Workshop on Salinity, sodicity and soil management under irrigated horticulture

Robinvale 19-20 Sept. 2019

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The effect of dust-borne sodium and salt on landscape processes

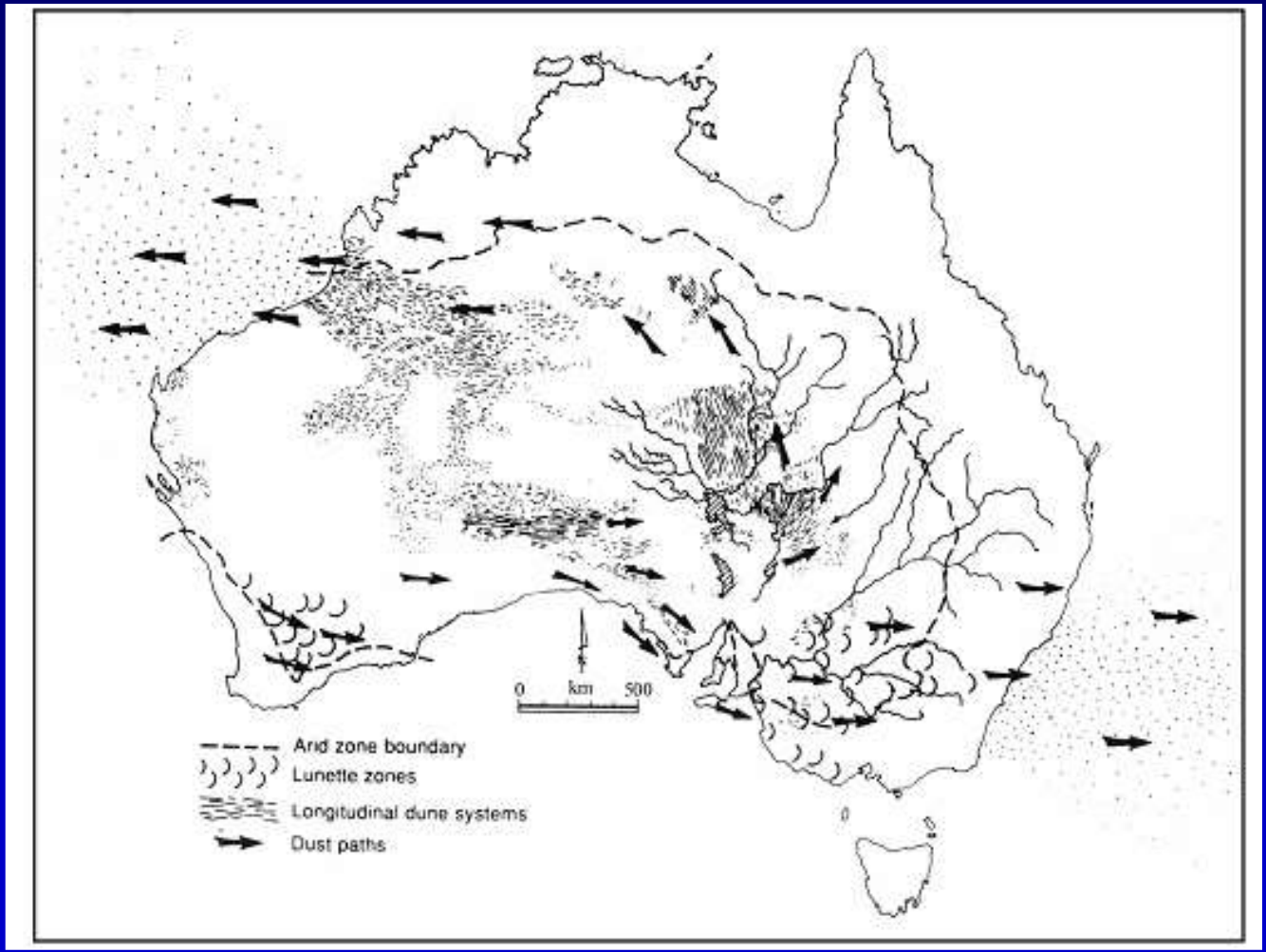
Content

- 1. Aeolian input into landscapes of Riverine Plain of SE Australia
- 2. Salt transport and deposition by dust
- 3. Permeability of saline-sodic soils
- 4. Amelioration using gypsum
- 5. Conclusions

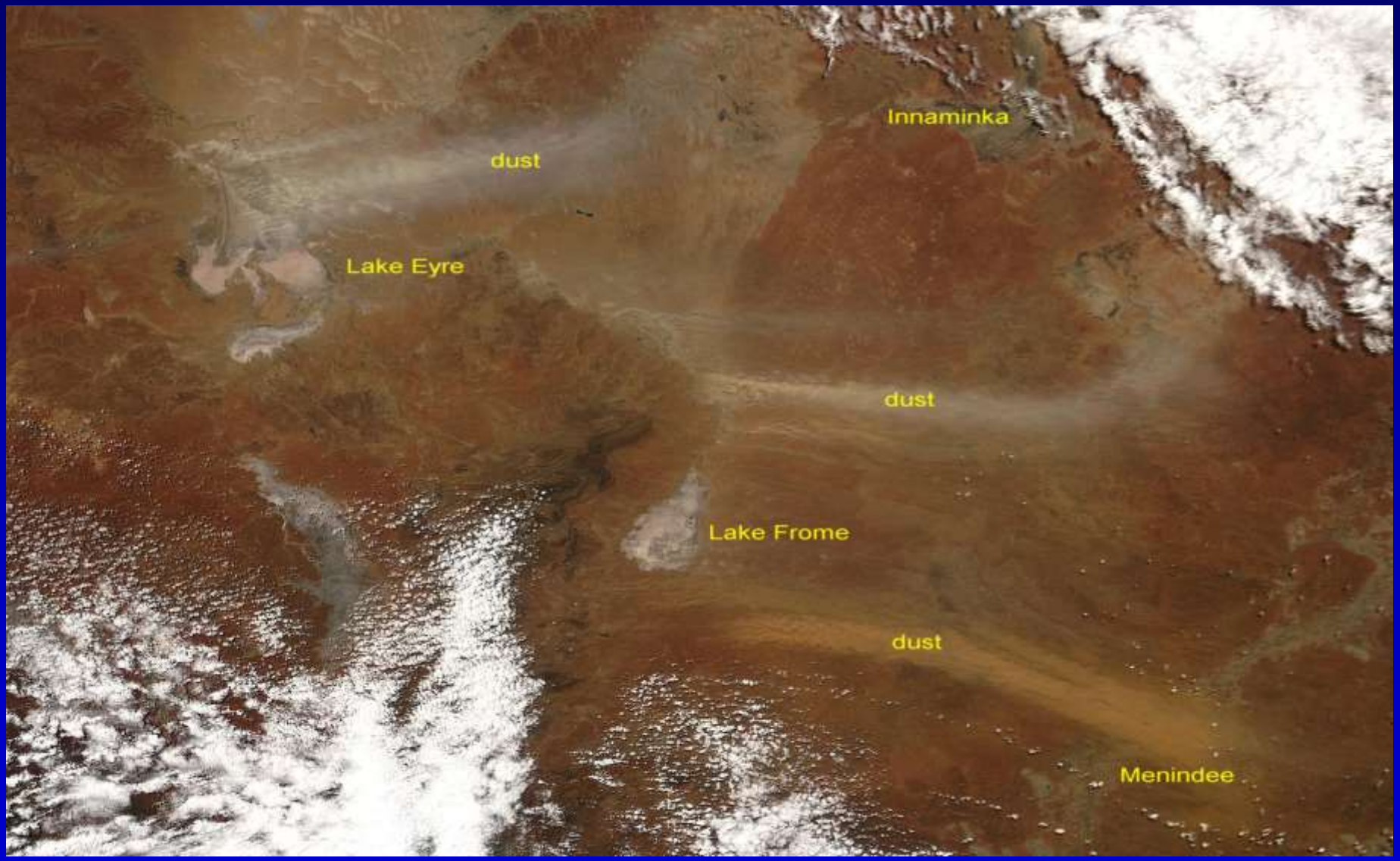
Introduction to Aeolian Inputs

- Various landform features in the Mallee region provide strong evidence of aeolian activity, e.g. lunettes, Boinka gypsum ridges and parna deposits.

Aeolian source areas and dust paths in Australia (Bowler, 1976))

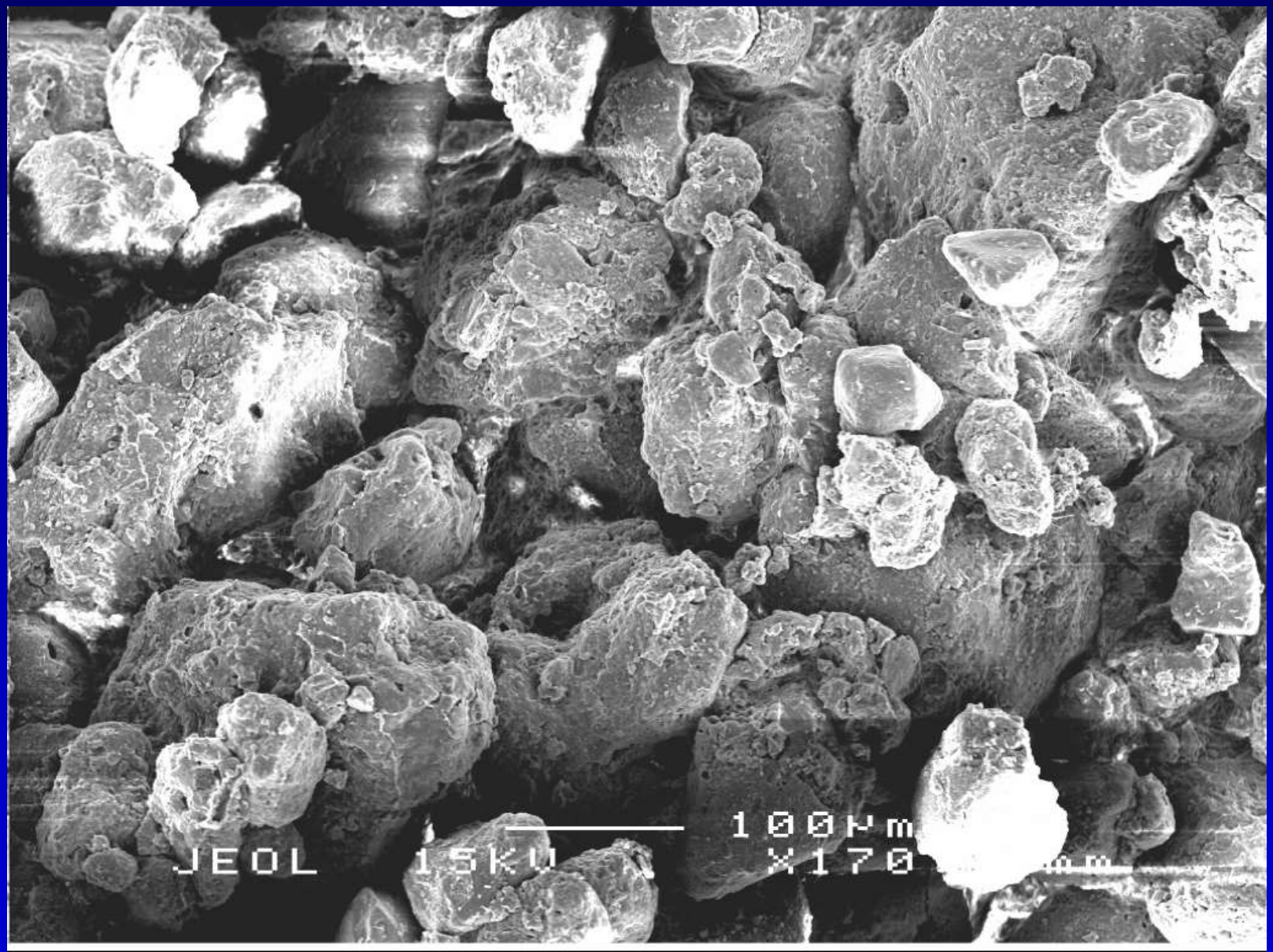


Dust transport from L. Eyre Basin (Courtesy of Dustwatch Oct. 2002)



Source bordering dunes via L.Cooper, Victoria

Parna Aggregates in source bordering dunes



Salt sources

- Salts in the Australian landscape are dominated by Na-salts
- Sources of salts will vary in different parts of the landscape
- Sources of salts:
  - cyclic salts (blown in from oceans)
  - aeolian deposition (can be associated with dust)
  - mineral weathering (generally slow)
  - connate sources from marine sediments (various with location)

Salt transport by aeolian dust (Shiga et al. 2011)

Relationship is highly controversial?

Dust and salt accumulation in lakes & playas

Shiga et al. (2011)

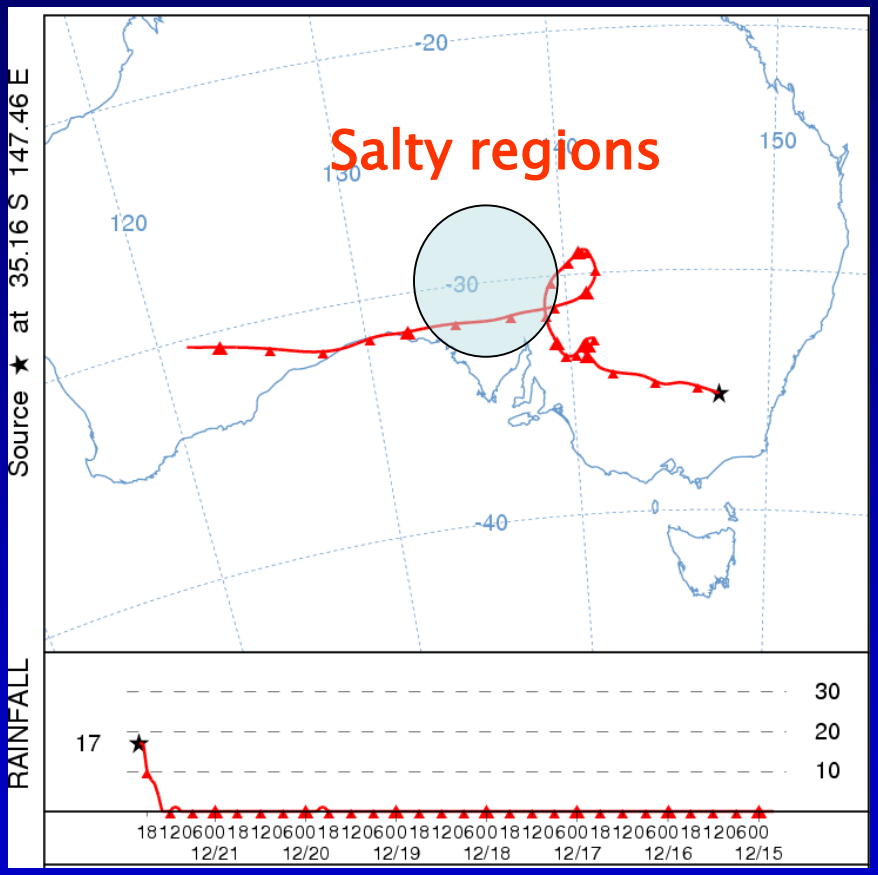
- **Used Ion Beam Analysis to chemically characterise dust deposited at various sites across south-east Australia.**
- **Used a set of equations and global values for elemental ratios to determine the contribution of terrestrial (and oceanic) NaCl to aeolian dust; verify these results using Principal Component Analysis.**
- **Used Back Trajectory Analysis to identify potential source areas for the salt associated with aeolian dust deposited across south-east Australia.**

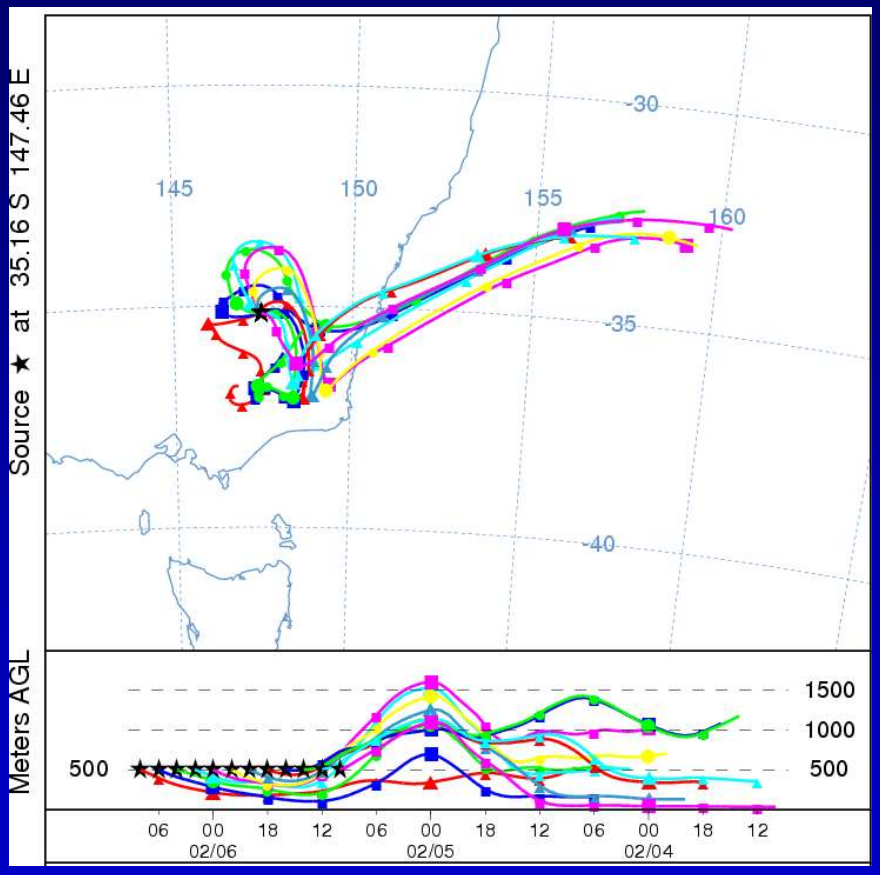
Calculated terrestrial salt component in dust samples from selected sites in SE Australia

Sample		ts ratio (ts / total)
Wagga Wagga	**Dec. 2007**	**0.122**
Wagga Wagga	Jan. 2008	0.000
Wagga Wagga	**Feb. 2008**	**0.000**
Wagga Wagga	Mar. 2008	0.000
Wagga Wagga	Apr. 2008	0.000
Melbourne	Apr. 2008	0.114
Melbourne	**Nov. 2007**	**0.000**
Melbourne	Mar. 2008	0.000
Adelaide	Feb. 2008	0.225

Can we use BTA to explain differences between high and zero ts values?

Back Trajectory Analysis – Wagga Wagga
Dec. 21st 2007, & Feb. 6th 2008





Dec. 21st2007

20 hrs (high ts) Note high rainfall at site

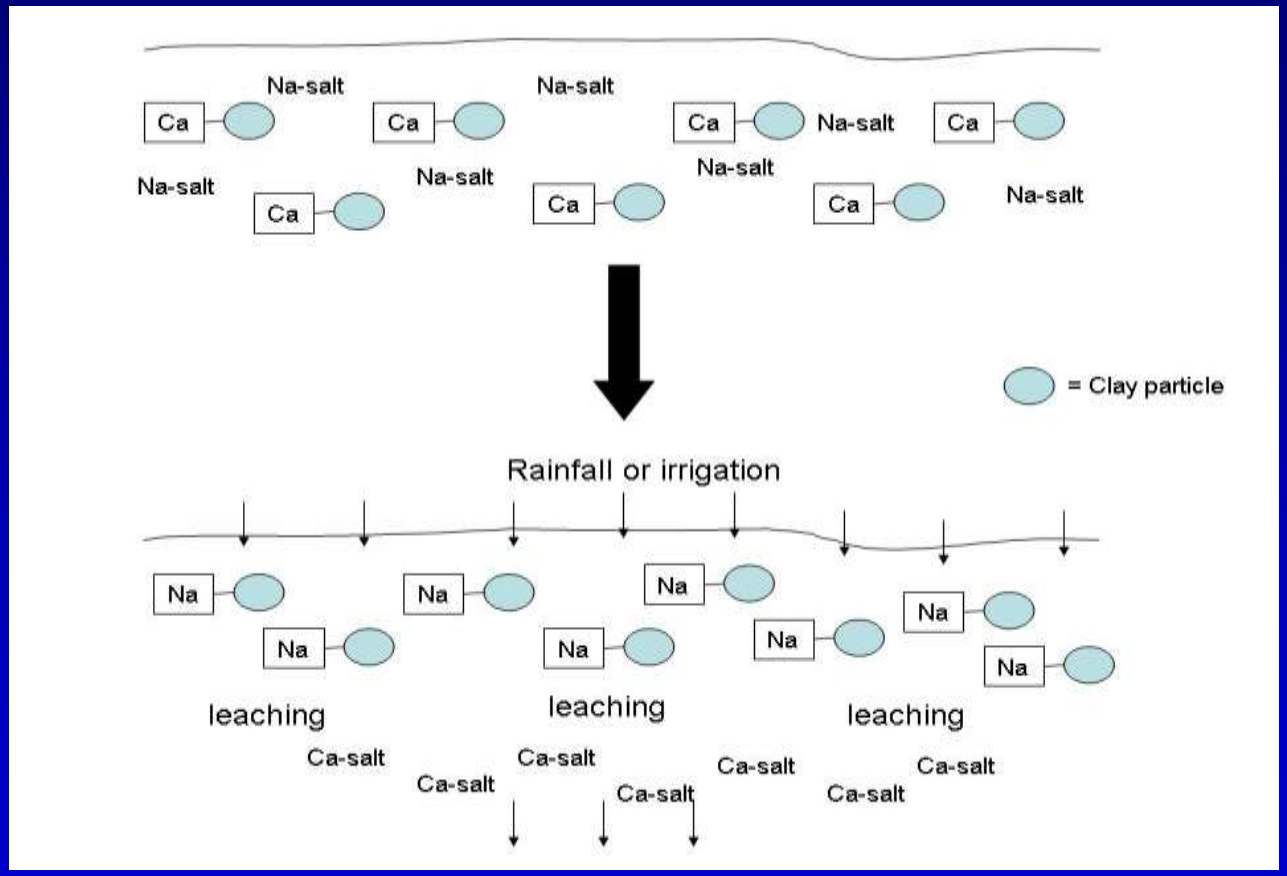
Feb. 6th 2008 (zero ts)

Salt loading to soil

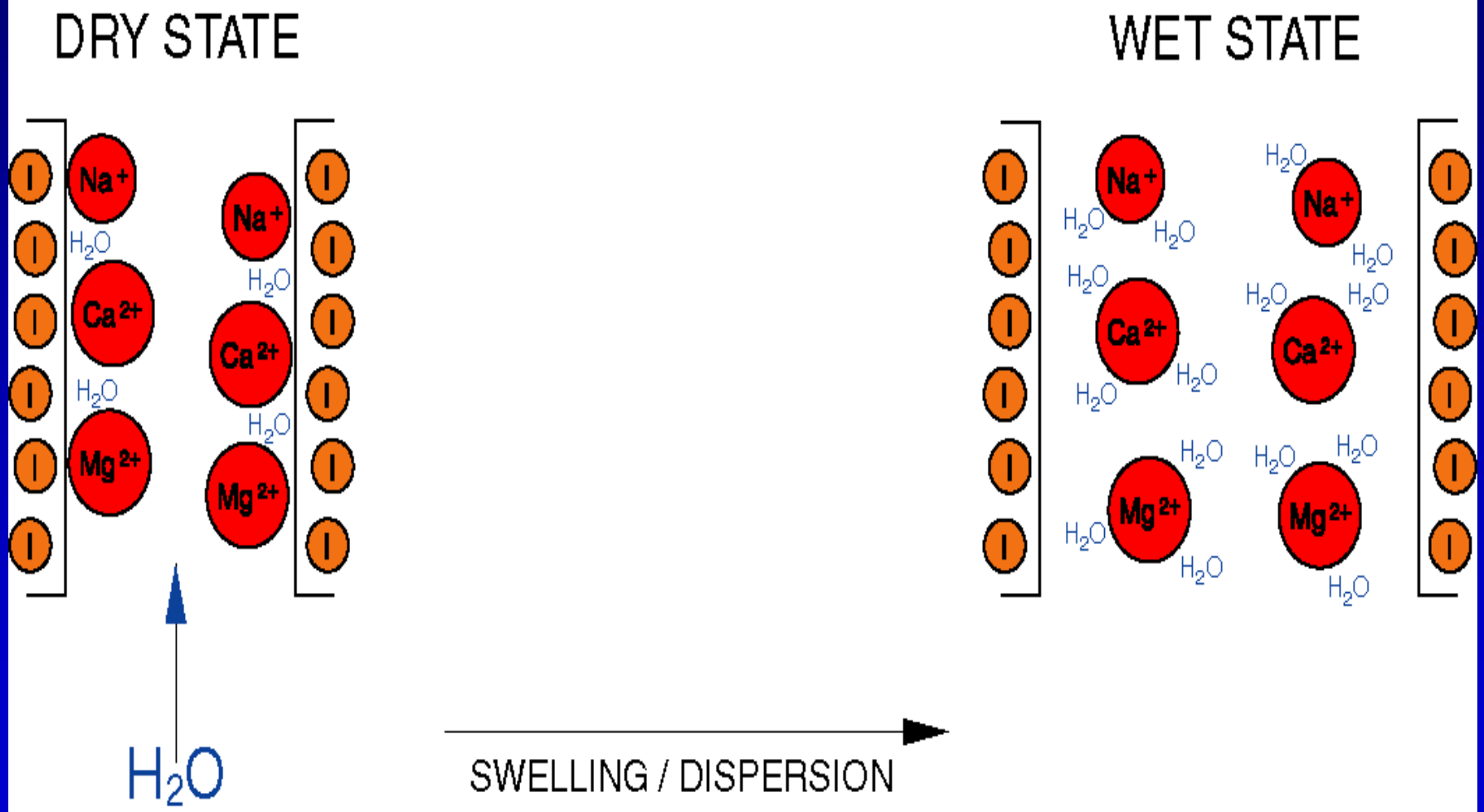
- Using some of the higher rates of dust deposition, i.e. 50 t/km^2/yr on the Central Tablelands and salt loadings on dust, salt accumulation rates can be calculated.

- These calculations predict up to 5-10 kg/ha/yr of salt (NaCl) accumulation.

Formation of a sodic soil from an initial saline soil.

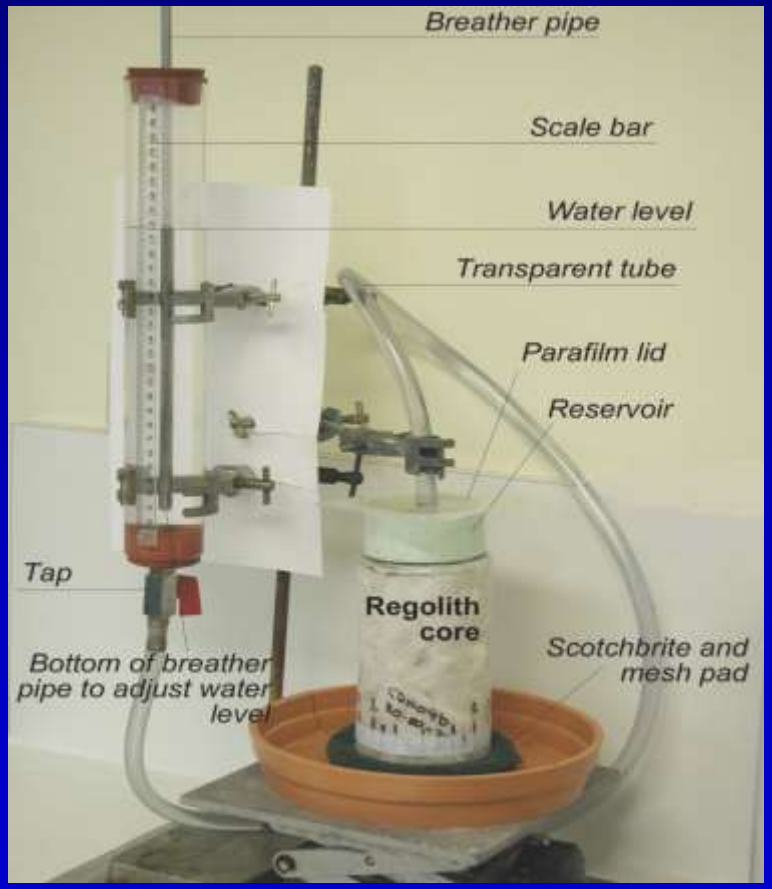


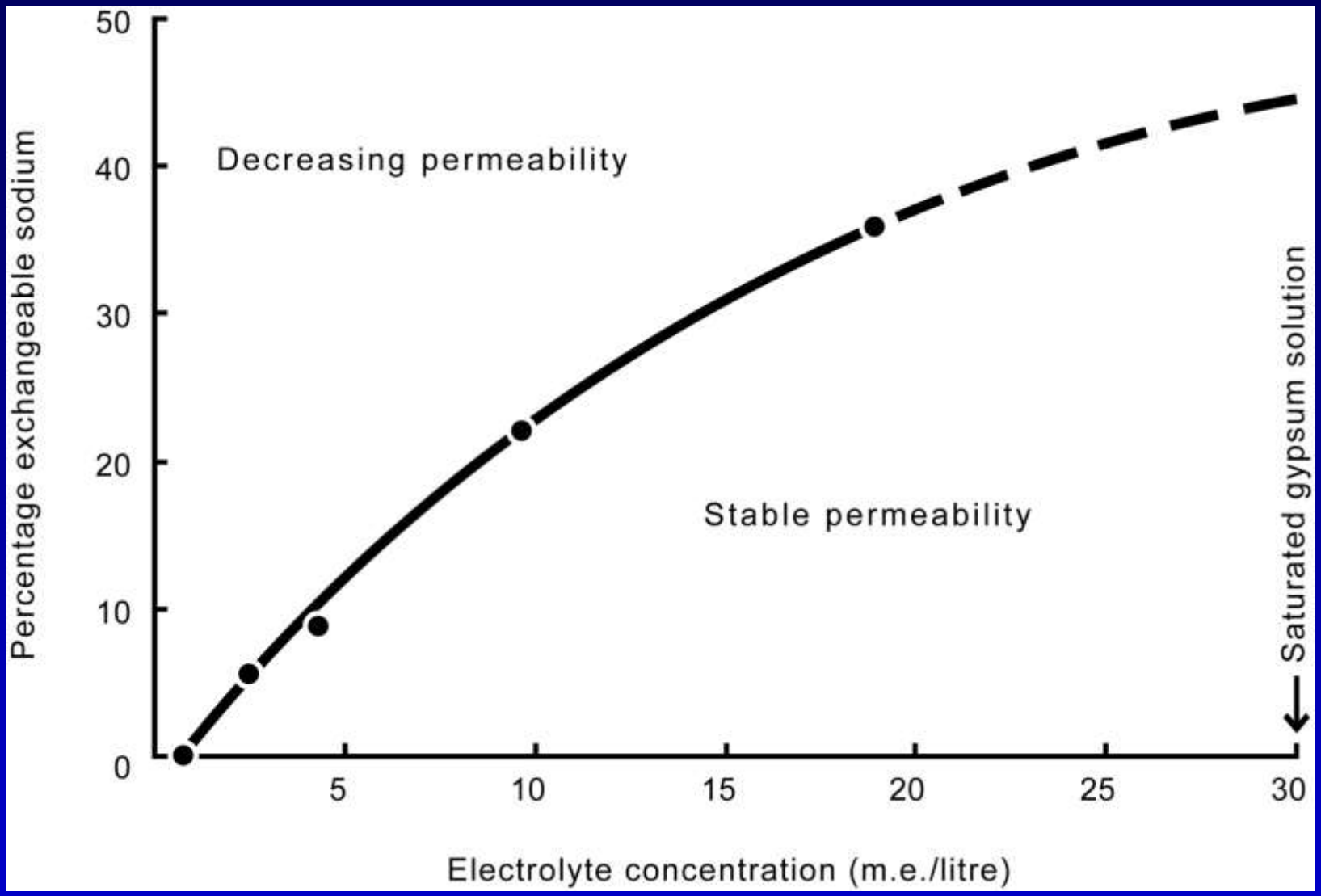
Schematic Diagram of the interaction of water with clay soils



Turner, M. L., Greene, R.S.B., Knackstedt, M., Senden, T.J., Sakellariou, A, and White, I. (2008).
Use of gamma emission CT to study teffect of electrolyte concentration on regions of preferred flow and hydraulic conductivity in deep regolith materials. Australian Journal of Soil Research, 46, 101-111.

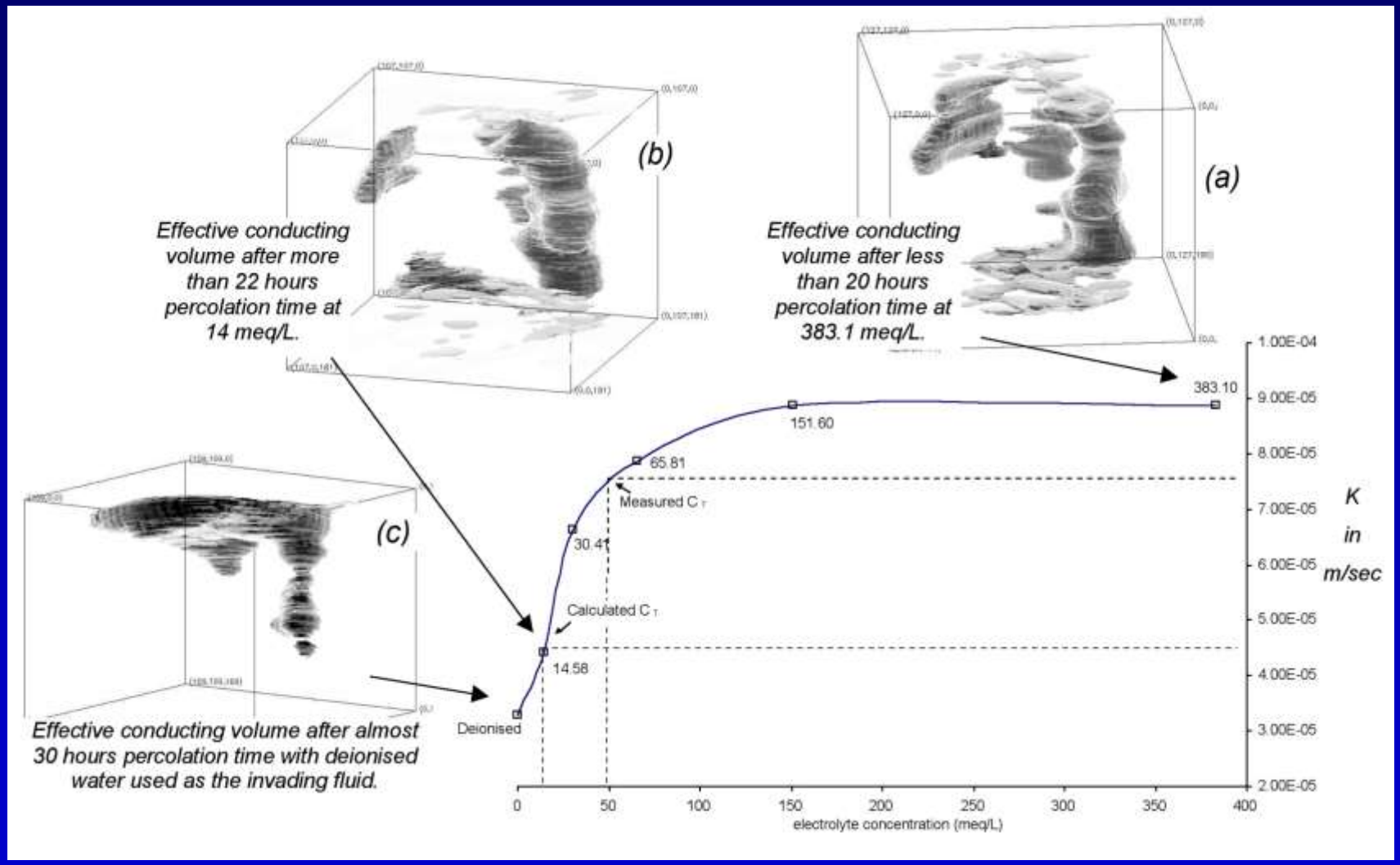
Permeability experiments





Quirk and Schofield (1955)

Hydraulic conductivity as a function of electrolyte concentration



Main soil types used for irrigation in SE Australia are texture contrast/red brown earths or chromosols/sodosols

- **Features**
- **Marked increase in texture between loamy surface soils to clay subsoils**
- **Surface soil often low in OM and prone to structural breakdown, hard setting and crusting.**
- **Heavy clay subsoil has low permeability and high mechanical resistance. Causes problems of poor drainage and root development.**

Addition of gypsum to rip lines to add calcium which displaces the sodium

Deep ripping of B-horizon to physically break it up

Conclusions

Na and salt accumulations in Riverine soils can have a substantial aeolian origin.

Na and salt have a major impact on soil processes particularly permeability.

Need to understand how processes vary depending on position in the landscape, soil type and climate.