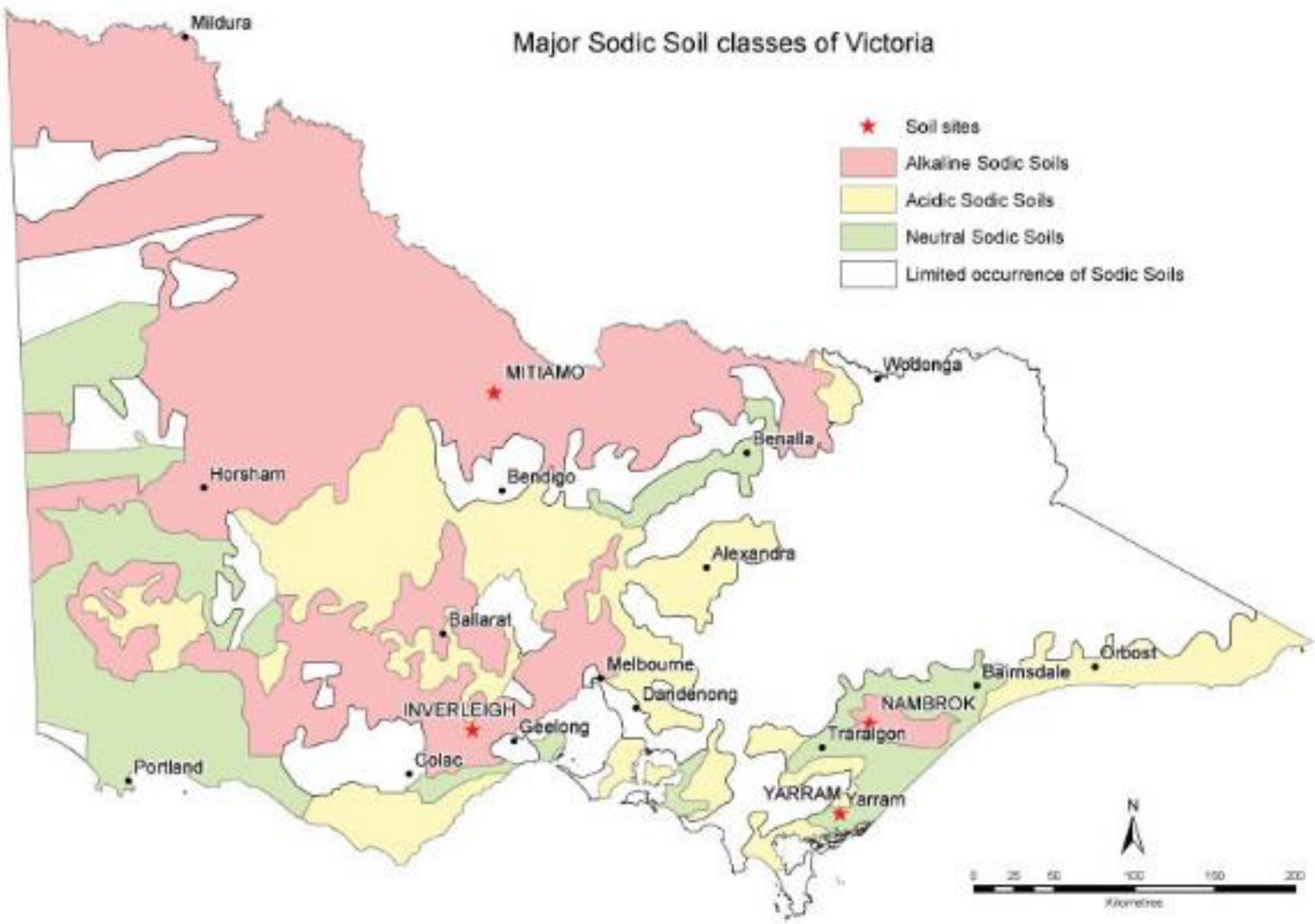


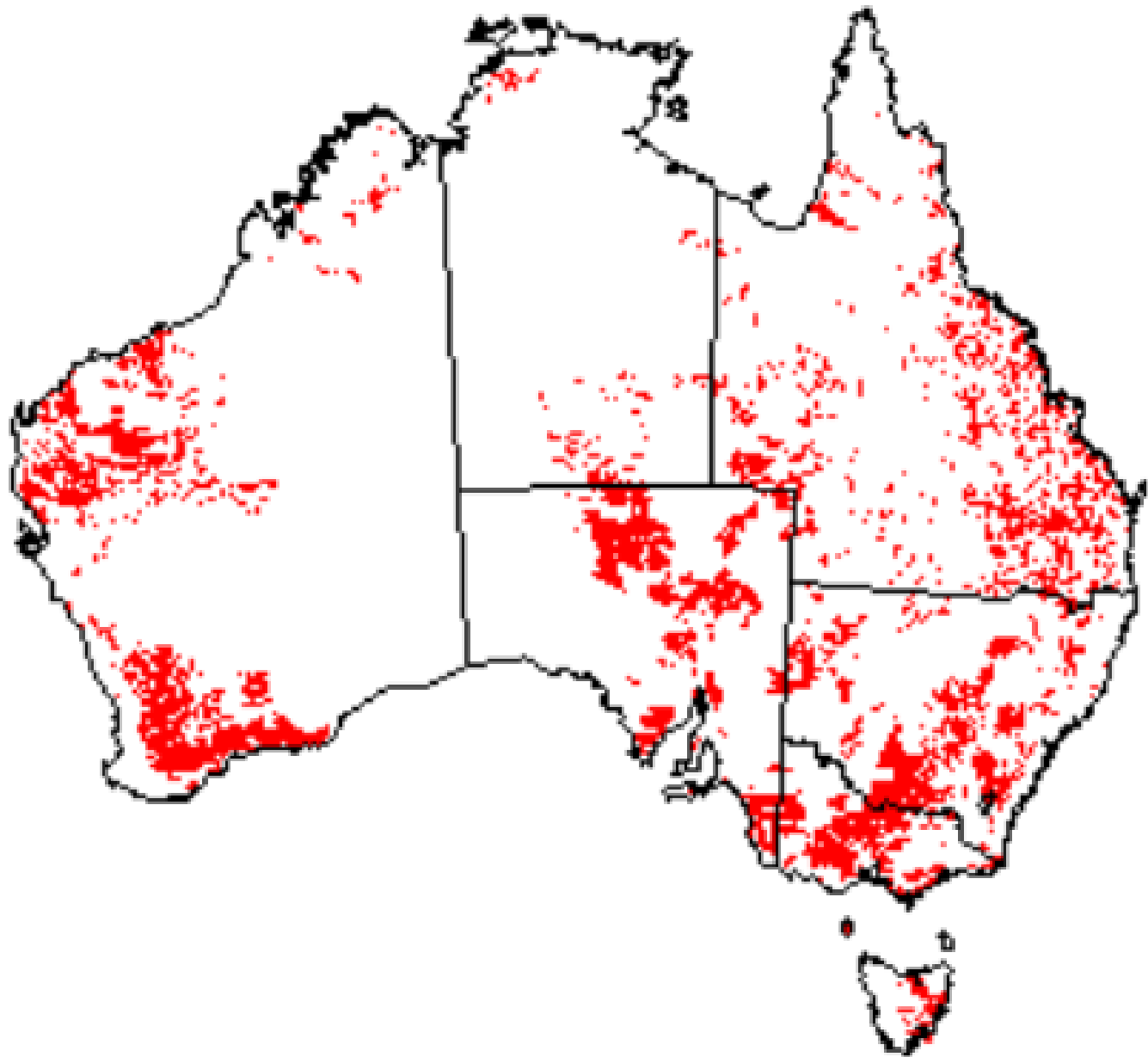
Sodic soils

Cam Nicholson



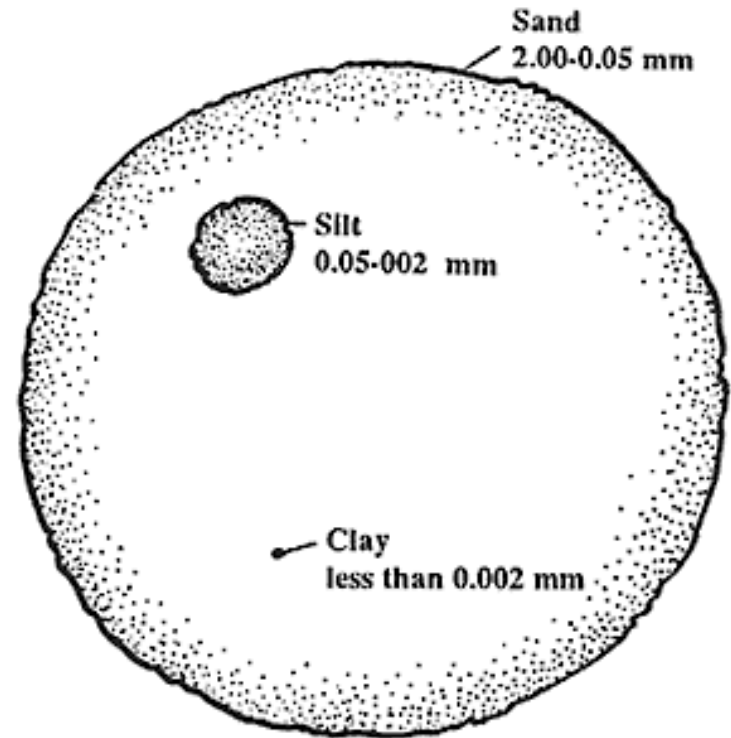
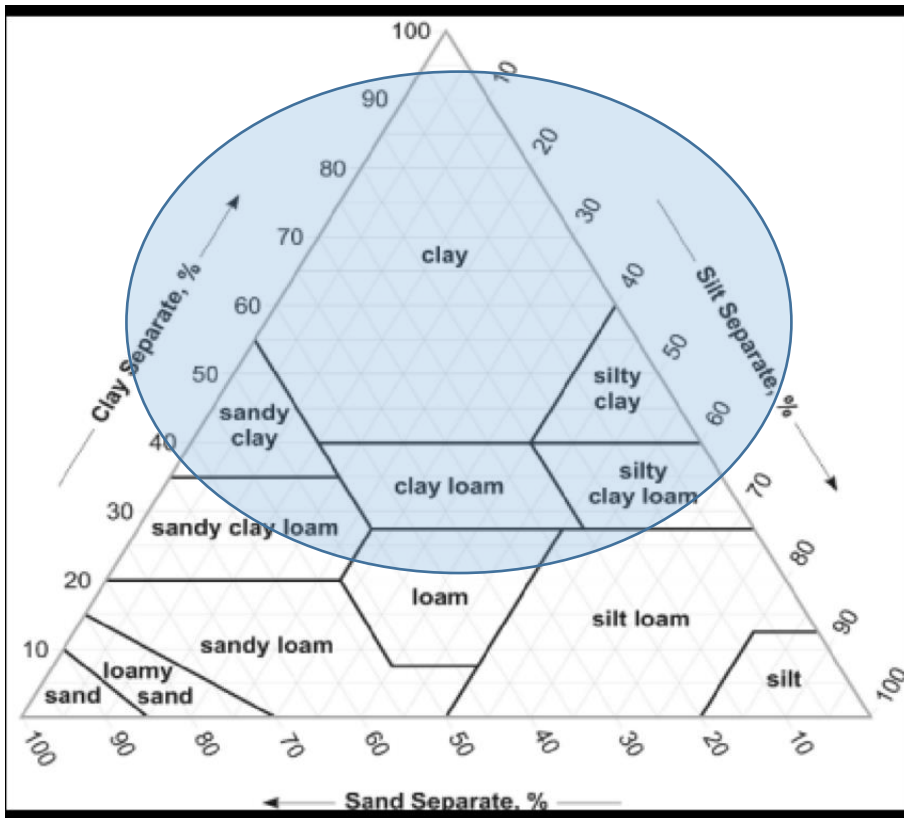
Major Sodic Soil classes of Victoria





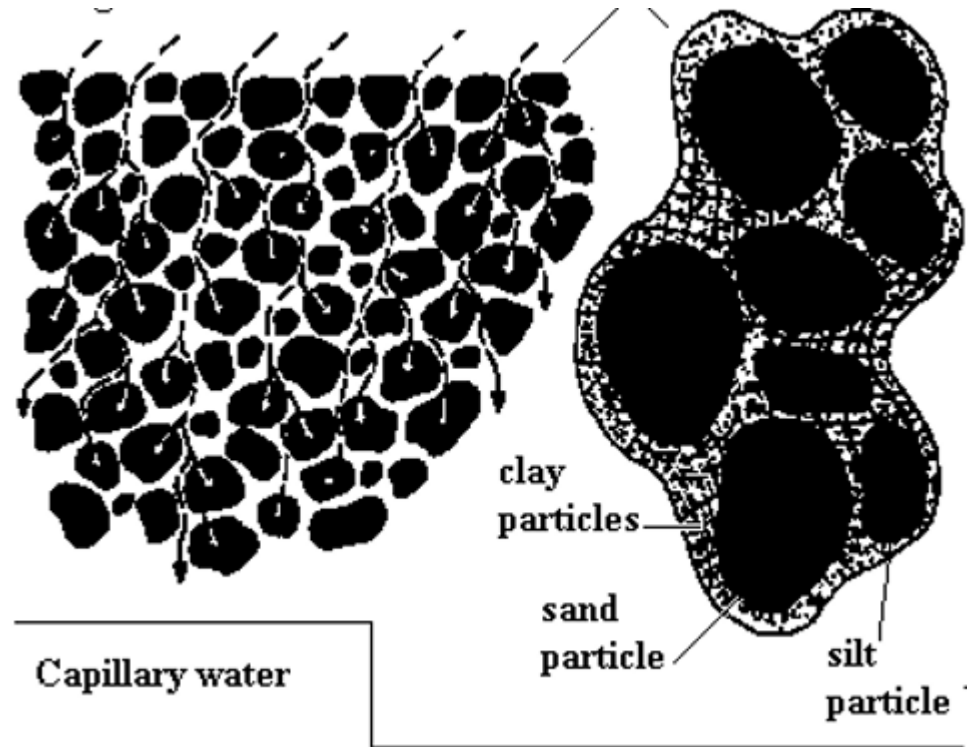
Soil texture

Proportion of sand, silt and clay



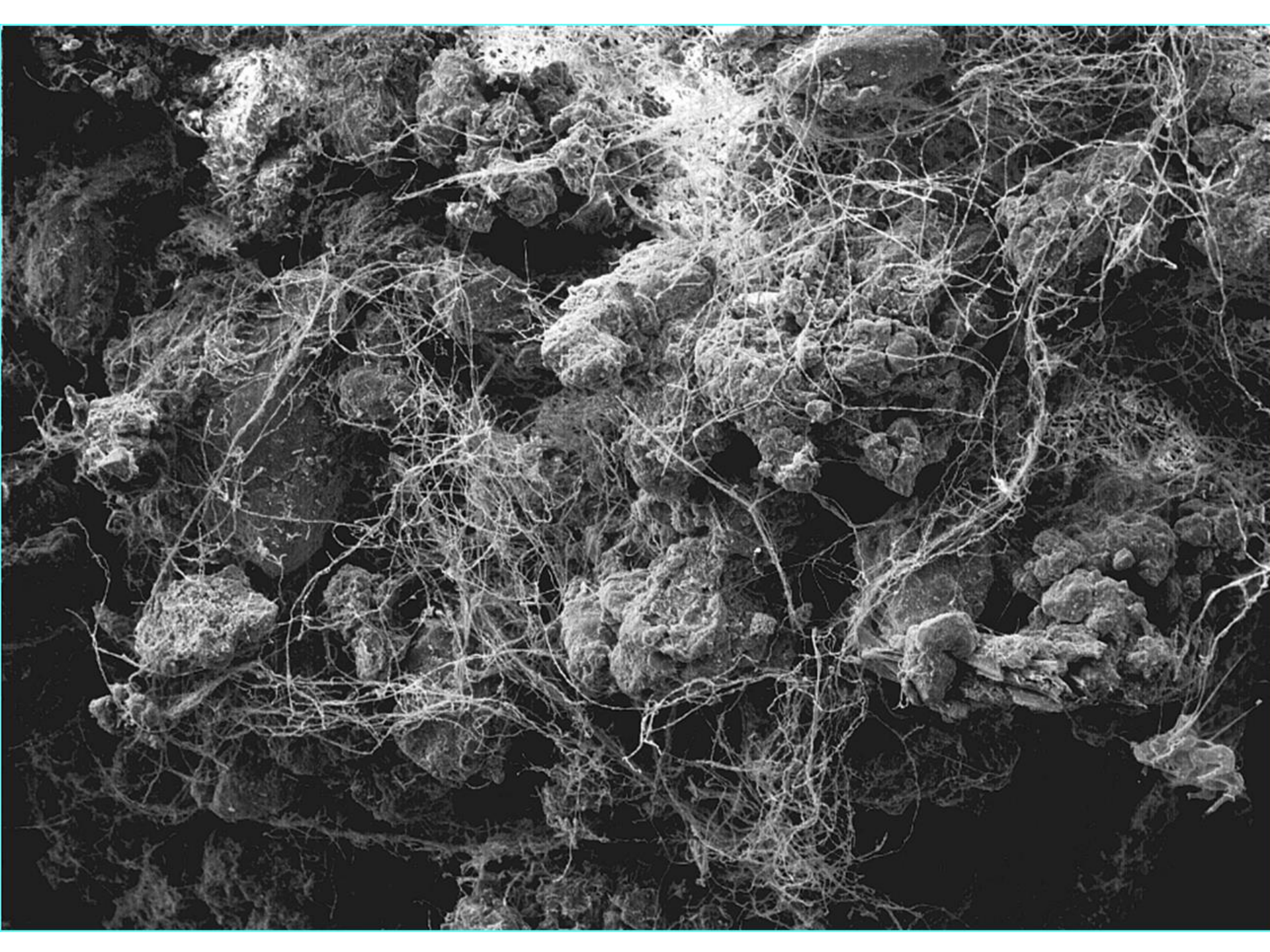
Soil structure

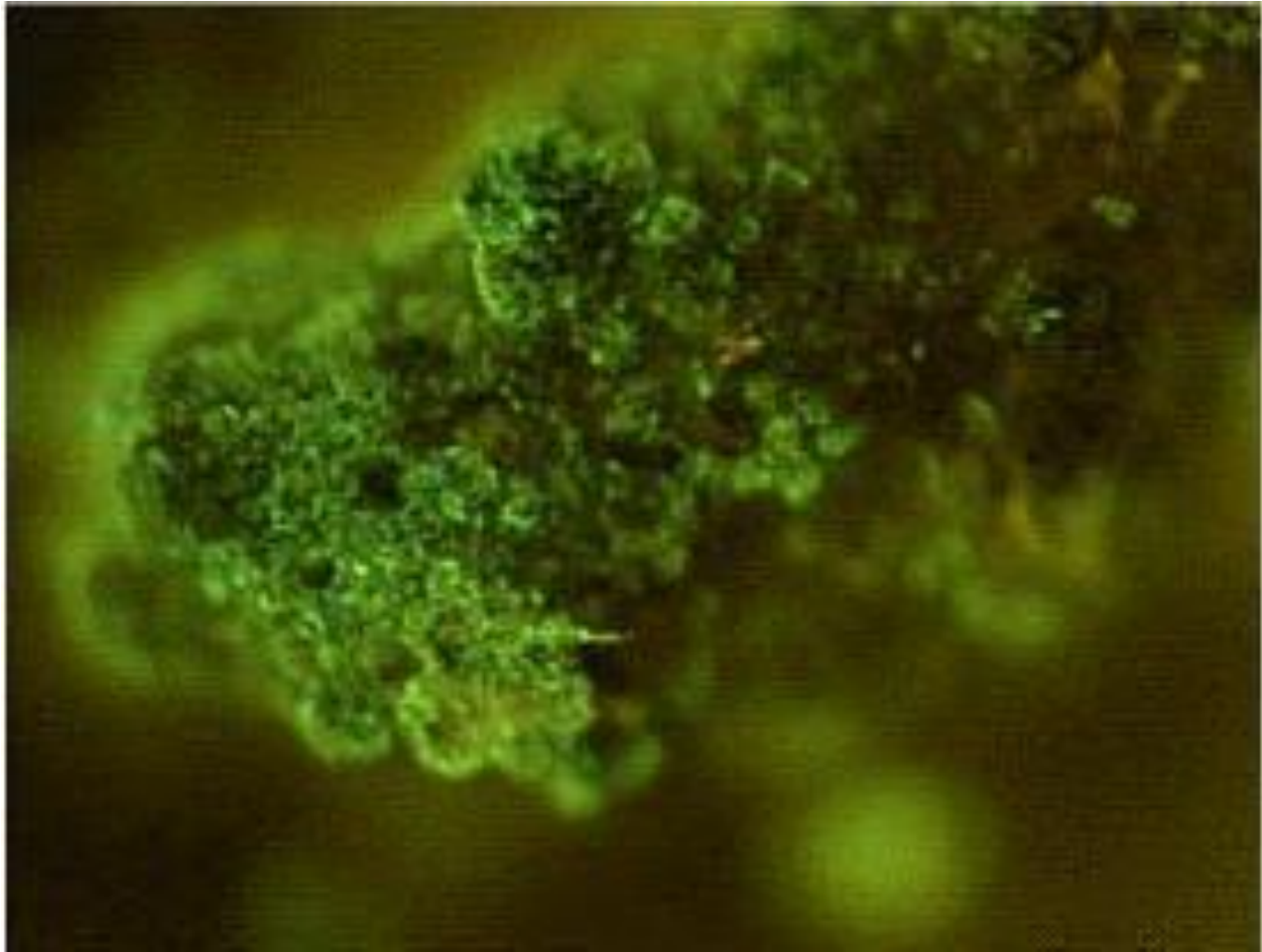
How the sand, silt, clay and air spaces clump together



The 'binding' of soil particles is both physical and chemical

Physical binding of soil particles





Chemical binding of soil particles

Cations

Elements (ions) with positive electrical charges that are attracted (like a magnet) to negatively charged particles on **clay** or organic matter.

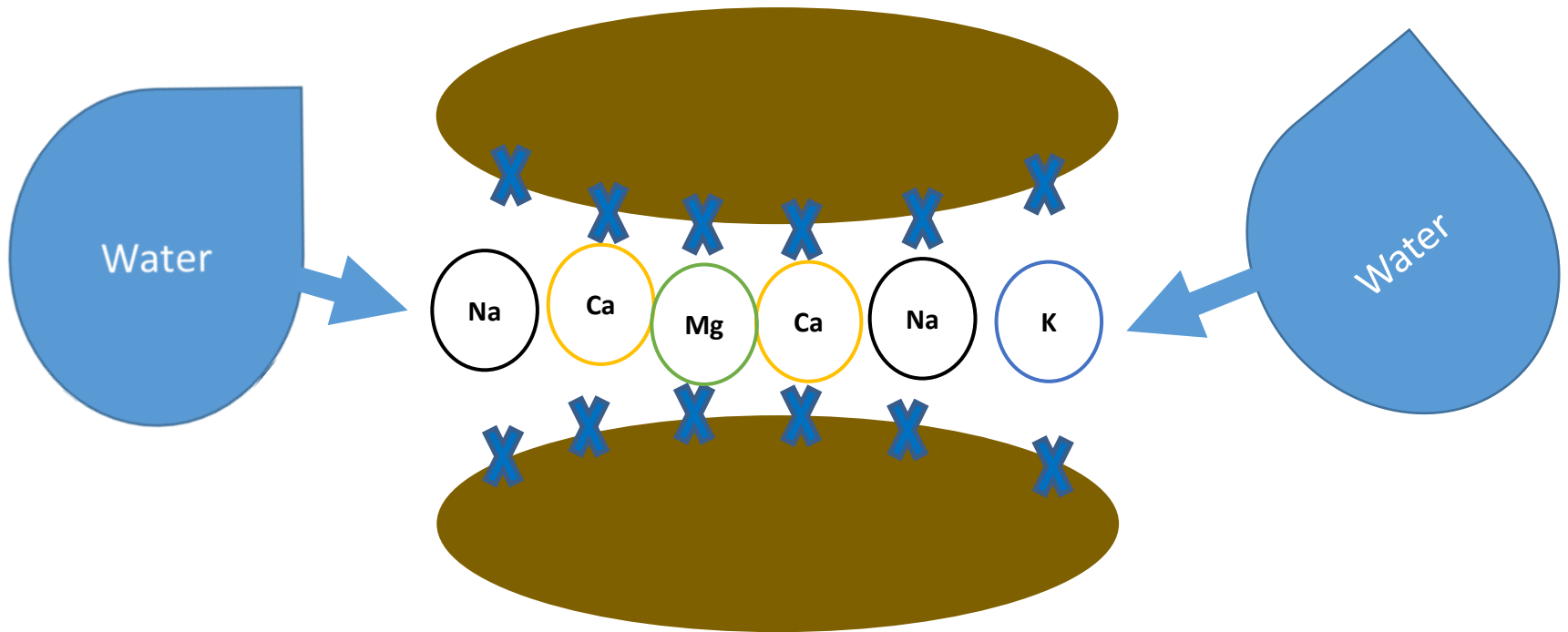
Common cations in soil:

- Calcium (Ca^{2+})
- Magnesium (Mg^{2+})
- Potassium (K^+)
- Sodium (Na^+)
- Aluminium (Al^+)

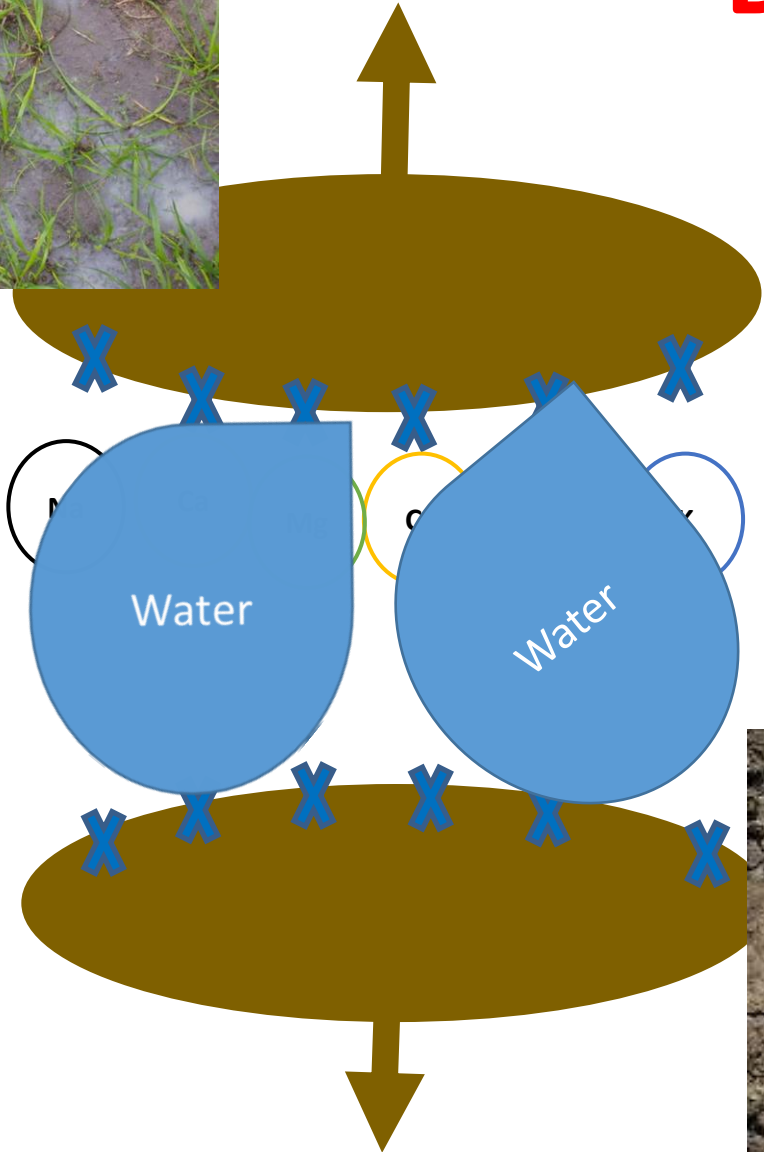
Cations

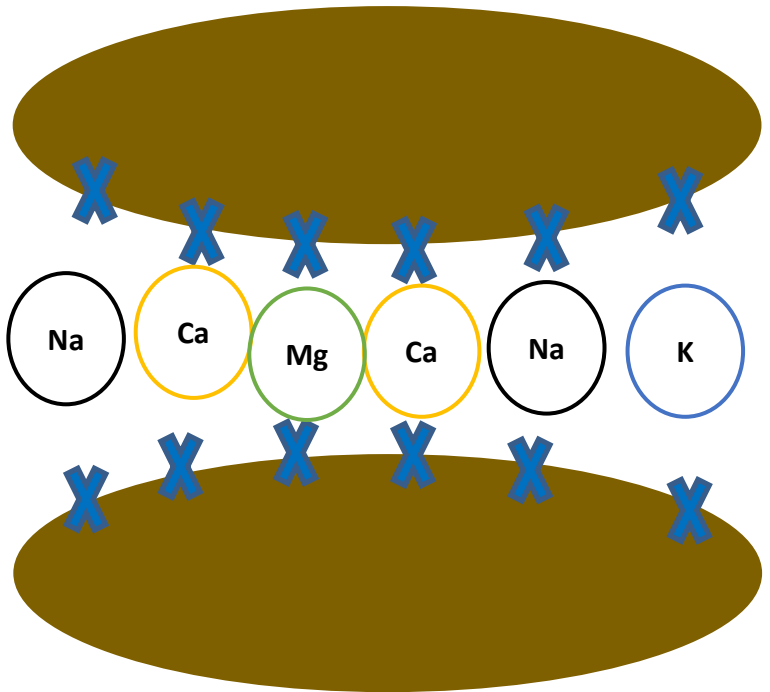
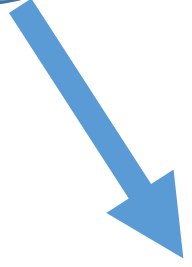
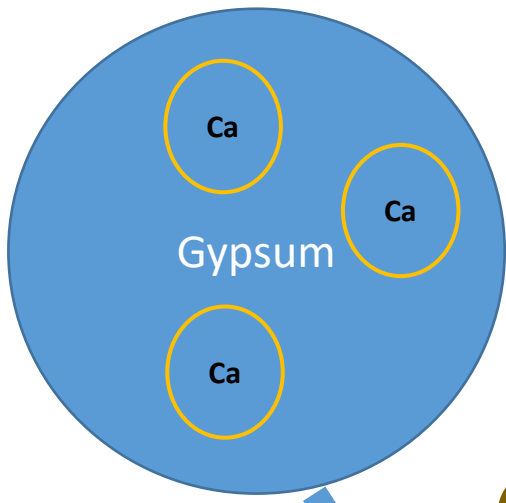
Have different binding strengths (relative flocculating power):

- Calcium (x 43)
- Magnesium (x 27)
- Potassium (x 1.7)
- Sodium (x 1)

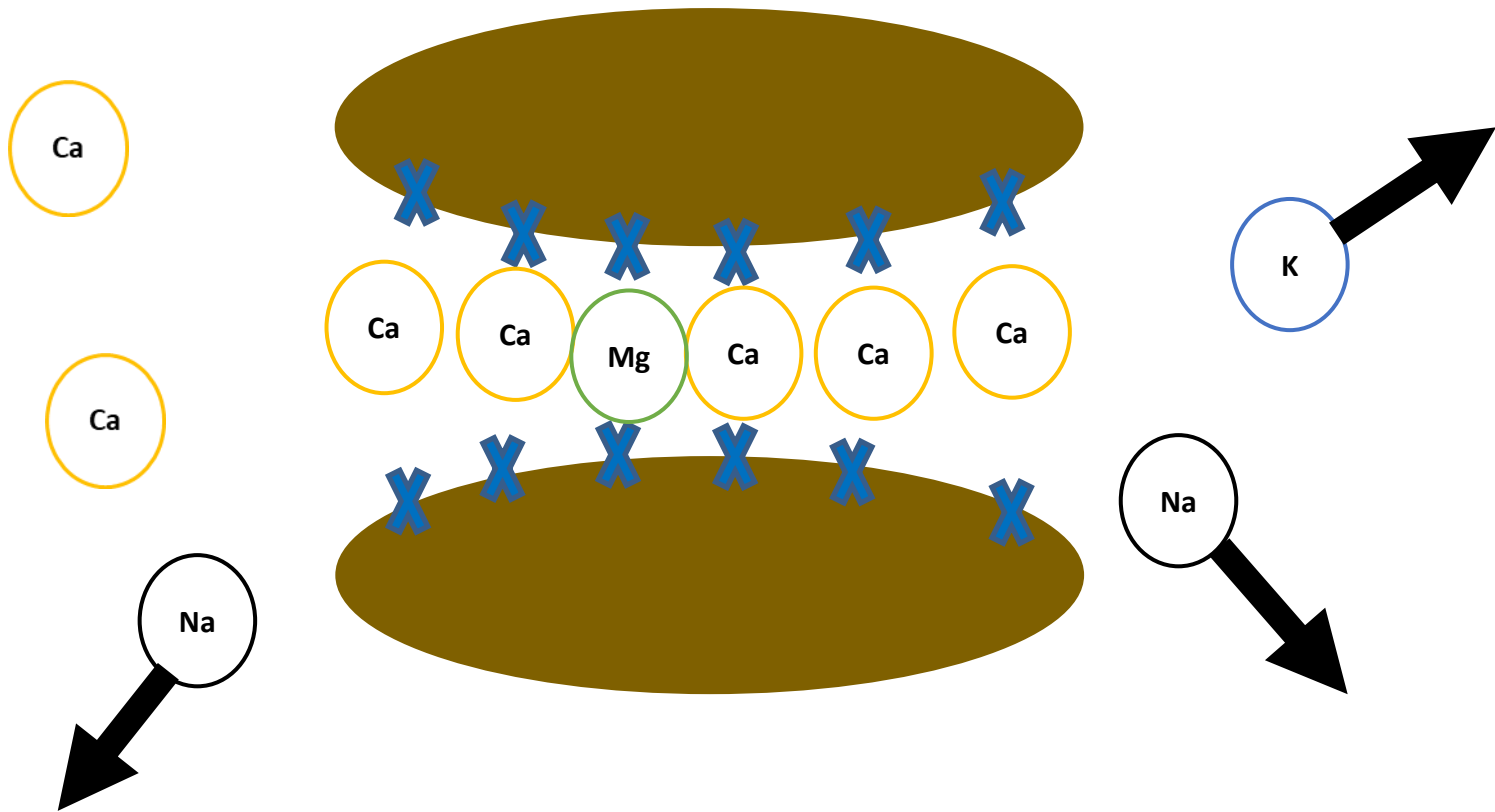


Dispersion





Flocculation



Cation exchange capacity (CEC)

Calculating cation exchange capacity (simplified)

- The soil is 'washed' to displace the Ca, Mg, Na, K and Al cations.
- The quantity of each cation washed off is measured.
- All the cations are added together (total CEC).
- Ratios and percentages are then calculated.

Calcium	(Exch)	meq/100 g	2.24
Magnesium	(Exch)	meq/100 g	1.60
Sodium	(Exch)	meq/100 g	0.27
Potassium	(Exch)	meq/100 g	0.32
Aluminium	(Exch)	meq/100 g	0.72
Calculations			
Sum of cations	(CEC)	meq/100 g	5.15
Calcium/Magnesium ratio			1.4
Sodium % of cations (ESP)			5.2%
Aluminium % of cations			14.0%

Exchangeable sodium percentage (ESP)

Measurement	Ideal
Sodium % of cations (ESP)	Less than 6

WARNING: Don't rely just on the chemical test results to decide on the use of gypsum

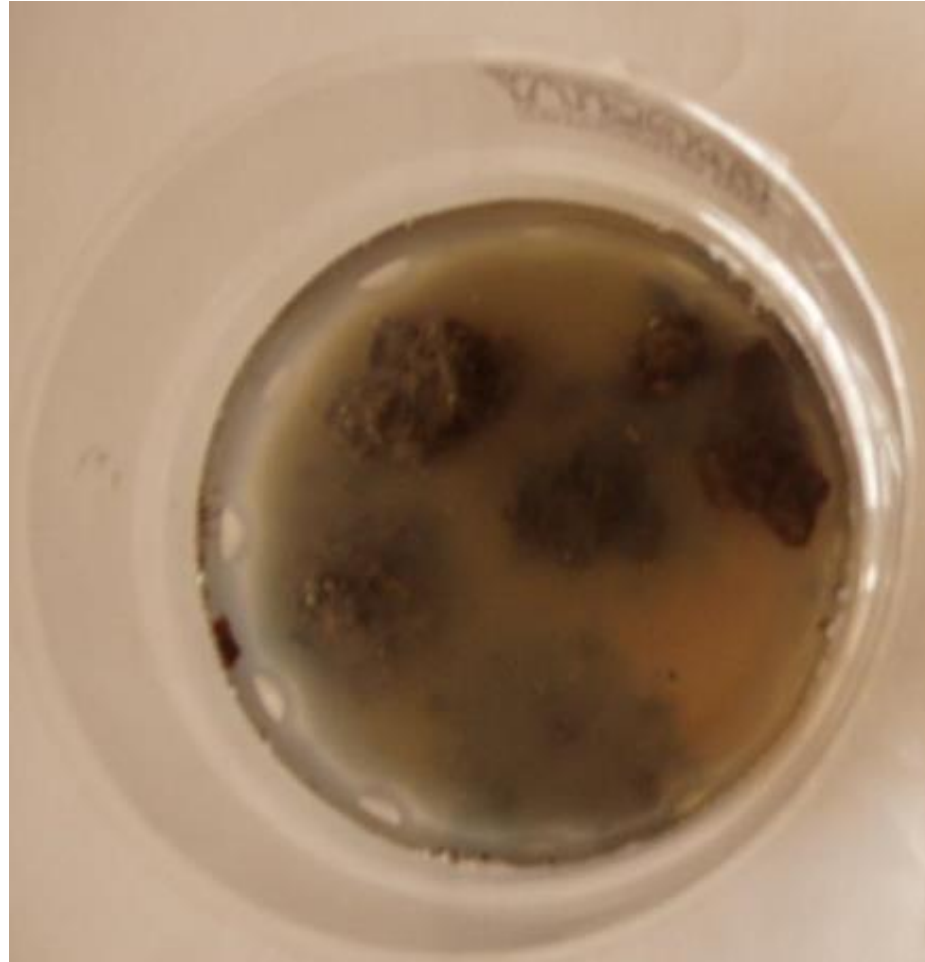
Testing for soil stability – the dispersion test

Dispersion test for soil

- Select 2 - 3 air-dry aggregates, 5–10 mm diameter (about the size of a pea).
- Place 75 mL distilled water in the container. Place the 2 -3 aggregates in the container of water, spaced equally around the side. Do not stir or otherwise disturb.

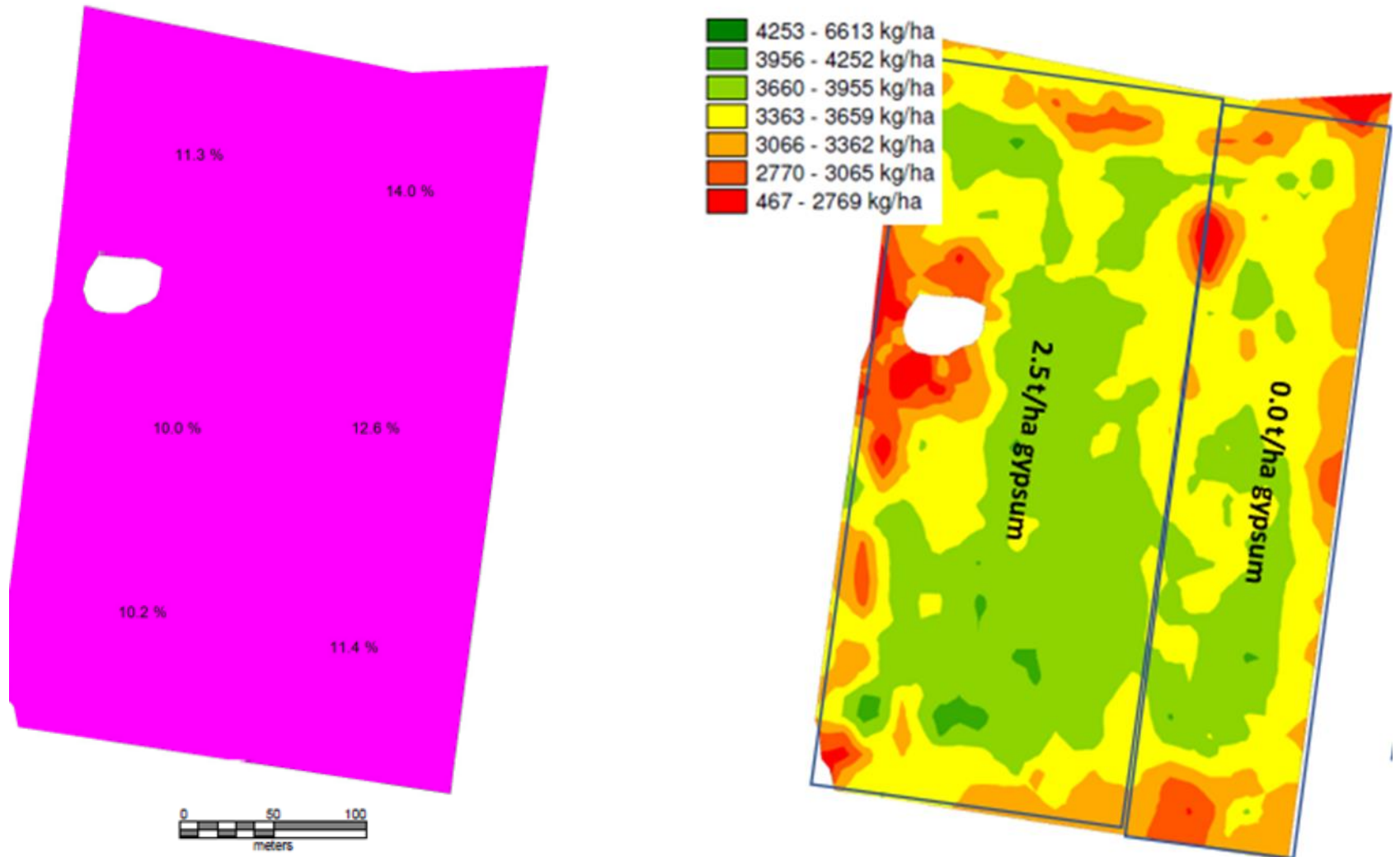


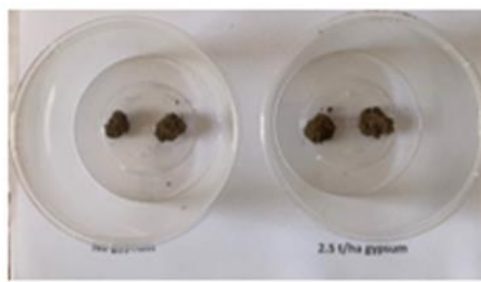
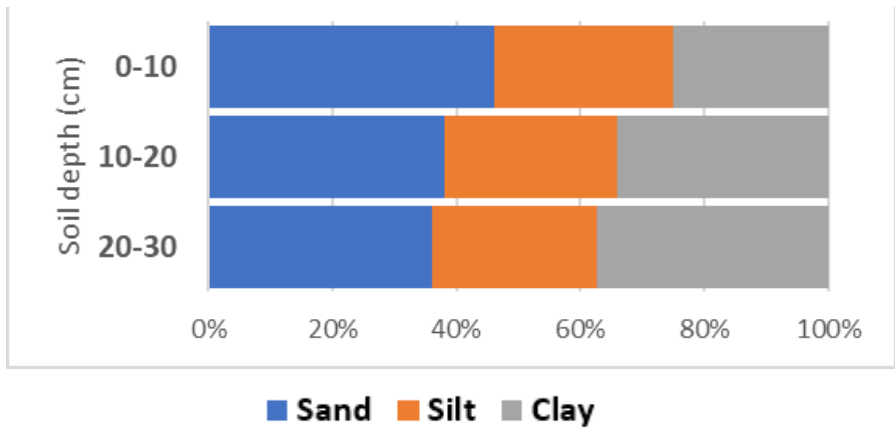
- After **2 hours** and **20 hours**, observe the aggregates for cloudiness (will be the colour of milky tea).



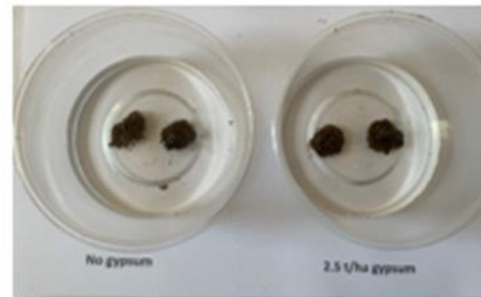
- If the aggregate has not dispersed, place about 20–40 g of soil (<2 mm) in a mixing bowl and add sufficient distilled water to bring the soil to a soft consistency. Mix for 30 seconds.
- Without using your fingers, form a 5 mm cube of the reworked soil using a spatula or mould. Place the cube of reworked soil into another container of distilled water. Do not stir or otherwise disturb. After 2 hours and 20 hours, observe the degree of dispersion.

Woody Yaloak gypsum trial

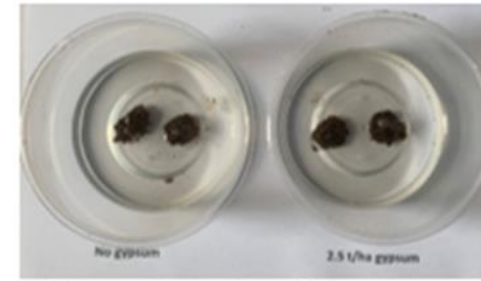




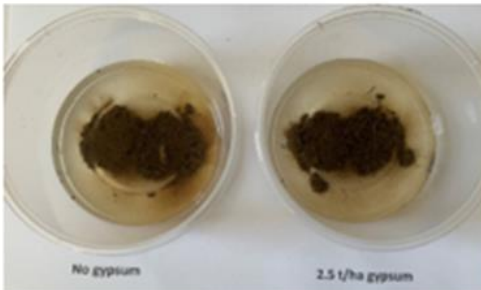
Start



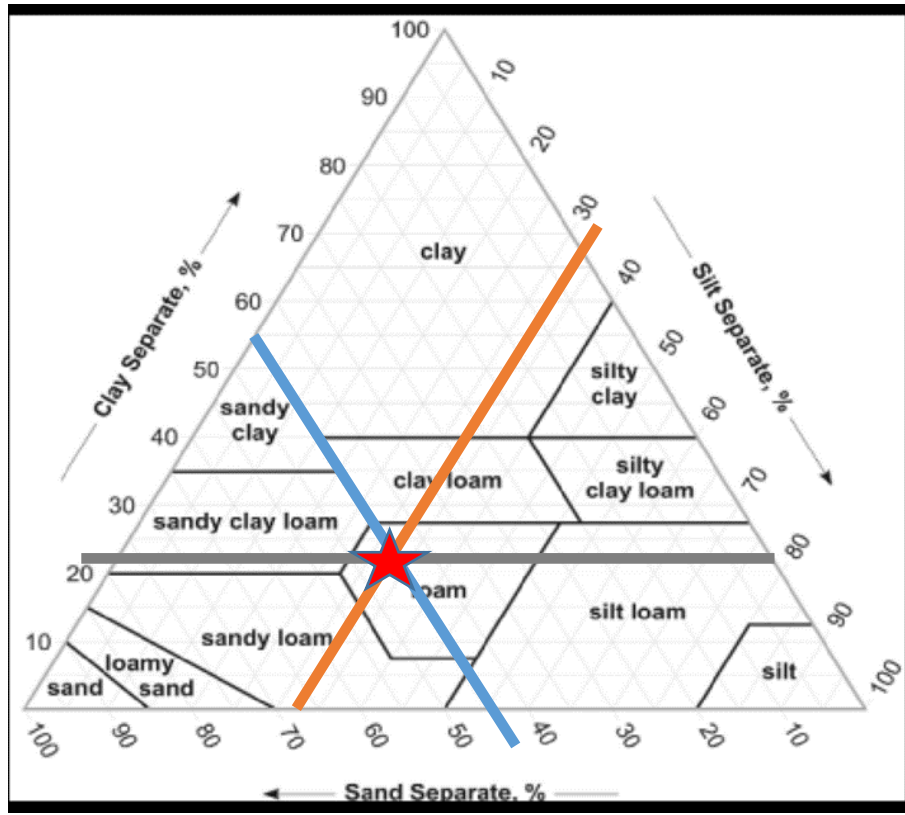
Observation after 2 hrs



Observation after 20 hrs



Observation 20 hrs after remould



Questions

Gypsum

Gypsum is calcium sulphate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)

Lime is calcium carbonate (CaCO_3)

To dissolve 1 tonne per hectare of:

- Gypsum takes 50 mm of water
- Lime takes 4000 mm of water

Buying gypsum



Sources

- **natural gypsum**, accumulated in shallow layers or pits
- **by-product gypsum** (phospho-gypsum) formed by the manufacture of fertiliser (1% to 2% P)
- **Rejected plasterboard**

Buying gypsum

Pure gypsum contains 23% calcium.

In Vic (by law)

- Grade 1 contains a minimum of 80% gypsum (19% calcium)
- Grade 2 contains a minimum of 65% gypsum (15.5% calcium)
- Grade 3 contains a minimum of 50% gypsum (12.5% calcium)

It should also contain less than 0.8% sodium chloride (salt).

Natural Gypsum Miners Association

www.gypsum.asn.au

How much gypsum?

Cam's rough rule of thumb



ESP	Clay loam (t/ha)	Clay (t/ha)
6	2.5	2.5
10	4.0	5.0
15+	5.0	7.5 - 10

How much gypsum?

Sodium displacement with calcium

Quantity of grade 1 gypsum required (t/ha) for different CEC and ESP levels (0 -10 cm).

Cation exchange capacity (CEC)	Exchangeable sodium percentage (ESP)					
	6	8	10	12	14	16
10	0.8	2.3	3.8	5.3	6.8	8.0
12	1.0	2.8	4.5	6.3	8.0	9.8
14	1.0	3.0	5.3	7.3	9.3	11.3
16	1.3	3.5	6.0	8.3	10.5	13.0
18	1.3	4.0	6.8	9.3	12.0	14.5
20	1.5	4.5	7.3	10.3	13.3	16.3

Clay soil with bulk density of 1.4, 40% efficiency of sodium displacement and 50% leaching).

If gypsum is applied, then the effect relies on receiving enough water to leach the sodium and magnesium out of the root zone.

Insufficient rain, layers in the soil that prevent downward drainage and/or a high watertable can reduce the effect of the applied gypsum.

Questions