PRODUCTIVE SALTLAND PASTURES

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Salinity Manual

Module 3
Processes

GRAMIL CENTRE

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

natural resource management program

All photos from SGSL DAFWA team

PROCESSES

WHERE DOES SALT COME FROM?

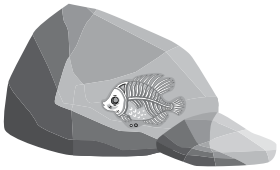
There are a number of different sources of salt in the landscape. Salt deposits are often classified according to the origin of the salt or its transport process. Soil salt can come from four main sources:

1. In rain water from the ocean (Cyclic). Most common in SW of WA.
2. From wind blown salt (Aeolian)
3. From the breakdown of parent rock: A very slow process (Parent material weathering).
4. From geological inundation by the oceans (marine sediments): Only on discrete parts of Australia (Connate or Fossil salt).

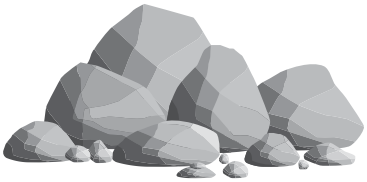
Salt in rainfall can range from about 20 kg/ha/per annum (usually inland with low rainfall) to more than 200 kg/ha/per annum (usually coastal with high rainfall) (Hingston and Gailitis 1976). In most of Australia, this is the source of stored salts.

Aeolian Salt
Salt attached to soil particles which are deposited by wind and leached by rainfall

Cyclic Salt
Rainfall deposits salt inland from the ocean



Connate Salt
Salt trapped in rocks and marine sediments deposited under the ocean



Rock Weathering
Salts are released as minerals weather

Aeolian salt

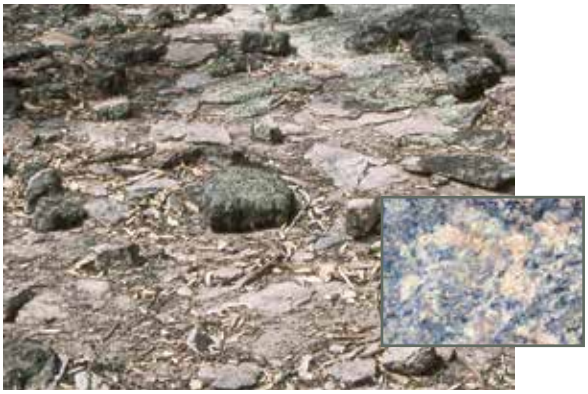
Aeolian salts are transported by wind and originate from inland sedimentary deposits including soil and dune sand, salt lakes and parna. Dry windy periods over geological time have moved large amounts of soil across the landscape. As it travelled, this wind has blown the salty clays with it. Erosion and leaching of these deposits can release significant quantities of salt into waterways. (photo: R. George)

Cyclic salt

Ocean spray contains much salt in the fine droplets of water. The wind move this salt inland from the south west capes with salt spray and airborne particles heading inland, where it is then deposited in rainfall. Over time these salts accumulate in the landscape. The amount of salt deposited on the landscape in this way ranges from over 200kg/ha/year near the coastal high rainfall areas to 20-35 kg/ha/year in the drier inland areas (Hingston and Gailitis 1976). (photo: R. George)

Connate/ Fossil salt

Fossil salts come from marine sediments, which were deposited during earlier geological periods when Australia was partly covered by sea. Some areas, such as of the South Coast of Western Australia were once below sea level. These low lying inland seas trapped marine salt within their sediments. This salt is readily mobilised by rising groundwater. These salts are already present, stored within the rocks, and are different to the salts that are released as a rock chemically weathers.



Parent Material (Rock weathering) salt

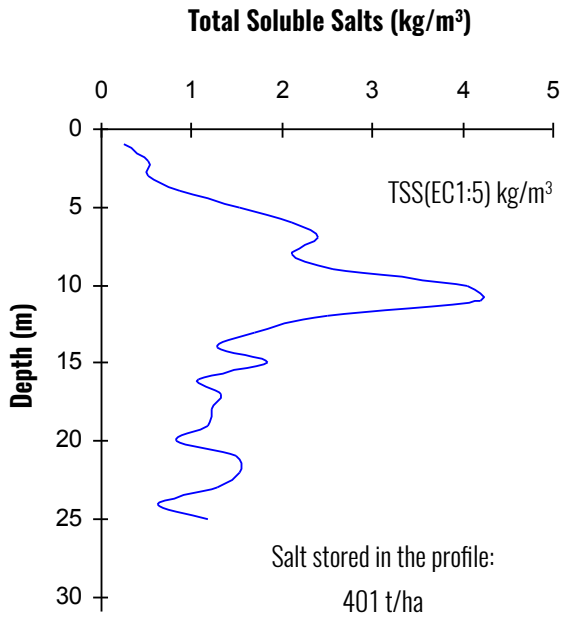
Rocks release soluble salt as their minerals breakdown by chemical weathering over time. The composition and amounts of salts released depend on the types of rock minerals. Generally this salt release is slow because the rate of soil formation by chemical weathering is slow. However, Australian soils are often old and have taken a long time to form, so the total amount of salt released can be appreciable.

Salt sources "Salinity – an introduction"

https://www.agric.wa.gov.au

SALT STORAGE

Salt has been stored in the landscape as the amount coming in (salt input) is higher than the losses (salt output) through leaching or drainage from the catchment. In areas where potential evaporation is high and rainfall is low (semi-arid and arid zones), salt falls on the landscape but is not flushed out sufficiently. Plants also use the fresh water and leave any salts behind in the soil. Therefore salt accumulates, usually below the root zone of original native vegetation creating a "salt bulge".



Typical graph and shape of salt storage down the soil profile showing the highest salt store (salt bulge) at 10m below the soil surface. Total salt stored in the profile to 25m is 401t/ha.

Salt accumulation is most noticeable in poorly dissected country (flat) where there is very little or no escape for groundwater or surface water. Where most of the drainage is internal (that is, drainage cannot escape the catchment), it moves to low points such as playa's.

When the depth of the regolith is great, storage can rise to thousands of tonnes per surface hectare. For example: with an input of 50 kg/ha/yr of salt and no flushing, >1000 tonnes per hectare could be accumulated in 20,000 years. This is a short time geologically.

SALT MOBILIZATION AND ACCUMULATION

The movement of salt within the landscape and its accumulation is affected by the amount of rainfall, the amount of salt in the rainfall, the soil texture and the local topography.

For the Lakes District soil survey (Teakle, Southern and Stokes, 1940) it was reported that heavier clay soils were saltier and there was a good correlation between texture and salinity. The high levels of salt in the heavy soils are the result of less rainfall percolating into the soil and hence reduced leaching of salt.

Wind action within salt lakes (parna) can lead to the formation of sheets of highly saline material blown out from the lake beds (Bettenay, 1961).

Pallid zone materials in the lateritic profile have been shown to store appreciable amounts of salt (Dimmock et al, 1974).

The degree of dissection (erosion) of the landscape largely determines the capacity of salts to be leached into the river systems. It also impacted on and the depth of soil formation with shallower regoliths storing less salt. The upper landscapes are usually the remnants of the old plateau. All of the major river systems tap ancient drainage lines with salt lake chains in their upper reaches resulting in high salt stores. Downstream of the salt chains, the valleys are successively more incised and steeper resulting in less salt stored.

Salt stored in the vadose zone can be mobilized due to groundwater rising and filling the soil voids. This process increases the salt concentration in the aquifer. Once mobilized, groundwater becomes the carrier and as water and salt move to discharge sites, evidence can be seen on the soil surface with plant death and salt crystals.

Salt accumulates at discharge sites due to evaporation of the water component in the summer-time. In winter some of the salts on the surface are washed into creeks and rivers. The amount of salt taken out of the landscape by this process is very small. It would take 100's, possibly thousands of years to wait for this process to remove all of the stored salts within the landscape.

Based on the amount of salt falling in rainfall in Western Australia Teakle (1937) concluded that there was no need to postulate that the salt in Western Australia soils and waters had its origin in the Miocene sea which existed 40 million years ago. He calculated that for Salmon Gums it would take 37,000 years to raise a 15 m regolith to its present salt store and 35,000 years to raise the soil regolith at Merredin to its present salt store from rainfall alone.

REFERENCES

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Salt sources – an introduction Dryland salinity in Western Australia | Agriculture and Food

https://www.agric.wa.gov.au/soil-salinity/dryland-salinity-western-australia-0

QUESTIONS

1. What is "Cyclic" salt?
    - ❑ Salt that is recyclable.
    - ❑ Salt that comes from the ocean in the form of a fine spray and is transported by clouds and wind.
    - ❑ Salt that breaks down over time.

2. How much salt falls in rainfall?
    - ❑ None
    - ❑ 1 – 5kg/ha/yr
    - ❑ 20 – 200kg/ha/yr

3. What does the term "salt bulge' mean?
    - ❑ Salt begins to increase in strength.
    - ❑ The area below the root zone of native vegetation which has the highest concentration of salt stored in the soil.
    - ❑ An area where salt is bulging to the surface.

4. What does ' mobilization" of salt mean?
    - ❑ Rising groundwater dissolves salt stored within the soil profile.
    - ❑ Salt moves in the air.
    - ❑ Salt is carried away by wind.

5. Why is salt accumulation more noticeable in flat country?
    - ❑ Because there is little or no escape from the catchment for groundwater and surface water.
    - ❑ Salt is attracted to flat land.
    - ❑ Salt is only found in the low flat areas of the landscape

NOTES

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