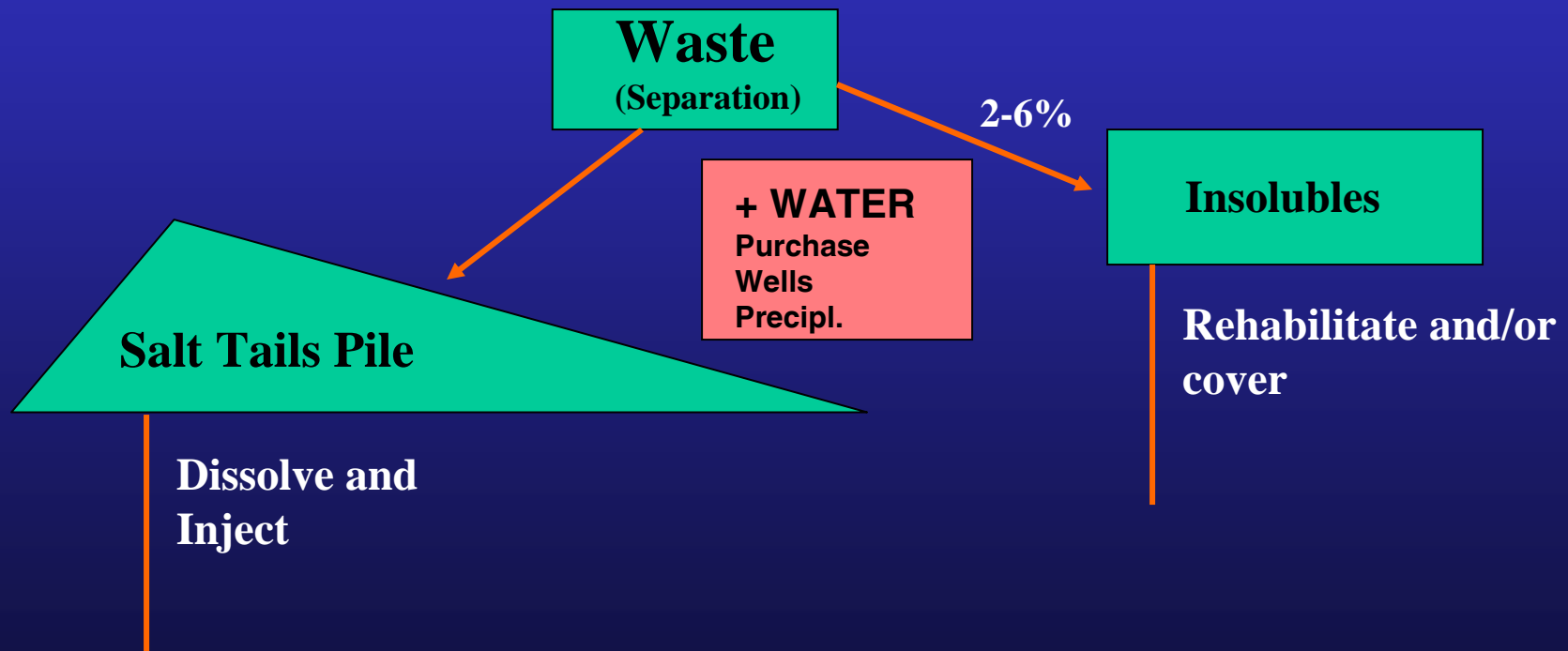


Potash Mining Wastes



Decommissioning

2005 Decommissioning Philosophy



Decommissioning

Other decommissioning Options for Salt



Covering

Underground Disposal

Storage and sale

Decommissioning

Other decommissioning Options for insolubles



Underground Disposal

Slimes Washing in Ponds

**Slimes Thickening in Mill
(debrining)**

Sub-aereal Deposition

Slimes Washing in Mill (CCD)
- salt and brine removal

Co-Mingling
- Traditional
- Non seg.

Potential Cover Materials

Cover Considerations

- 1) Pile Height
- 2) Slope Angles and Length
- 3) Solubility
- 4) Impact of Salt on vegetation
- 5) Overall Area



**K & S Wintershall
Tails Pile 240 m
Maximum slope > 40°**

Potential Cover Materials

Alternate Cover Research (Insolubles modification)

- 1) Lime
- 2) Cement
- 3) Fly ash

- Wet/dry cycles
- Freeze-thaw cycles
- Permeability
- Shear strength

Glacial Till
Polymerized Bentonite-sand
HDPE



Test Cover Experience

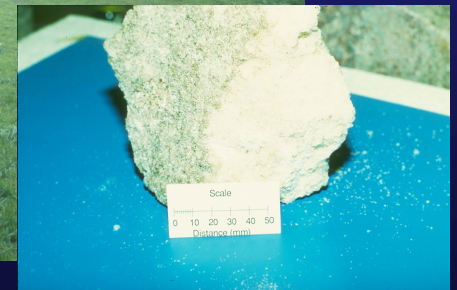


Germany

Sigmumshall, Germany



Test Plots
Dissolution
Features



Test Cover Experience

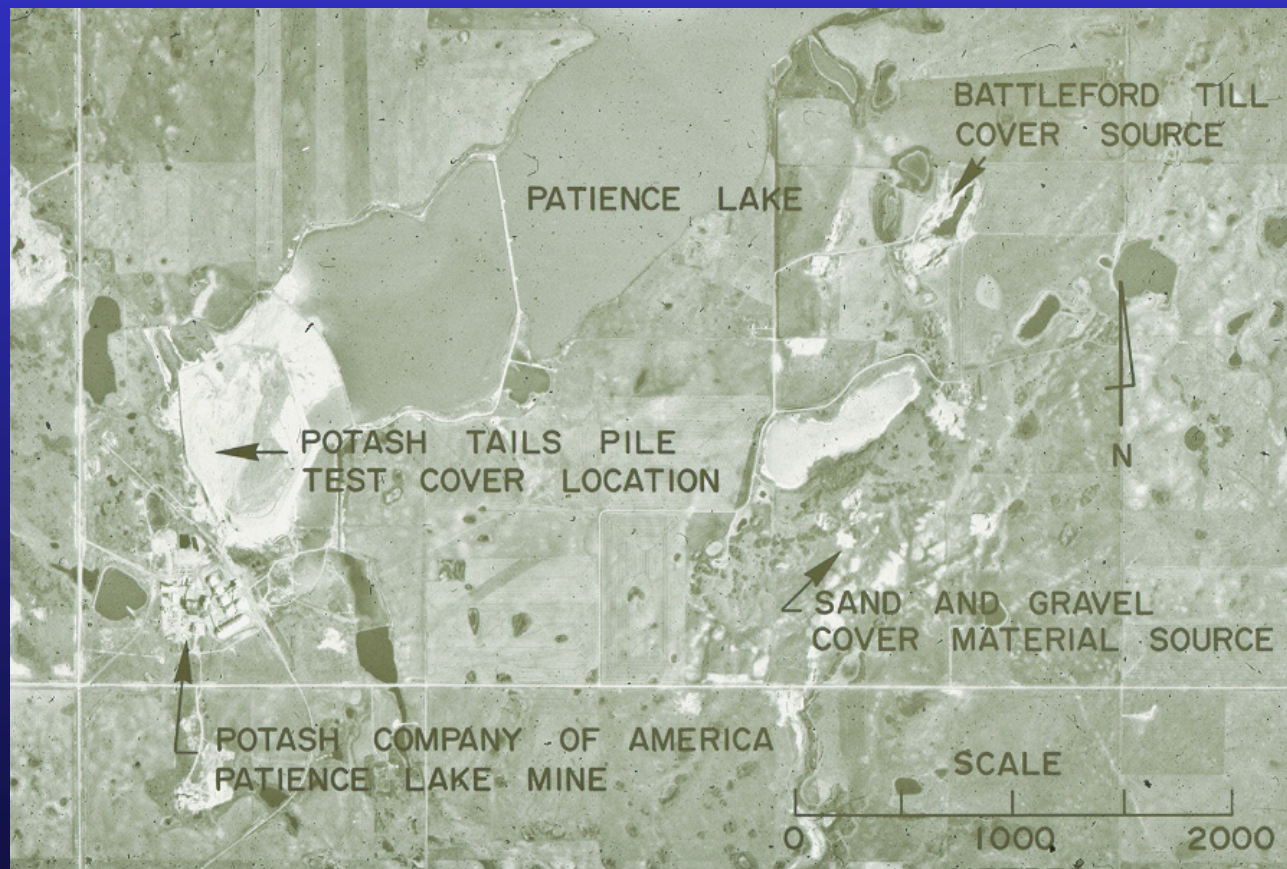


Germany



Test Cover Experience

Canada



Test Cover Experience



Canada

Glacial Till



1989



Polymerized bentonite-sand 1989



HDPE 1989

Test Cover Experience



Canada



HDPE



Test Cover Experience

Canada



Test Cover Experience



Canada

Glacial Till



Test Cover Experience



Canada



Summary



Future Research

Detailed investigation into Patience Lake test cover

- Changes in Density and Water Content
- SWCC changes
- Audit of natural vegetation
- Wildlife assessment
- Calculation of changes in tailings dissolution rate