Mechanism for Vertical Ionic Migration

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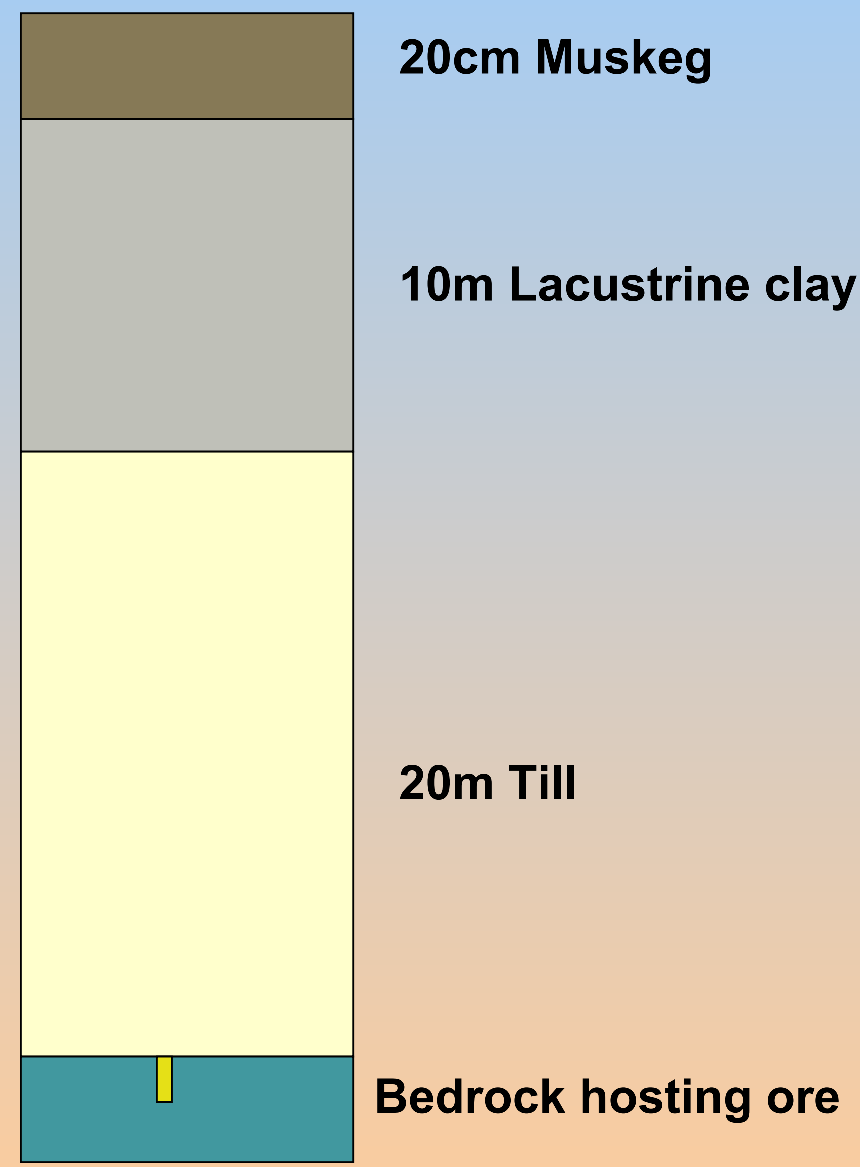
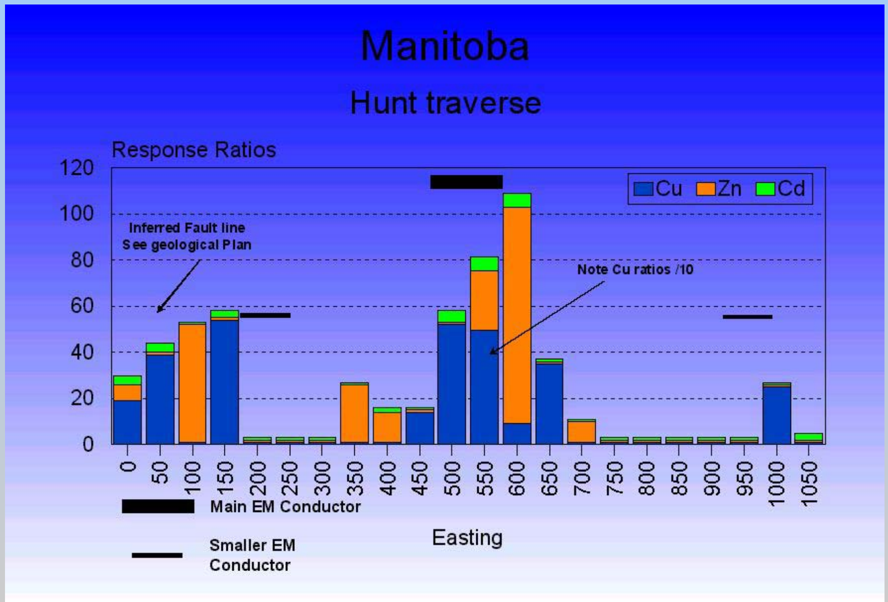
Hunt Transect -Manitoba

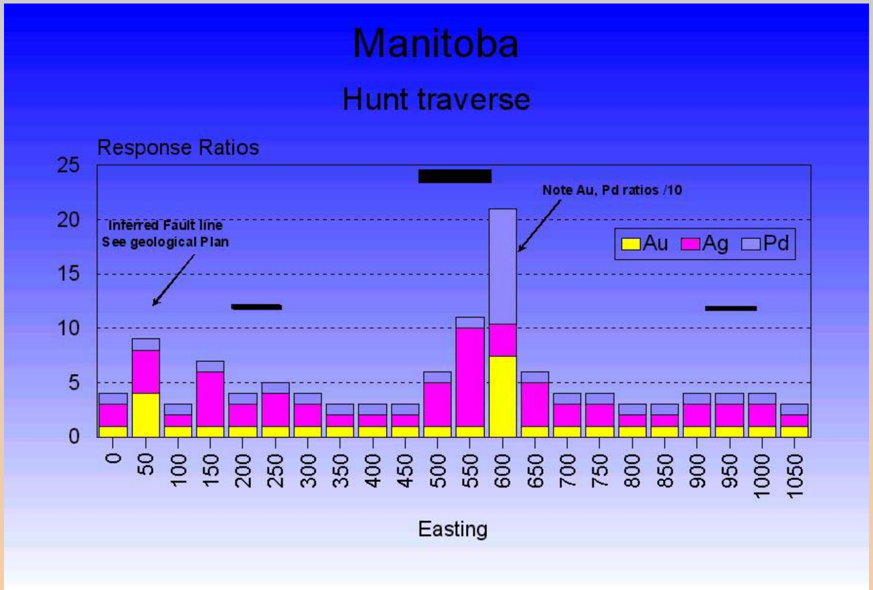
Profile


20cm Muskeg
10m Lacustrine clay
20m Till
Bedrock hosting ore



MMI-A

MMI-B



Data Courtesy
Mark Fedikow
Dan Ziehkle

Evidence for vertical migration

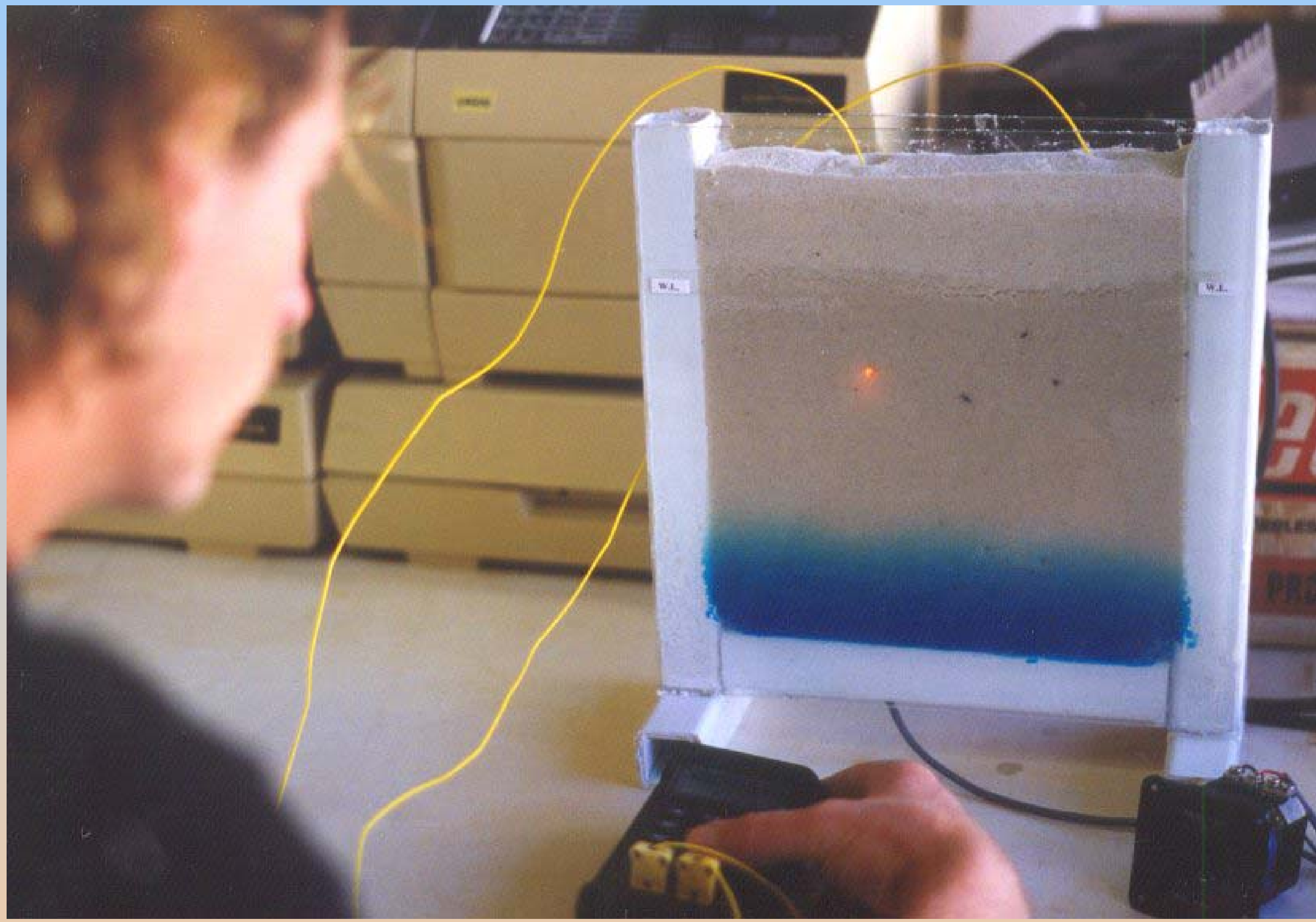
- High resolution geochemical techniques provide geochemical signals over ore deposits
- Some of these are over demonstrably transported overburden (eg glacial terrain, Canada, salt lakes, Australia)
- These anomalies are sharp , and vertically above mineralization

Potential models

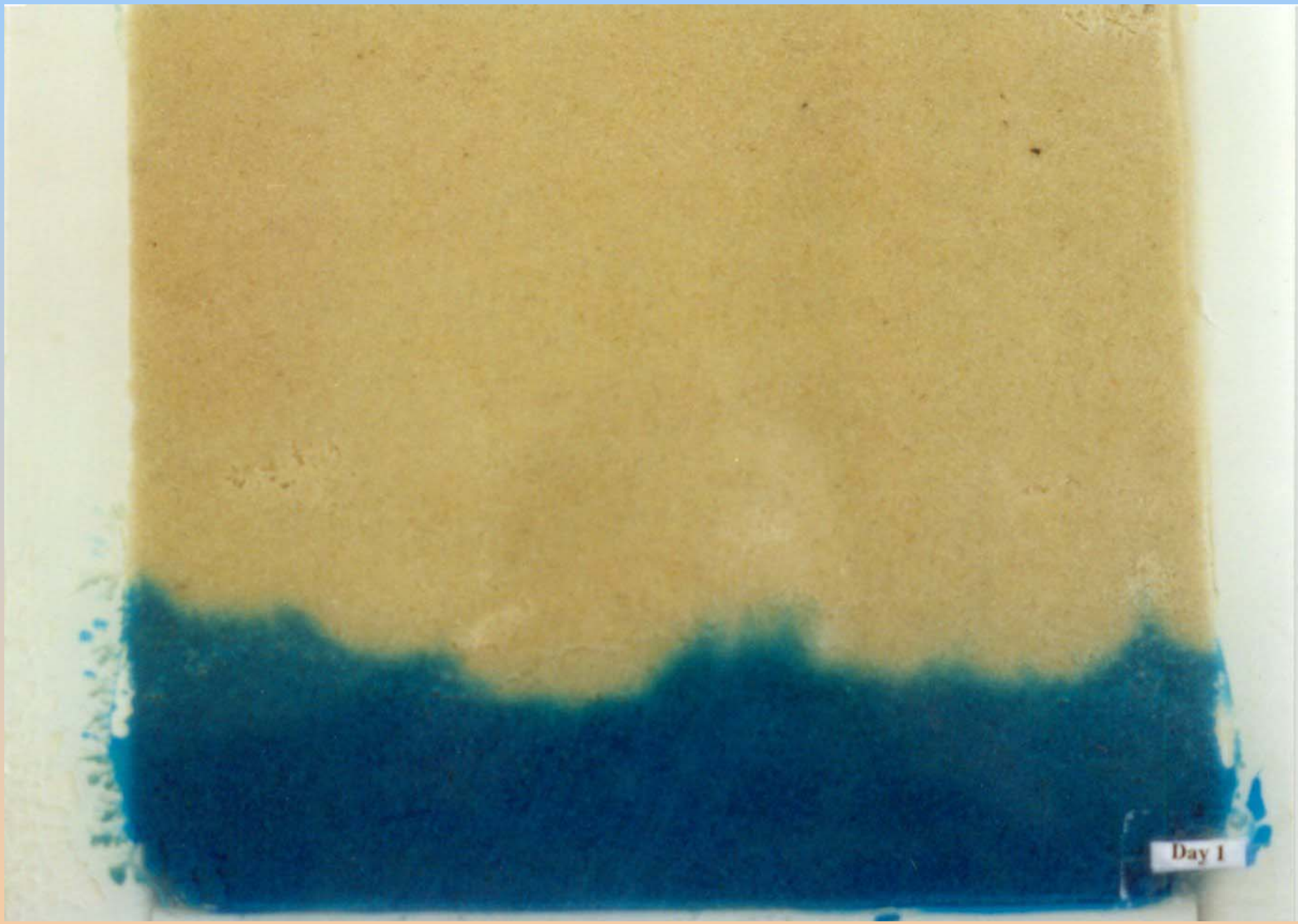
- Gaseous
- Electrochemical
- Diffusion
- Capillary rise/ evaporation

Brown & Webster Concluded (MERIWA Project 1993-1995)

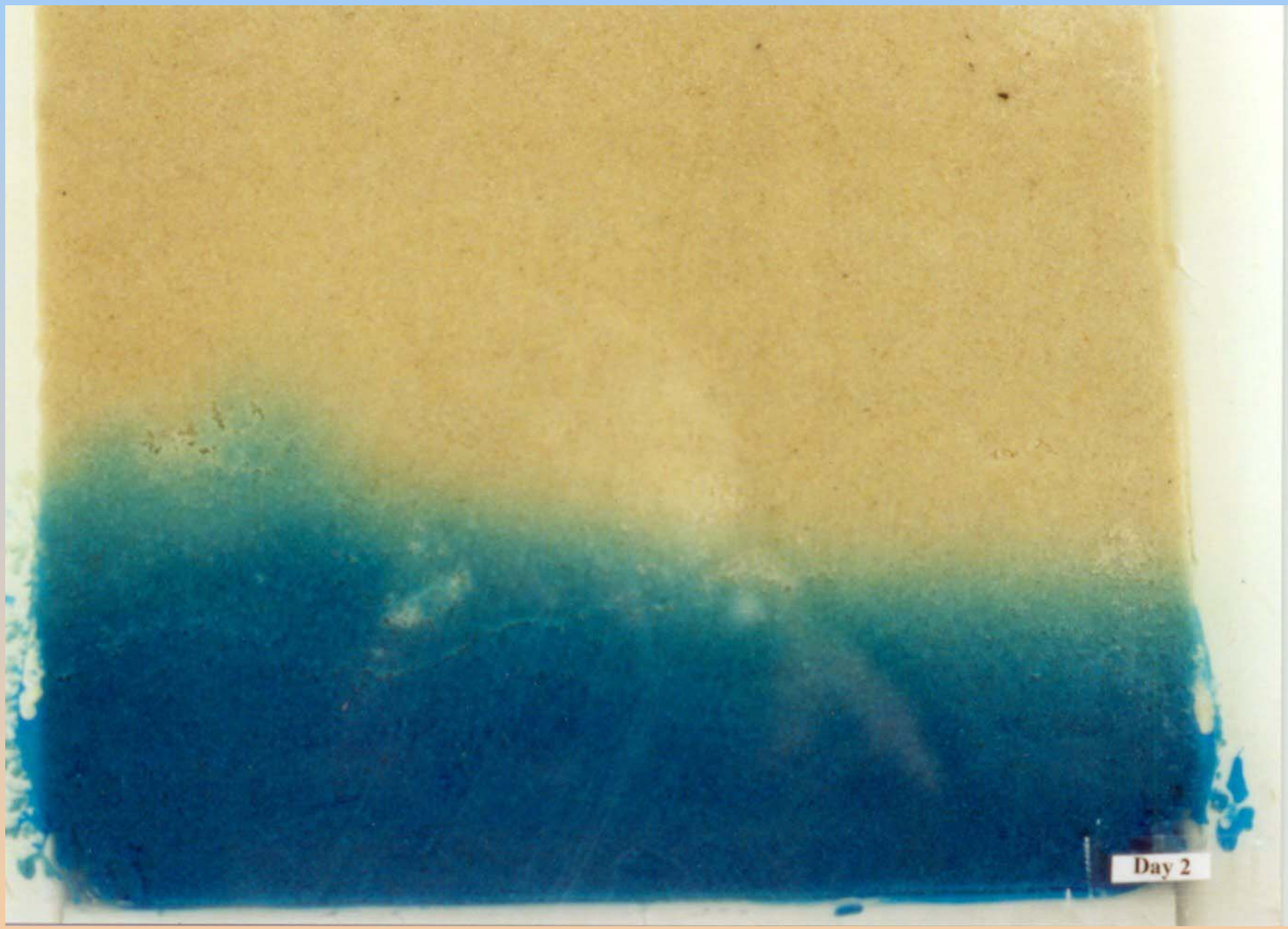
- Gaseous mechanism possible – but complicated, supporting evidence “thin”
- Chemical imbalances may produce “electrical” consequences
- Diffusion too slow, too broad
- Capillary rise likely only above the W.T.
- Did not consider Convection



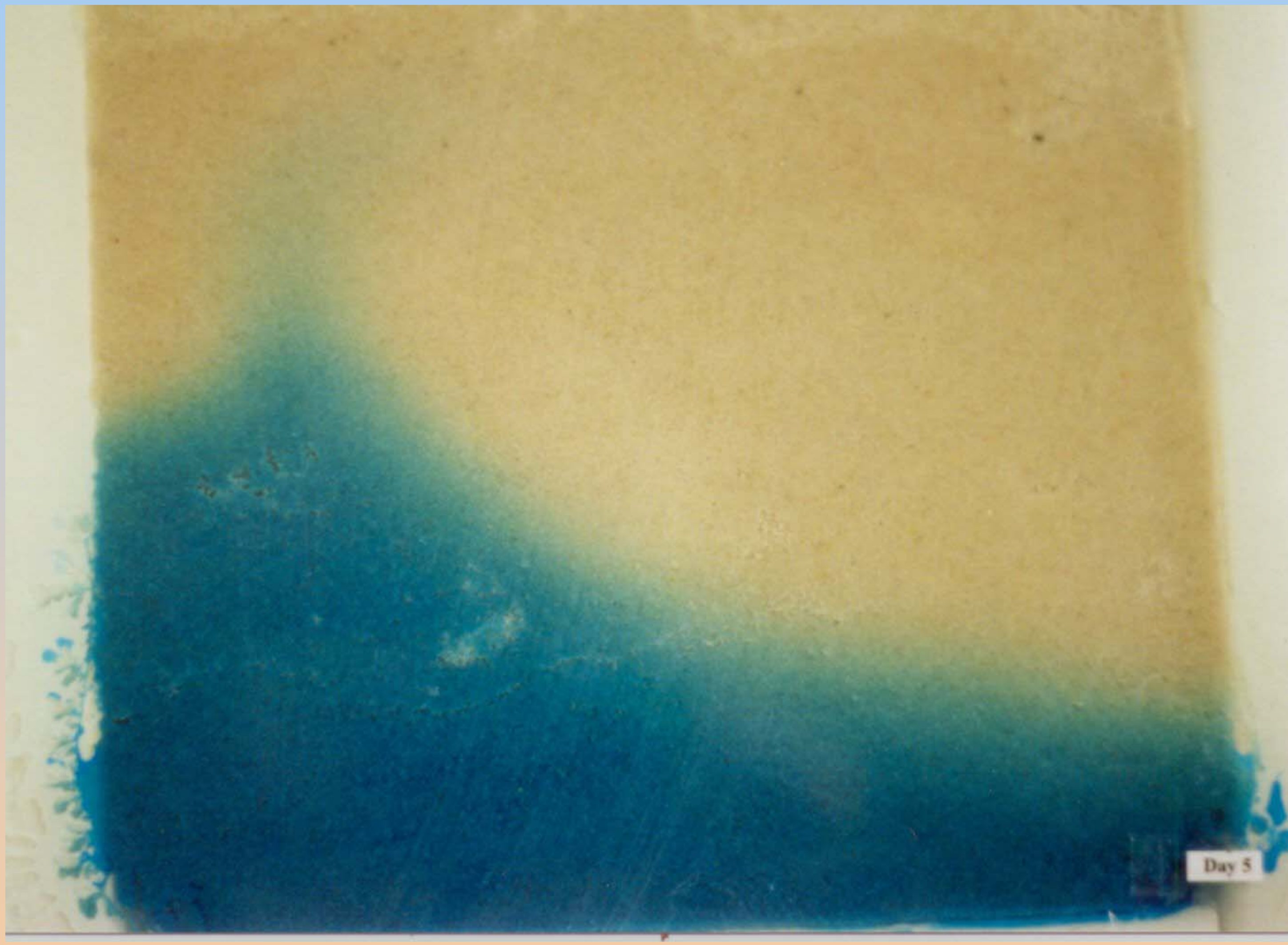
Experiment set-up. A rheostat attached to a light bulb is adjusted to provide a 1 degree centigrade temperature differential, in a water saturated sand column. The water in the lower part of the sand-filled box has been impregnated with blue dye. The bottom part of the box was photographed every day for a week.



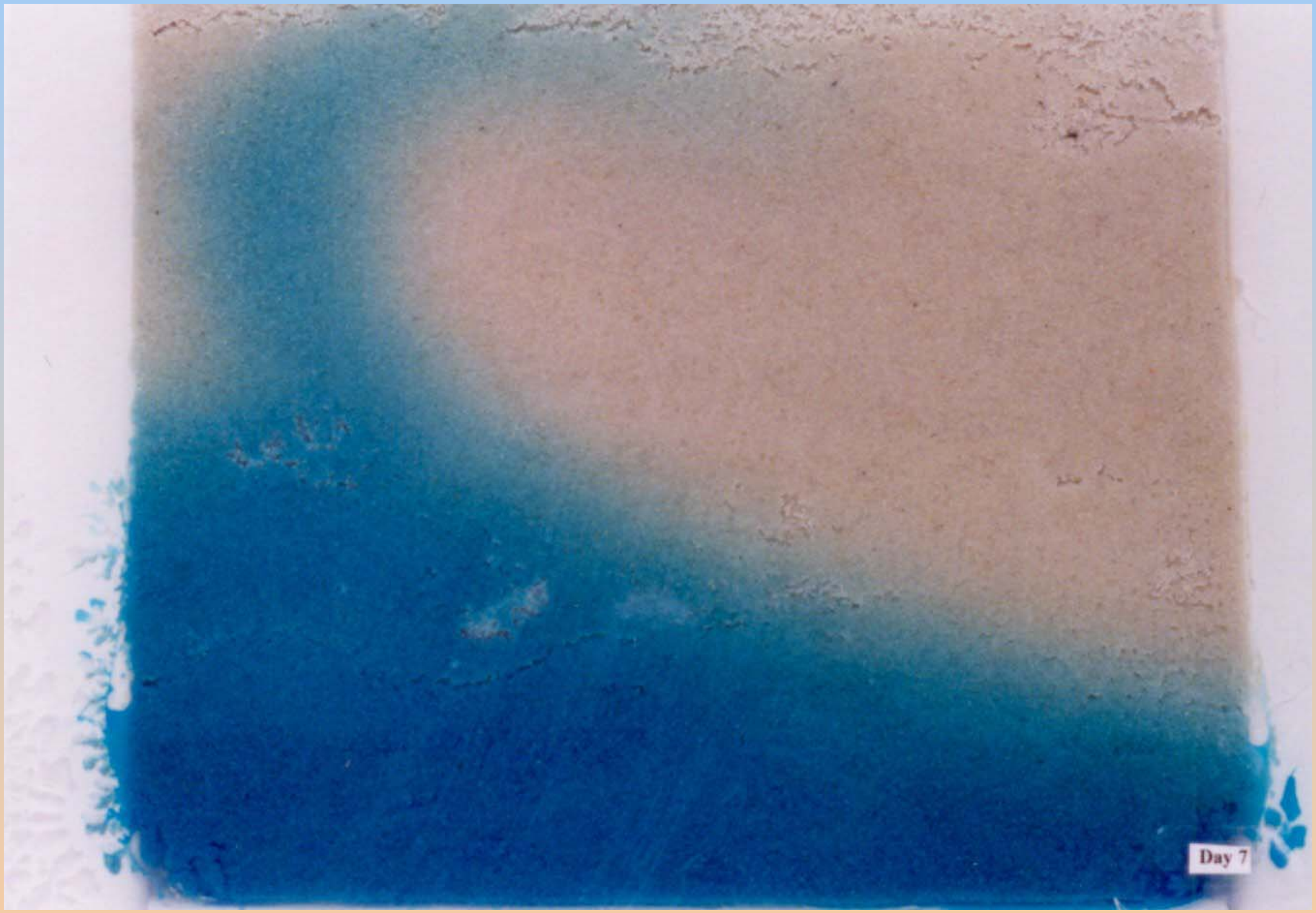
T=1 day. The interface of the blue dye and water is undisturbed.



T=2 days. A "disturbance" of the blue dye interface develops around the heated zone.



T=5 days. A vertical “plume” of dye ascends directly above the heat zone.



T=7 days. The “chimney above the heat source has reached the water surface.

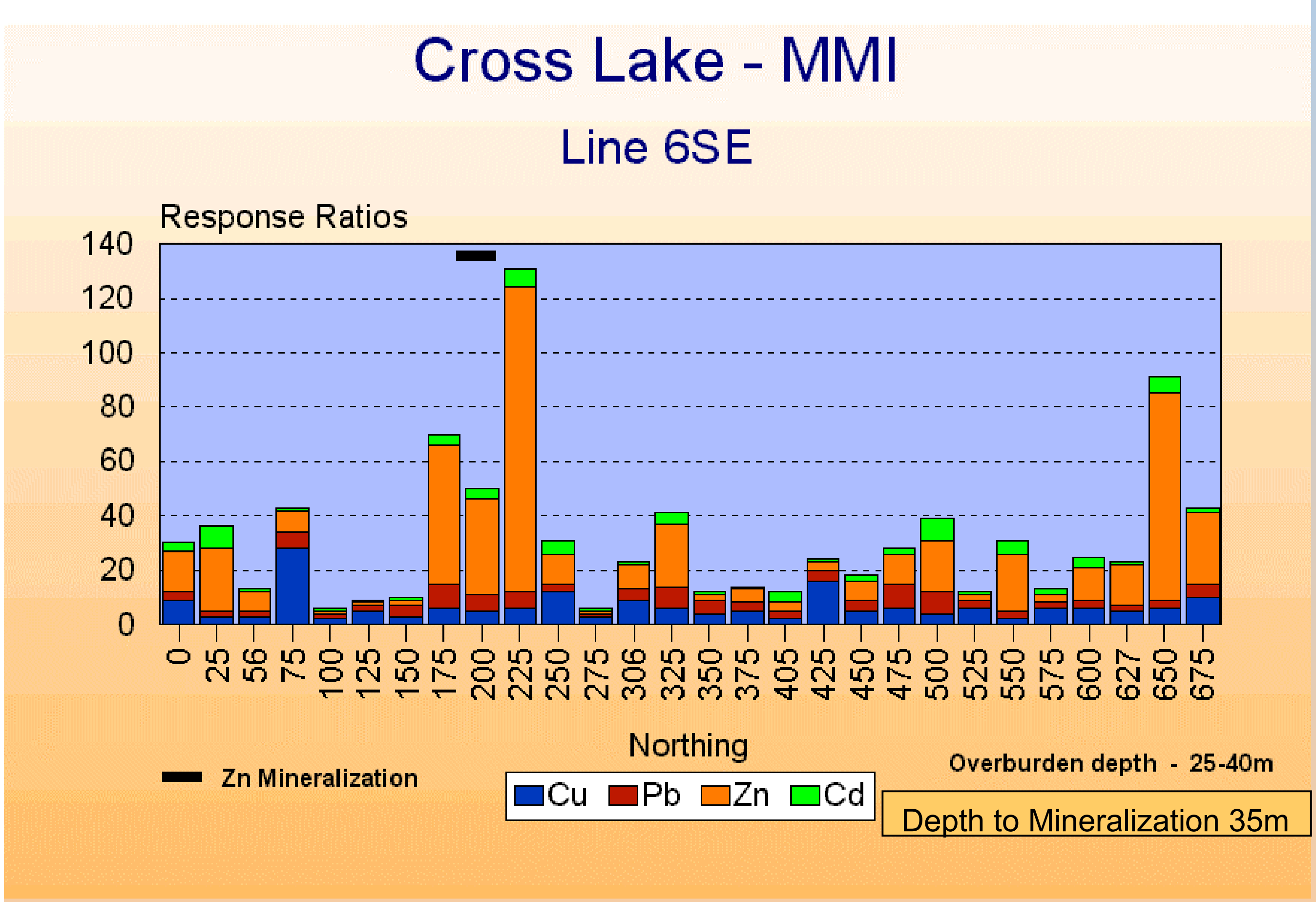
Imprint of blue dye

Some six weeks after the experiment ceased (ie light (heat) was turned off), an imprint of dye just below the surface was noted. This has occurred by capillary rise from the water, and evaporation near the sand surface .

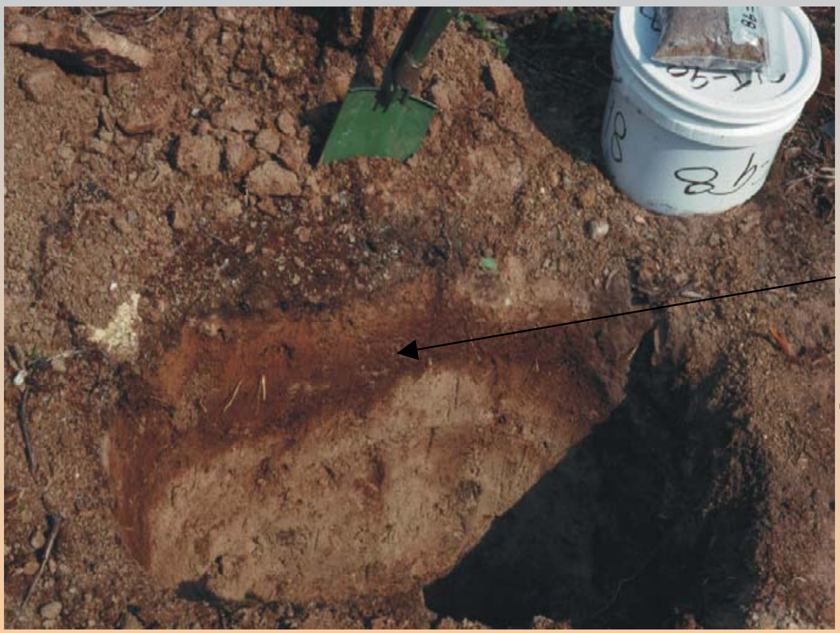
Is this process likely to occur or contribute in nature?

- Oxidation of sulphides is exothermic
- Eg Zn to $ZnSO_4$ 190 kilocalories per mole
- 1g of ZnS oxidizing would heat 190cm column (1sq cm) by one degree centigrade
- Temperature differentials of 1-2 degrees are measured beneath water tables over the top of orebodies and “reduction zones”

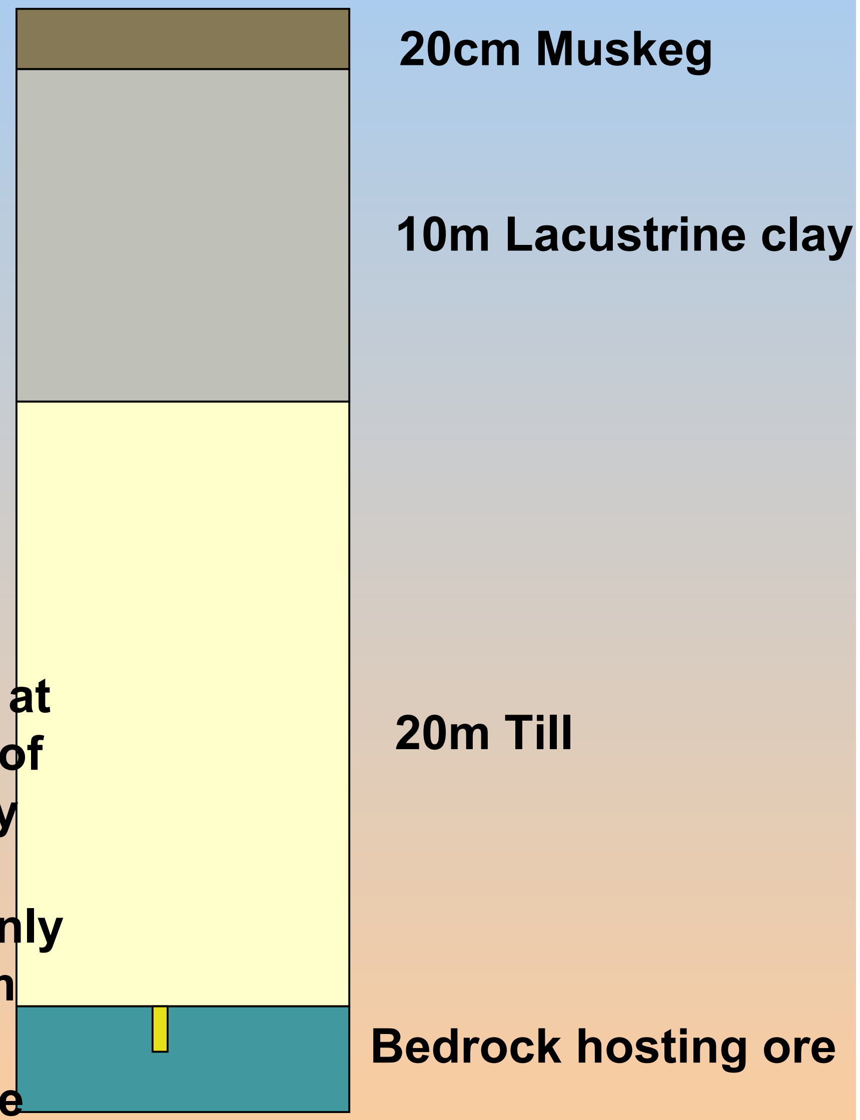
Example I - Cross Lake
MMI & Interpreted Profile
(Data Courtesy CAMIRO)



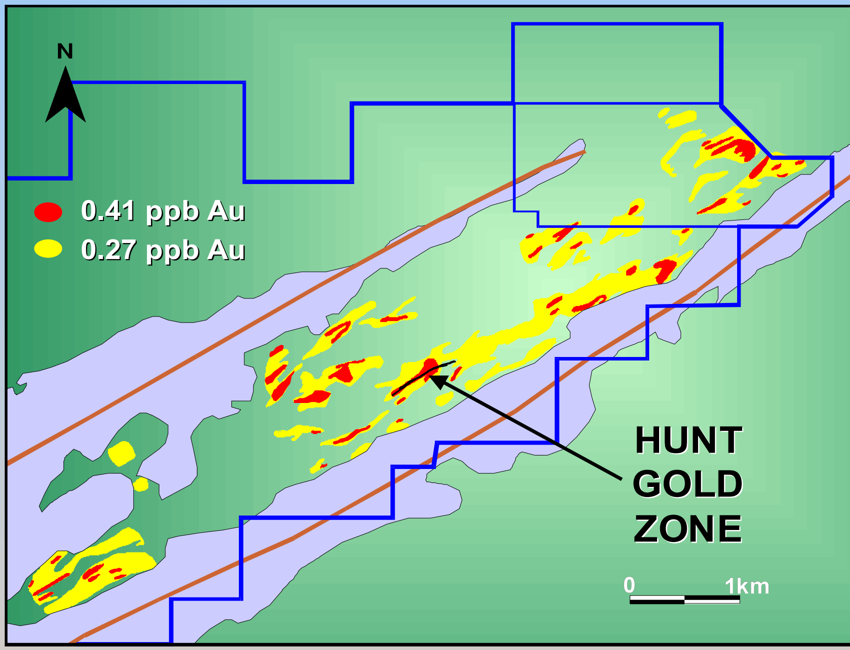
Example II – Hunt Gold Zone Northern Manitoba



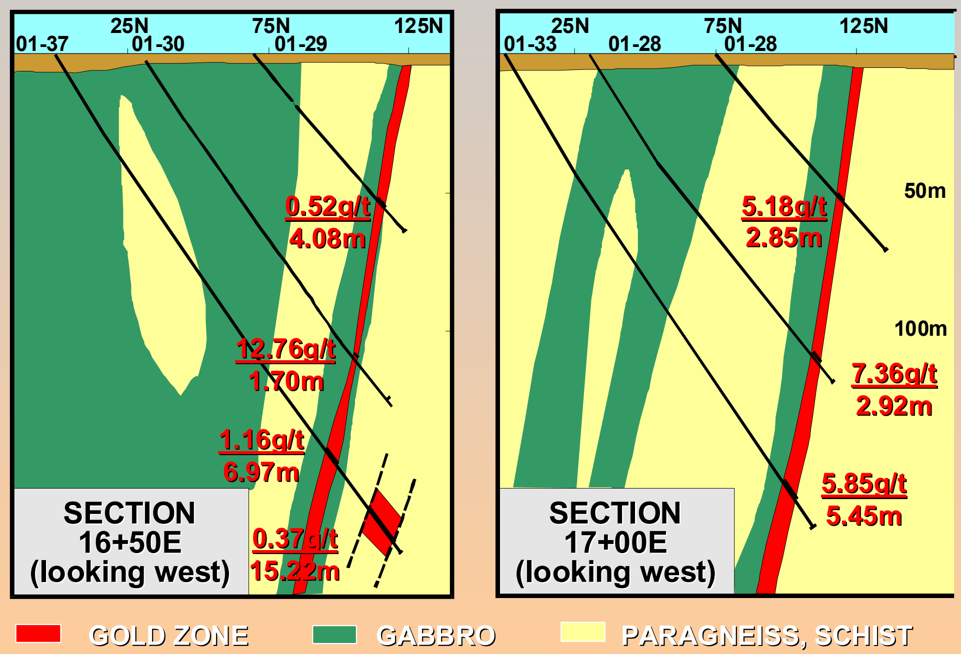
Sample at the top of capillary fringe – commonly 10-15cm below interface



MMI Au Geochem



1. Hunt Zone intersected by 24 holes
2. Strike length 700 metres
3. Drilled to depth of 150 metres (open)
4. Grades up to 9.37 g/t gold over 8.15 metres in well-defined ore shoot
5. Typical of shear-hosted gold deposits in Precambrian terrains in Canada



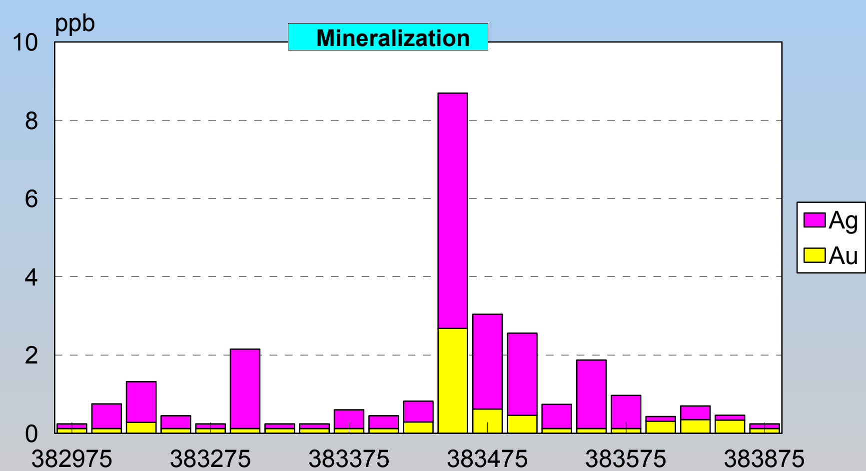
Courtesy
Mark Fedikow &
International Curator

Example III Salt Lakes – Western Australia

Environments with 10-100m of “stable” lacustrine sediments

MMI - Salt Lakes, W.A.

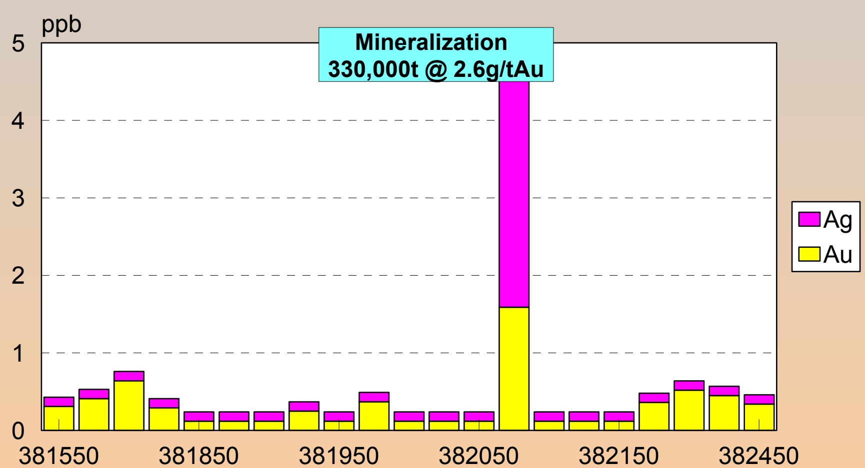
Swordfish, L. Cowan



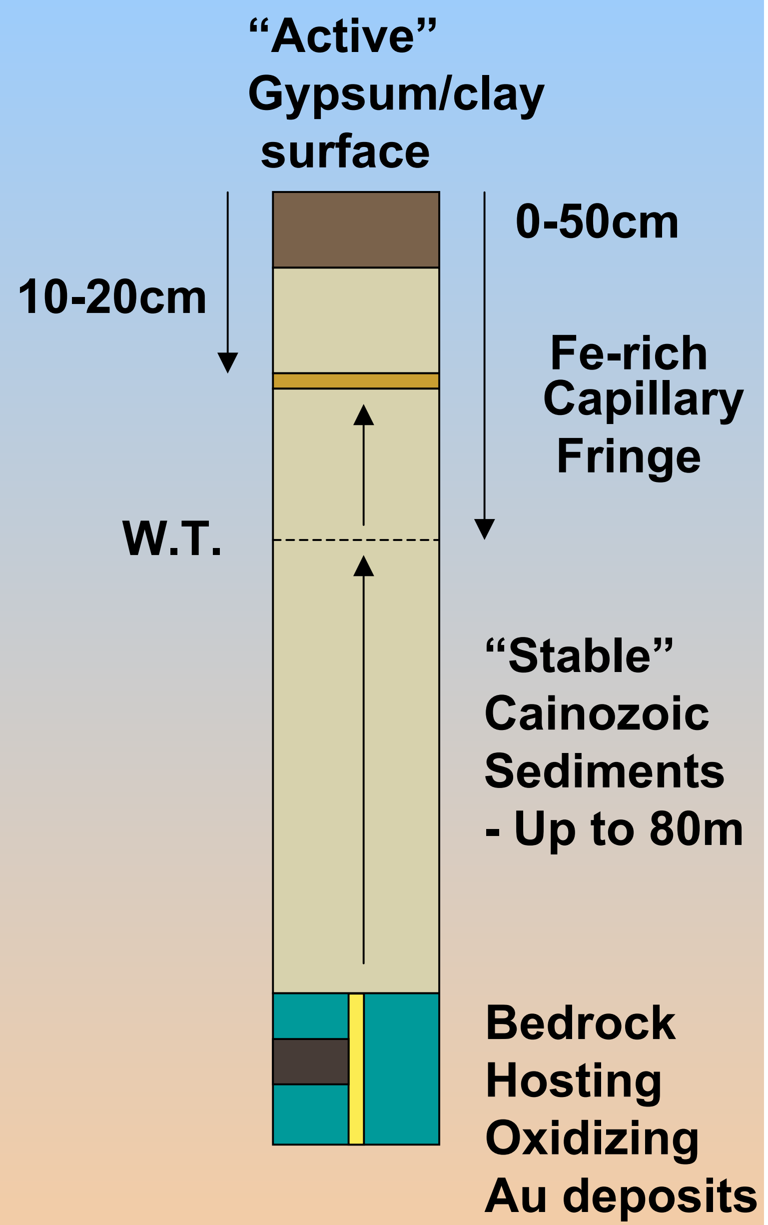
Courtesy Croesus Mining, Original data W.M.C.

MMI - Salt Lakes W.A.

Cobbler - L. Cowan



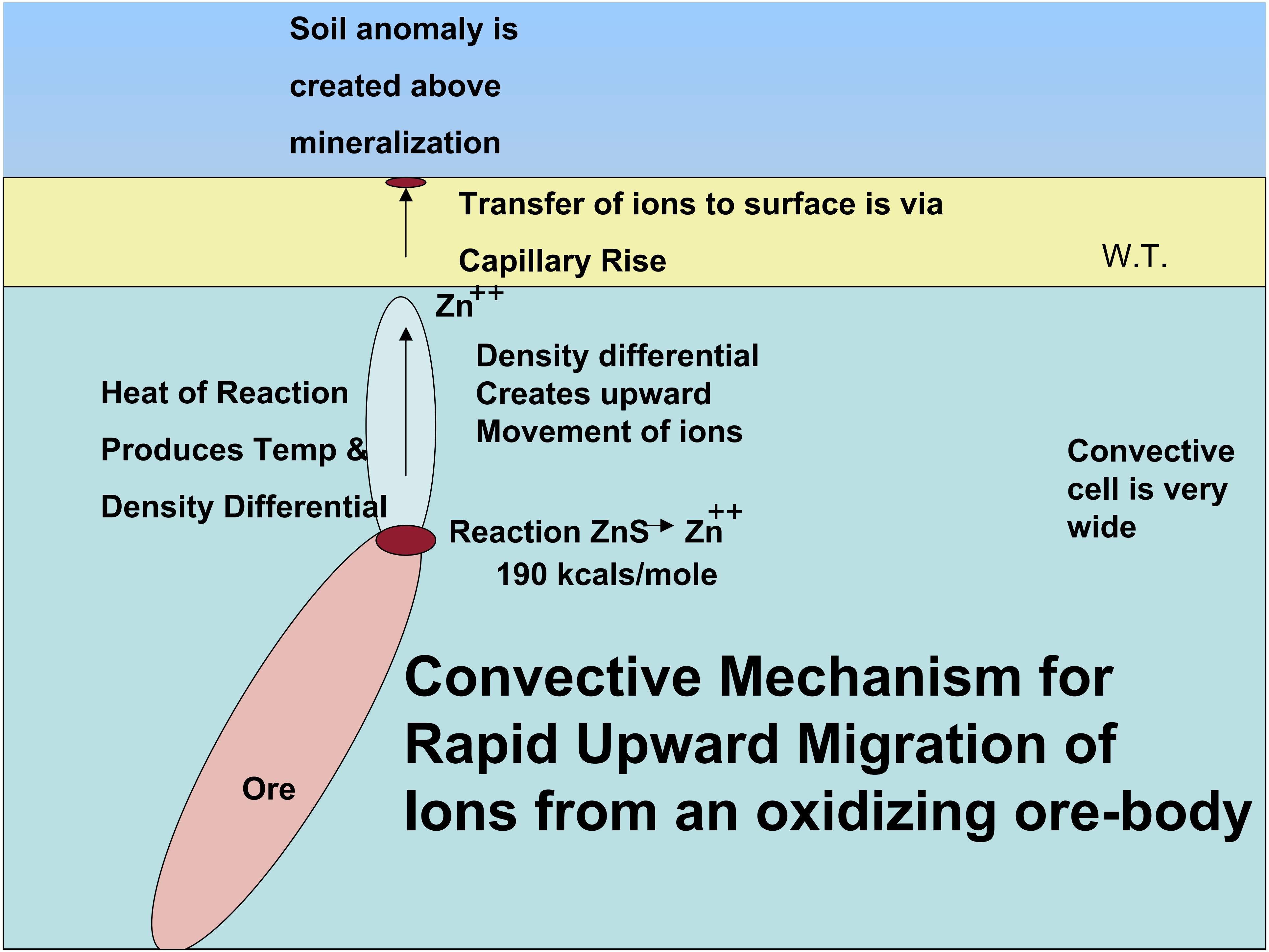
Courtesy Croesus Mining, Original Data W.M.C.



Capillary fringe is a gypsum layer with Fe-rich bands

Sampling position is upper part of Fe rich layer -about 10-15cm below surface

Depth-type orientations are useful


Soil anomaly is created above mineralization
Transfer of ions to surface is via Capillary Rise
W.T.
Zn++
Density differential Creates upward Movement of ions
Heat of Reaction Produces Temp & Density Differential
Convective cell is very wide
Reaction ZnS→ Zn++
190 kcals/mole
Ore
Convective Mechanism for Rapid Upward Migration of Ions from an oxidizing ore-body

Consequences (if true)

- Oxidation of an orebody is required to produce surface geochem anomalies

- Non-oxidized sulphide deposits will have limited surface expression

- Gold deposits require oxidizing accessory sulphides to help generate vertical plumes

Questions raised

- Is the rate of oxidation of an ore-body sufficient to generate anomalies seen?
- Can T differentials of less than one degree also create convection?
- If convection is not a mechanism how is the heat generated by an oxidizing ore-body dissipated?

Conclusions

- Gaseous mechanisms are not precluded (particularly above the water table)
- Electrochemistry not precluded (particularly below the water table)
- Diffusion is no longer a pre-requisite of “wet models”
- Convection coupled with capillary rise and evaporation will contribute in the appropriate environments (e.g. glacial overburden and salt lakes)