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AUSTRALIA'S CAPITAL UNIVERSITY

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Cretes and 'Chemical' Landscapes, South Australia

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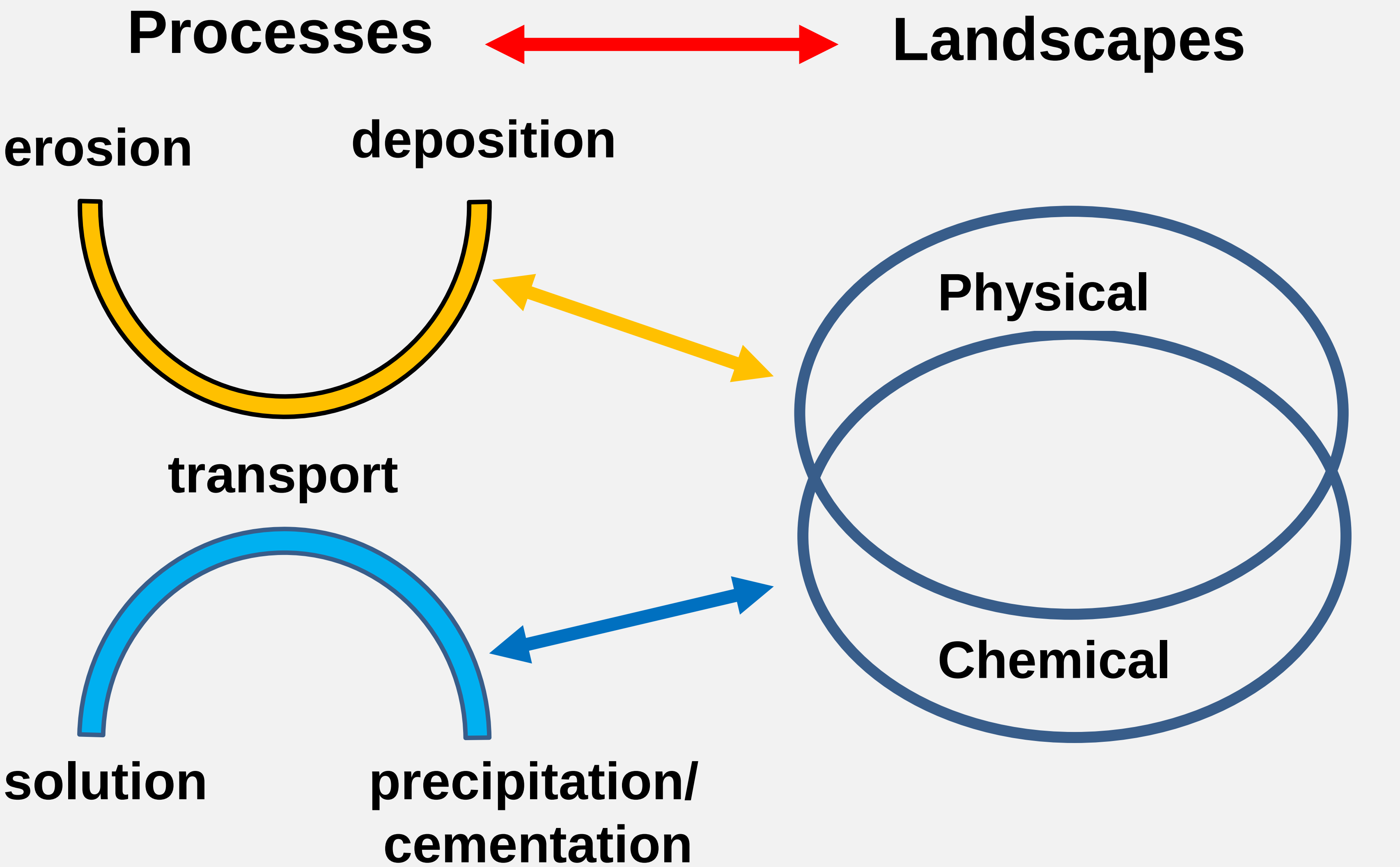
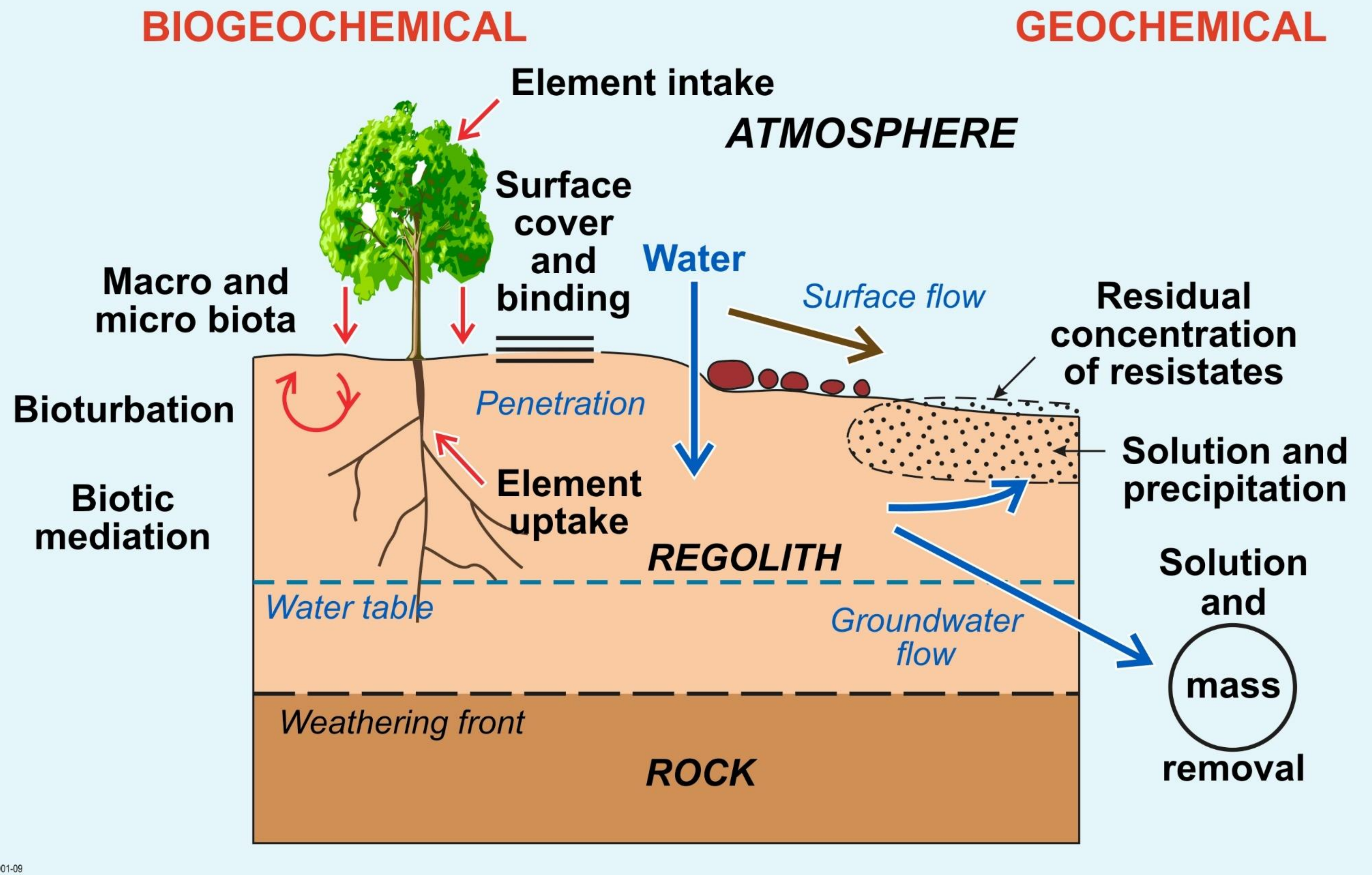
‘Physical’ and ‘Chemical’ Landscapes



Importance of the abundance & behaviour of water & biota.

CHEMISTRY OF LANDSCAPES

Major geochemical and biogeochemical processes in the landscape.



Some observations of landforms, regolith & cretes from two sites in the Lake Eyre Basin of northern South Australia.

1. Area between William Creek and the southwest edge of Lake Eyre – a microcosm of the broader regional landscapes of northern South Australia.
2. Area in the western catchment of Lake Arthur, 60 km east of Maree – a site with unusual silcretes.

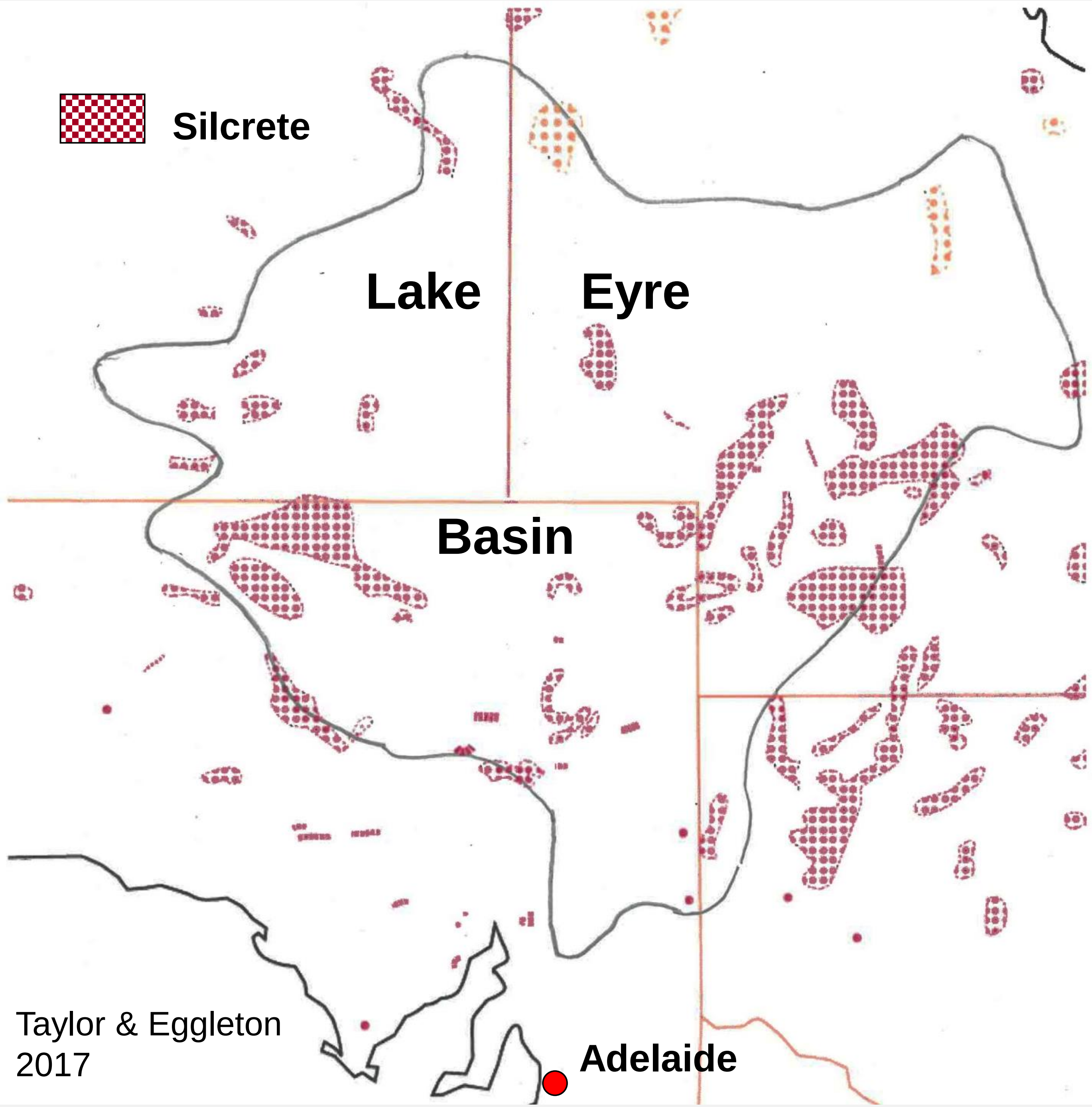
Catchment area of the Lake Eyre Basin

Closed basin with catchment of 1.4 million km^2

15% of Australia's current land area.

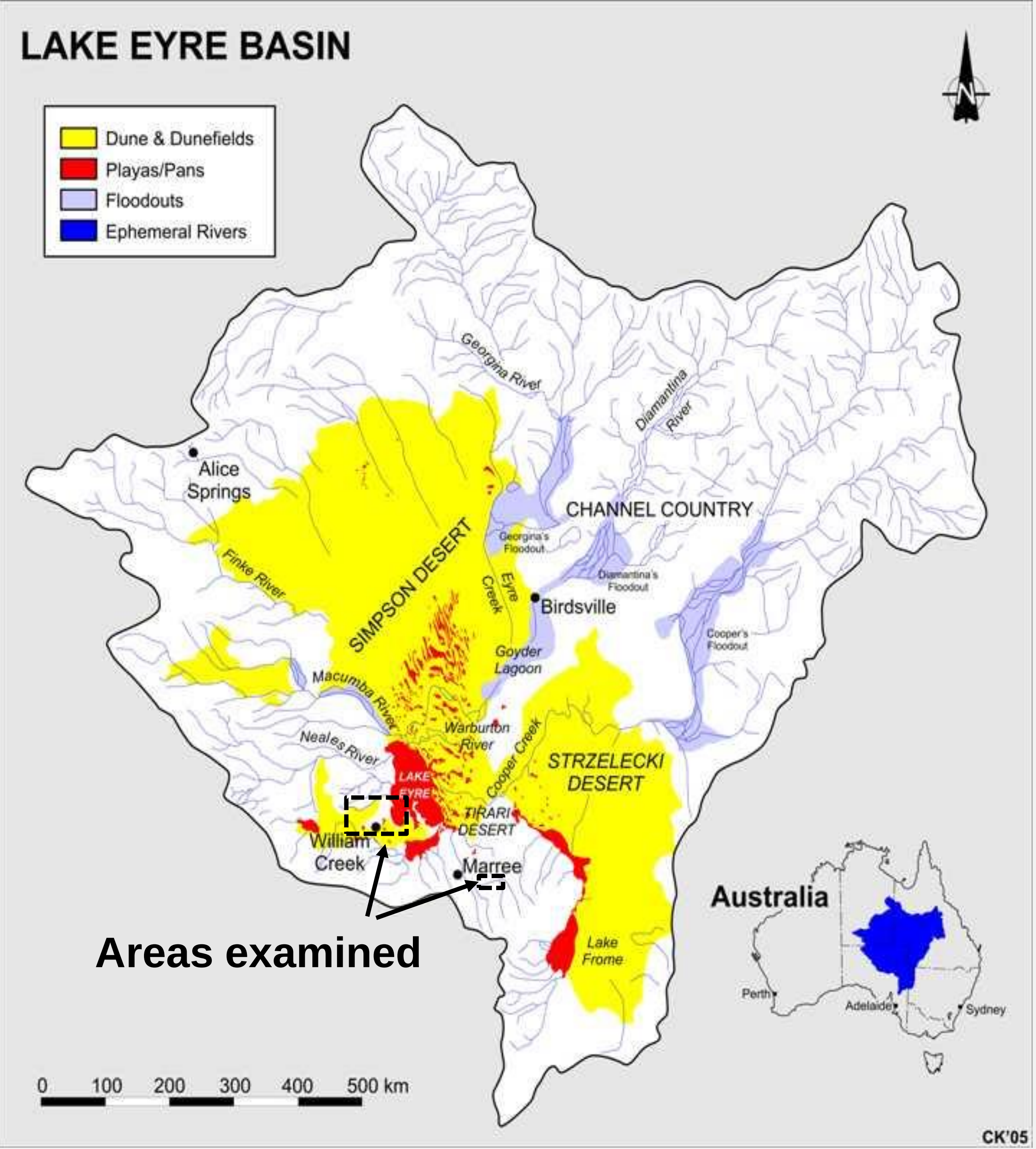
Silcretes and other cretes are widely developed around the basin.

Recent filling events generally reflect the varying strength of the northern monsoon.



Distribution of silcrete around the Lake Eyre Basin.

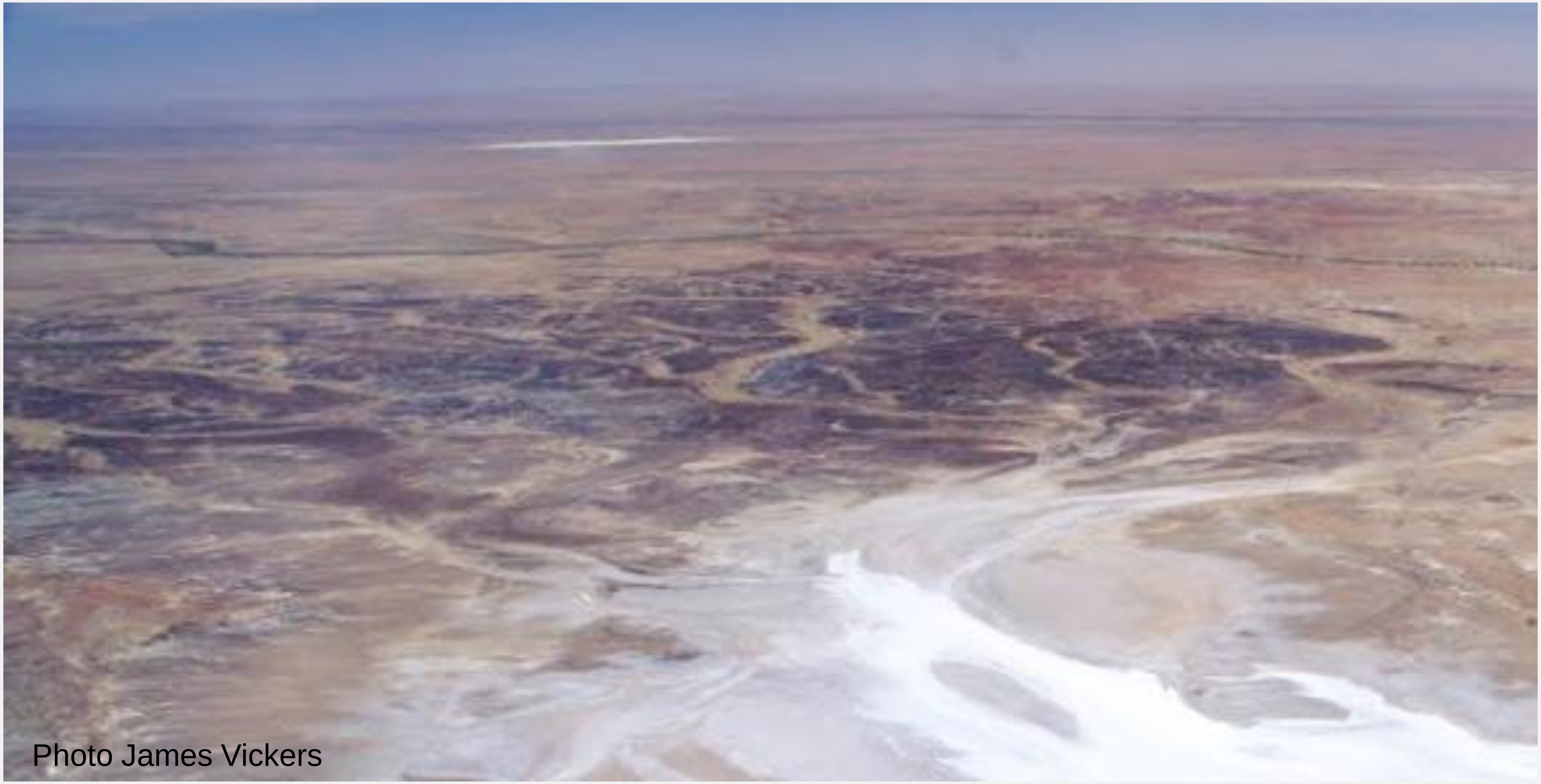
The enclosed LAB is potentially an ideal site for investigating chemical mass transfer (CMT).



Key surface features of the Lake Eyre Basin and location of the areas examined.

Superimposed on, and with geological elements of, older basins comprising the Great Artesian Basin.

Area between Lake Eyre and William Creek

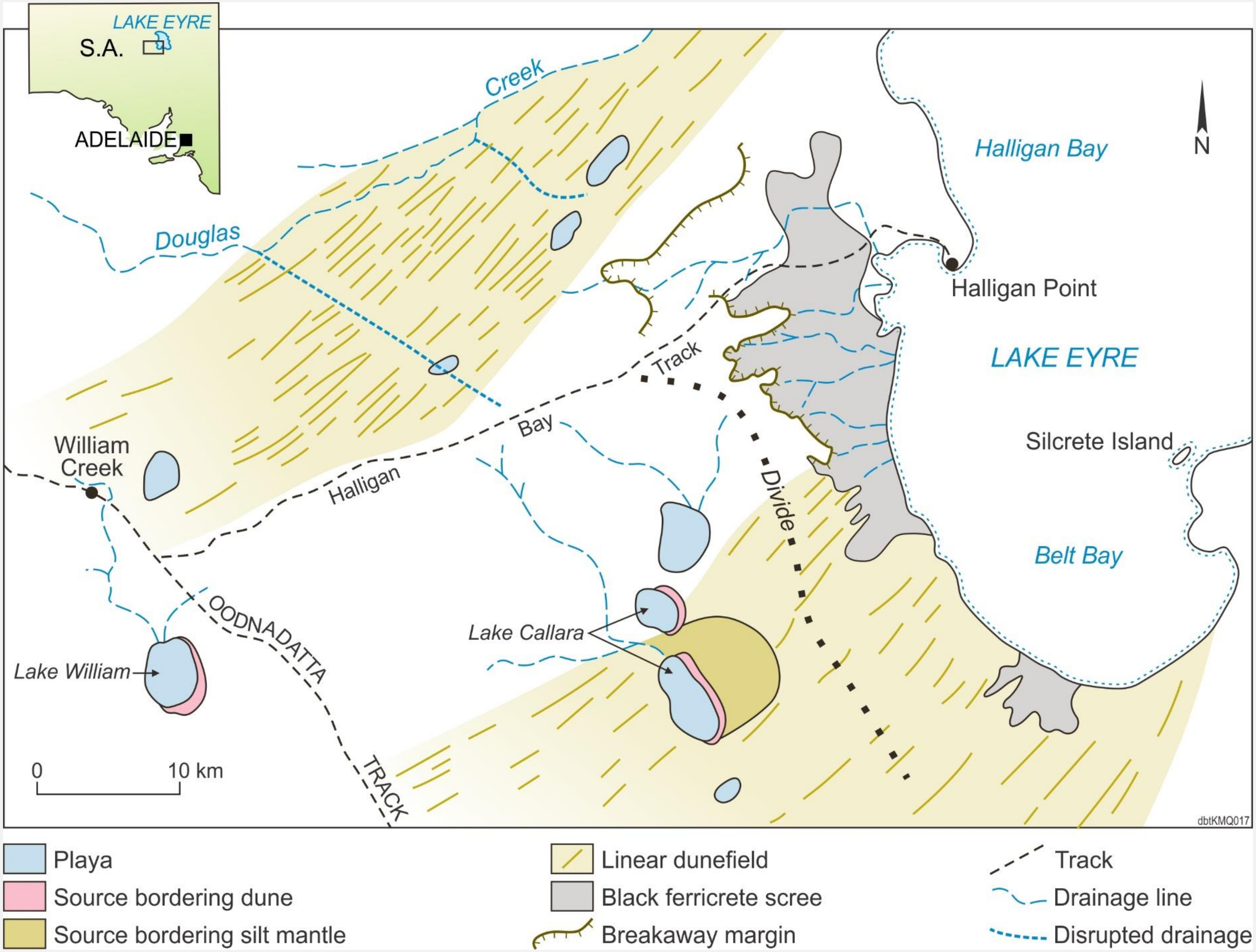


Oblique aerial view of area, looking NW from over Belt Bay.

Area of ‘black crete’ scree off breakaway SW edge Lake Eyre

Massive, fine-grained Ferricrete.

Area between Lake Eyre and William Creek, key landforms



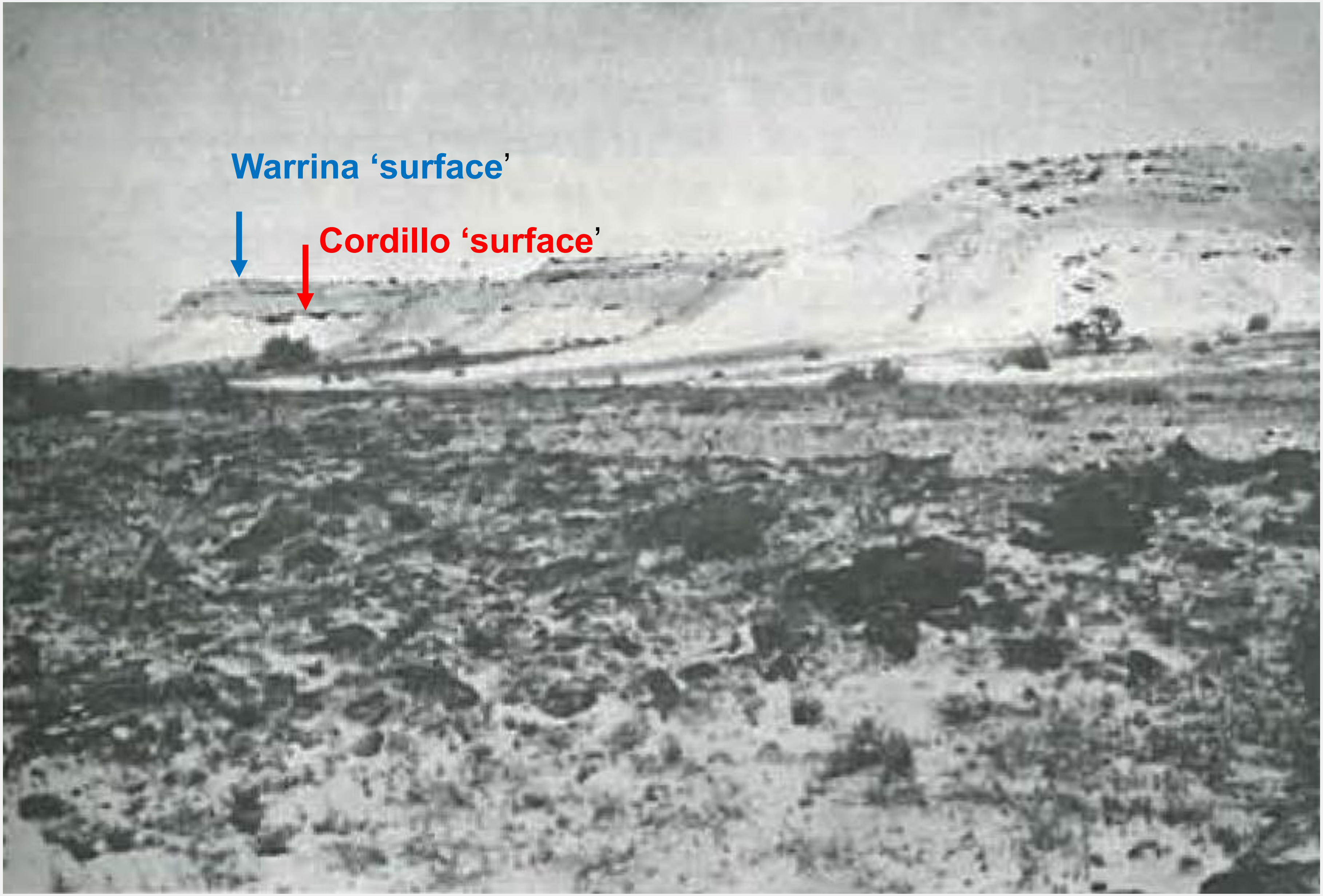
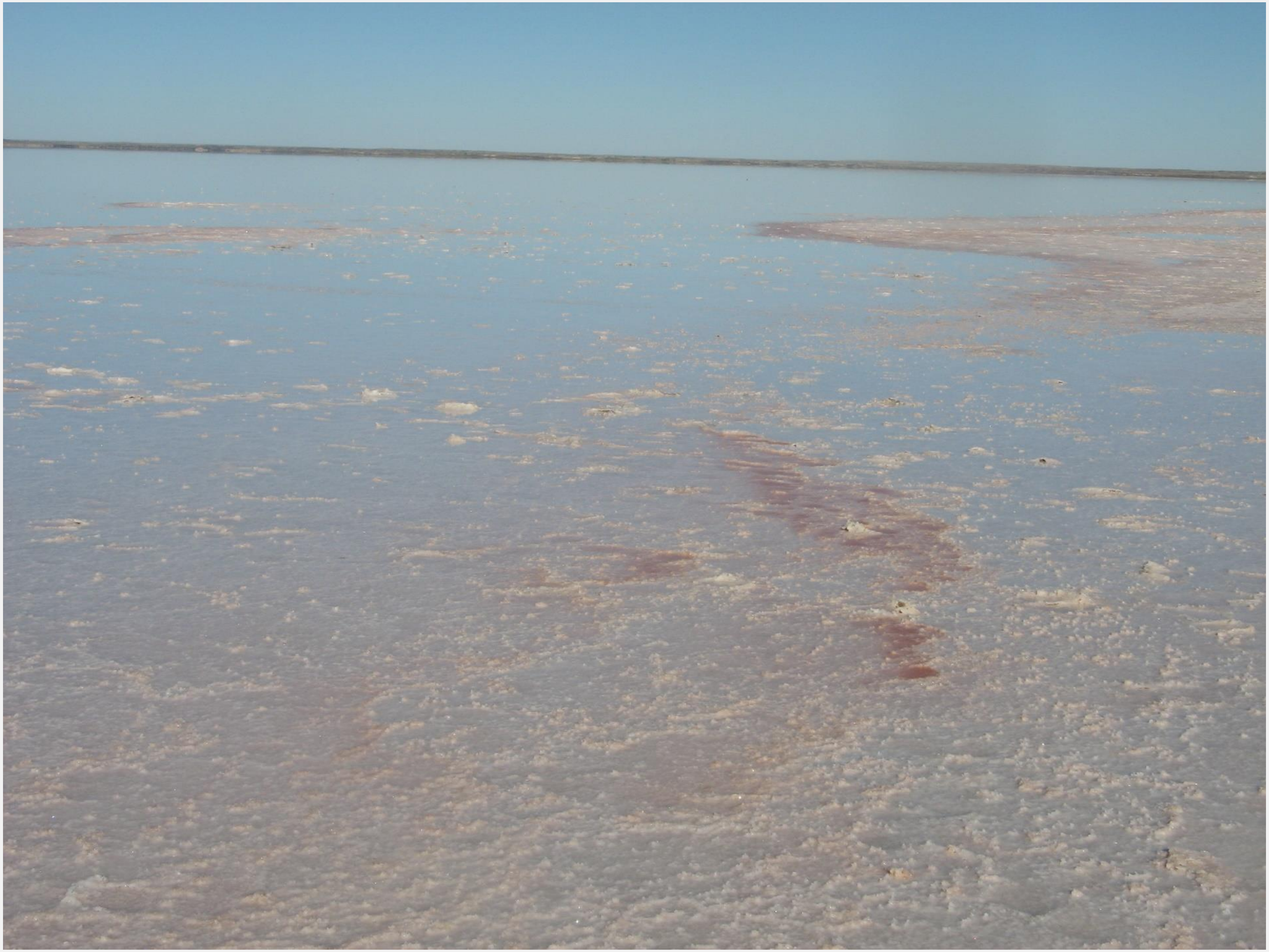


Photo from Wopfner (1978), 8 km west of Lake Eyre.

A similar view from the same general area 2016.

Silcrete described as pillow-type (knollenstein) by Wopfner (1978), 45 km east of William Creek.

Linear dunes in NW dune field Lake Eyre-William Creek area.



Water on surface of Lake Eyre, Belt Bay.

Salt crust and surface features Lake Eyre Halligan Point.

‘Igloo’ structures in salt crust

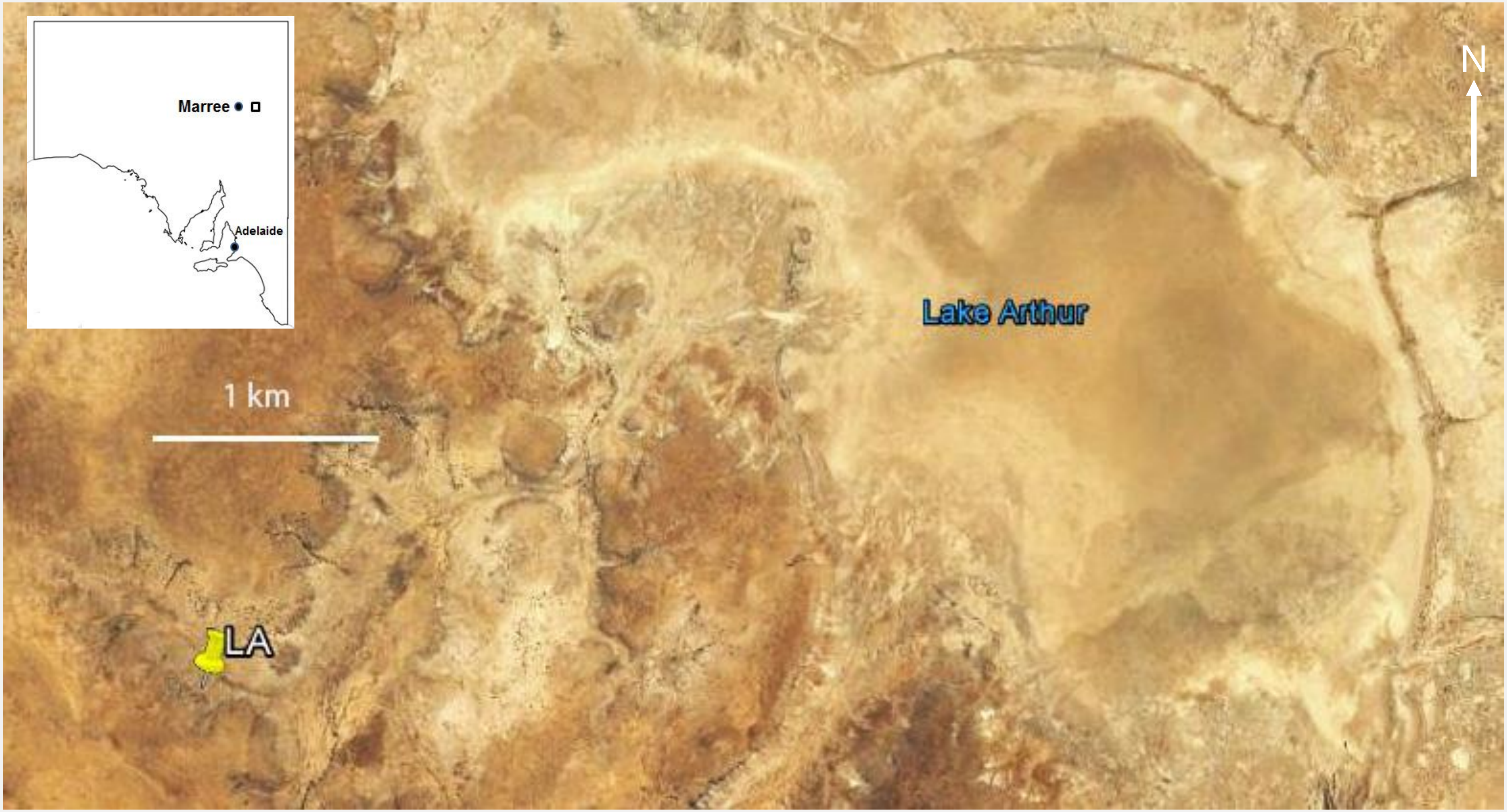
Sequence of landform associations

1. **Formation of silcrete/ferricrete in periods of marked chemical weathering under wetter climatic conditions. (Late Cretaceous-Early Cenozoic)**

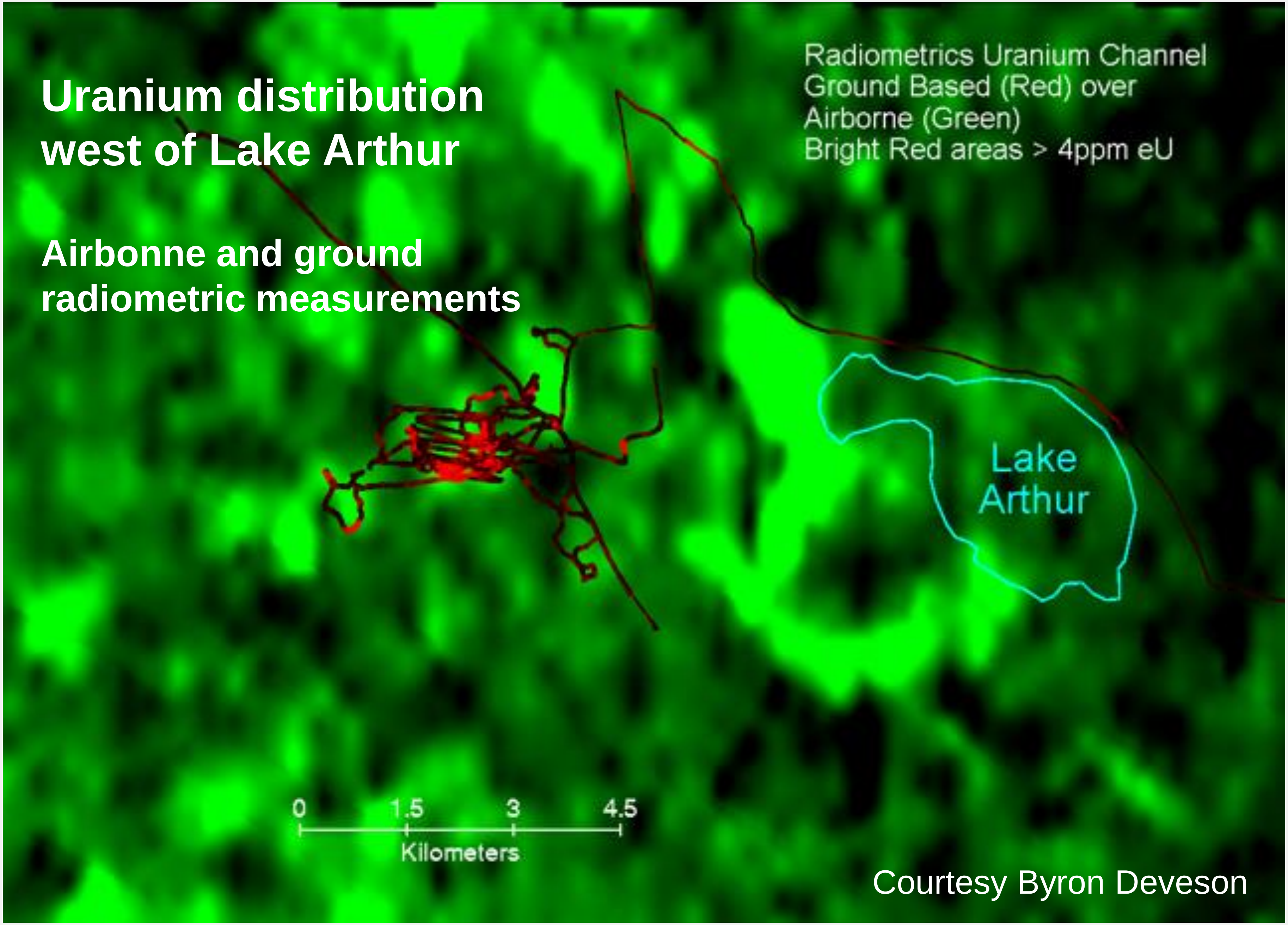
2. **Progressive drying, reduced chemical weathering with ongoing physical erosion, topographic inversion of indurated zones and breakaway/mesa development. (Late Cenozoic)**

3. **Marked aridity, decreased fluvial erosion, increased wind transport/deposition resulting in dune development and drainage disruption. Evaporative conditions and development of playa-related landforms and chemical deposition of halite, gypsum and calcrete. (Pleistocene-Holocene)**

An unusual silcrete near Lake Arthur, 60 km east of Maree

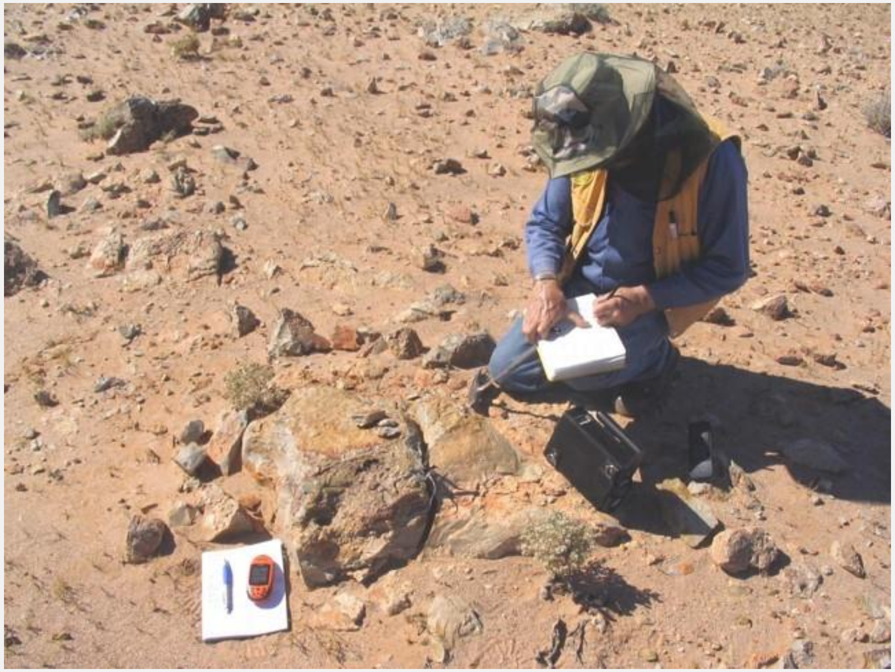


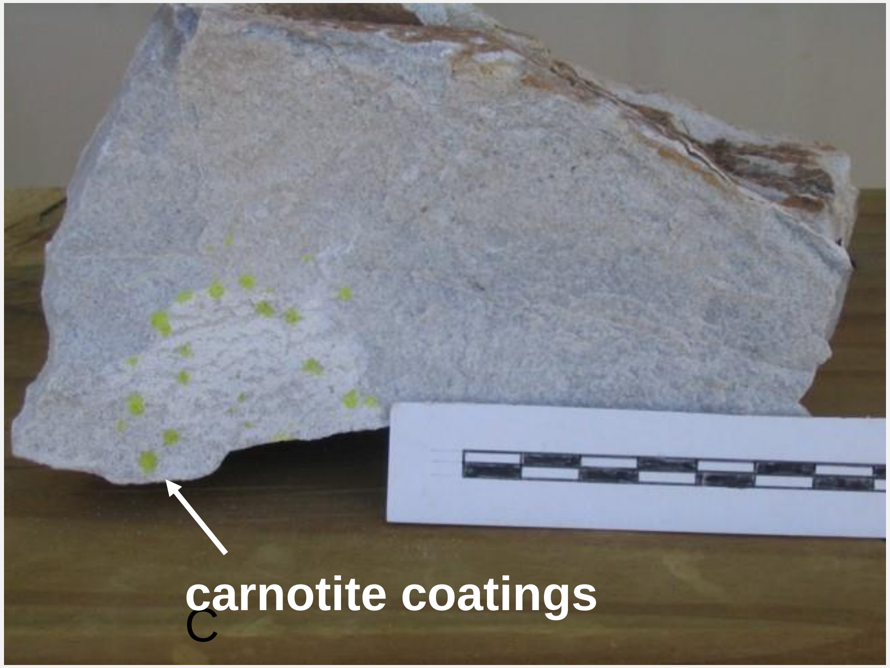
Radioactive outcrops (2000 c/s) on the side of a mesa (LA).

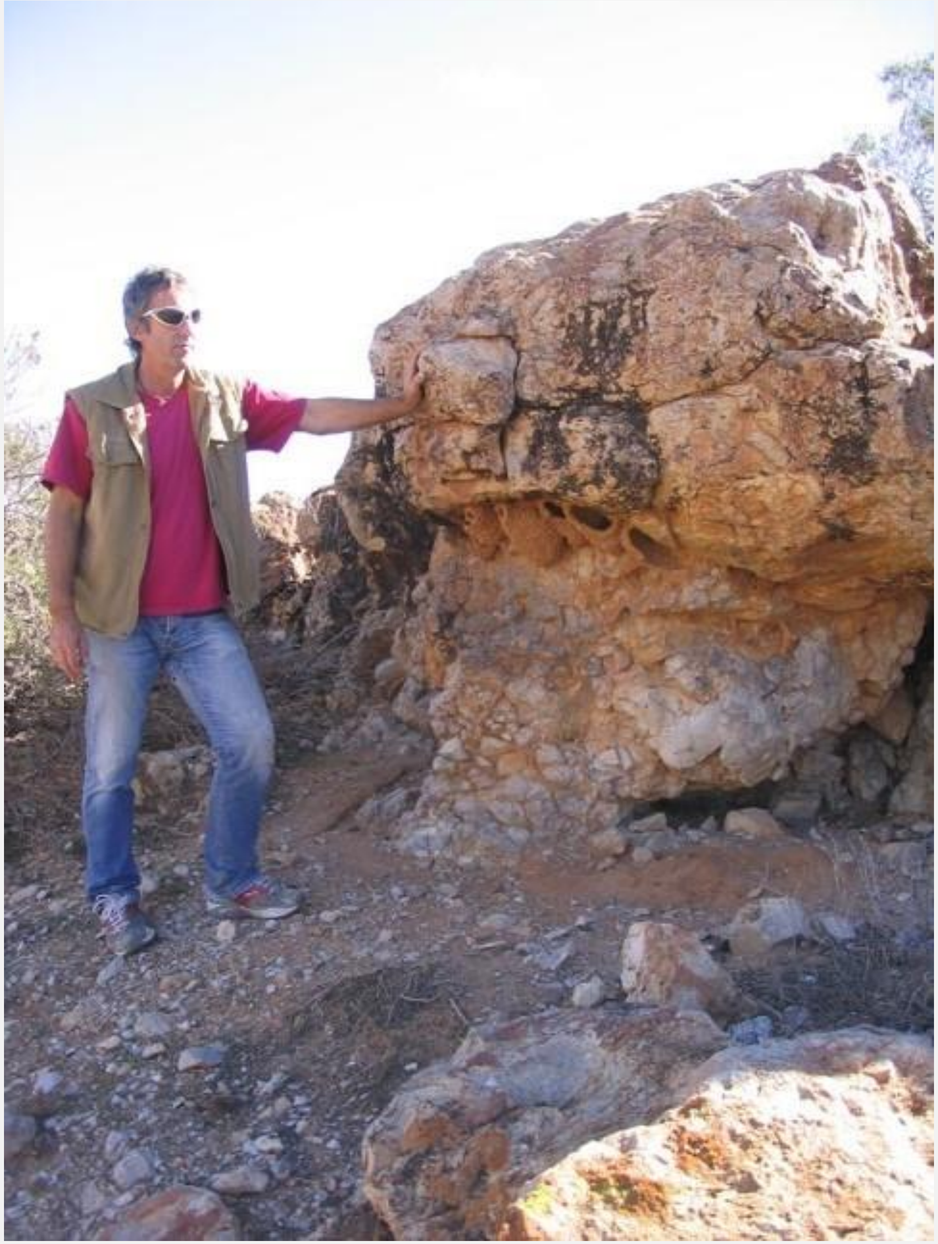


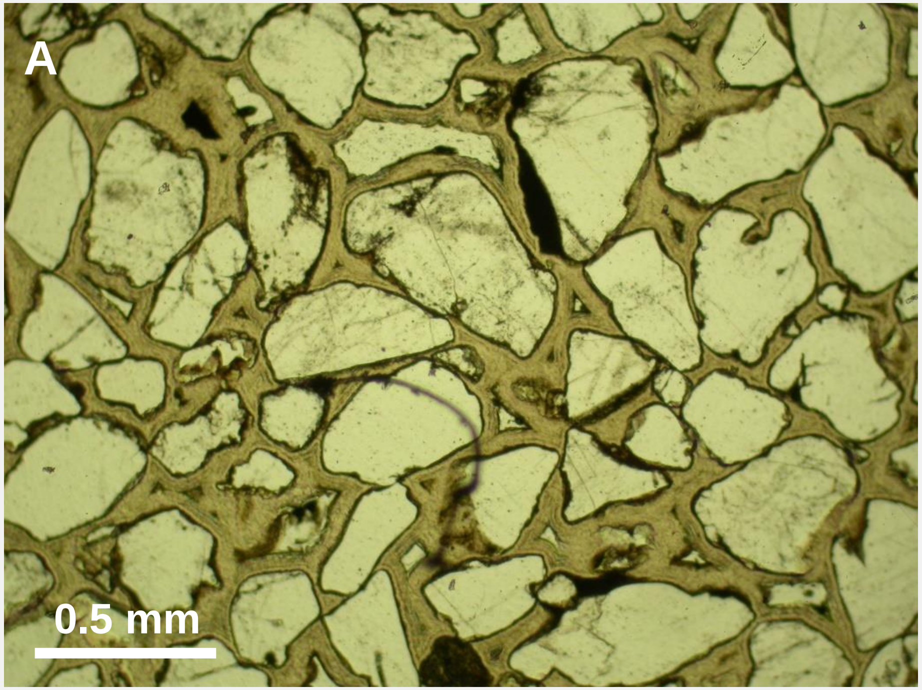
Uranium distribution
west of Lake Arthur
Airbonne and ground
radiometric measurements
Radiometrics Uranium Channel
Ground Based (Red) over
Airborne (Green)
Bright Red areas > 4ppm eU
Lake
Arthur
0
1.5
3
4.5
Kilometers
Courtesy Byron Deveson

Uranium-enriched silcrete site.

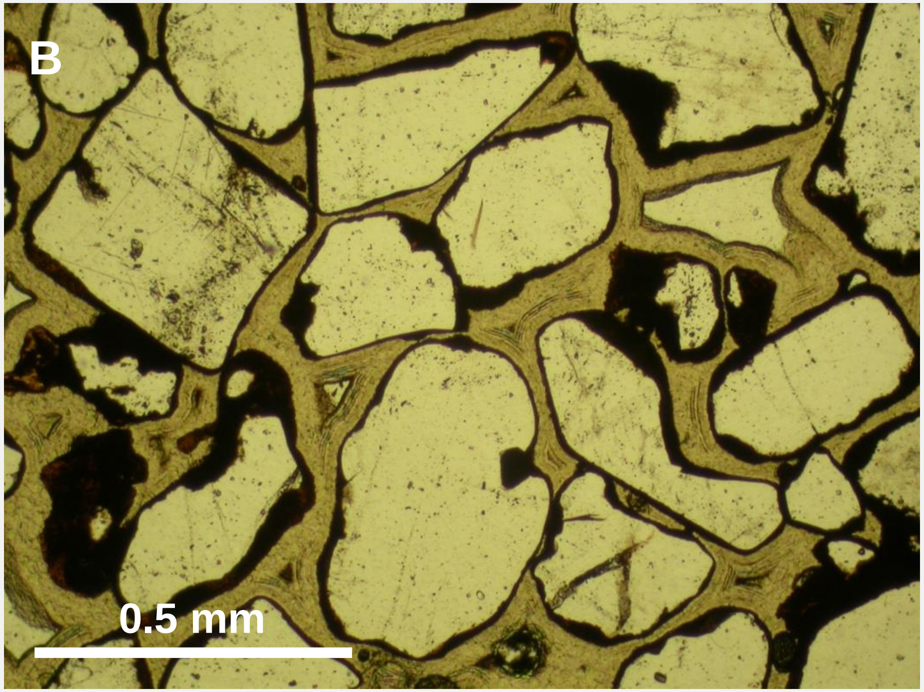








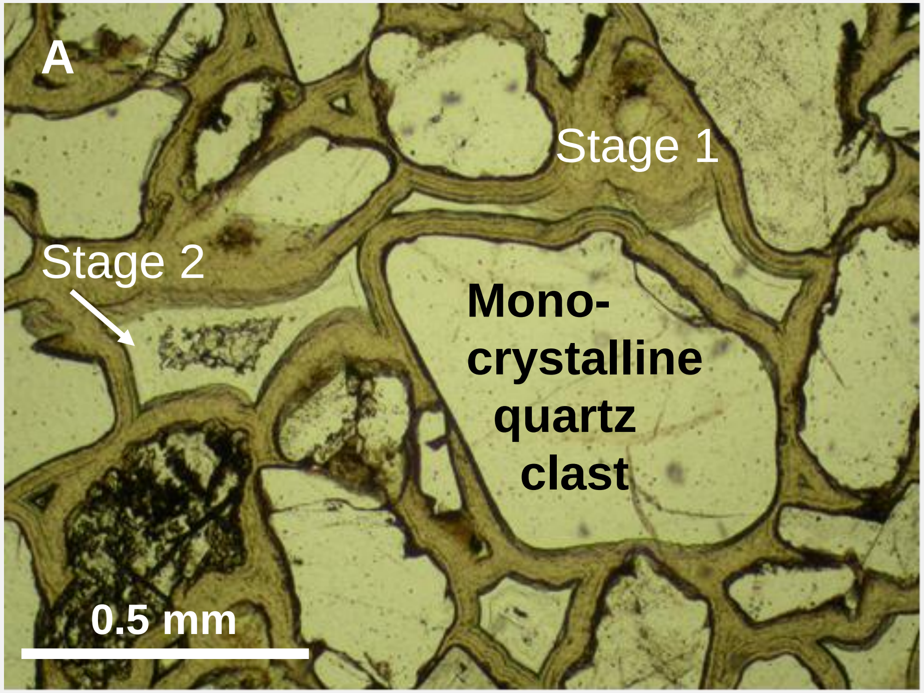
Thin section of silcrete sample LA1.



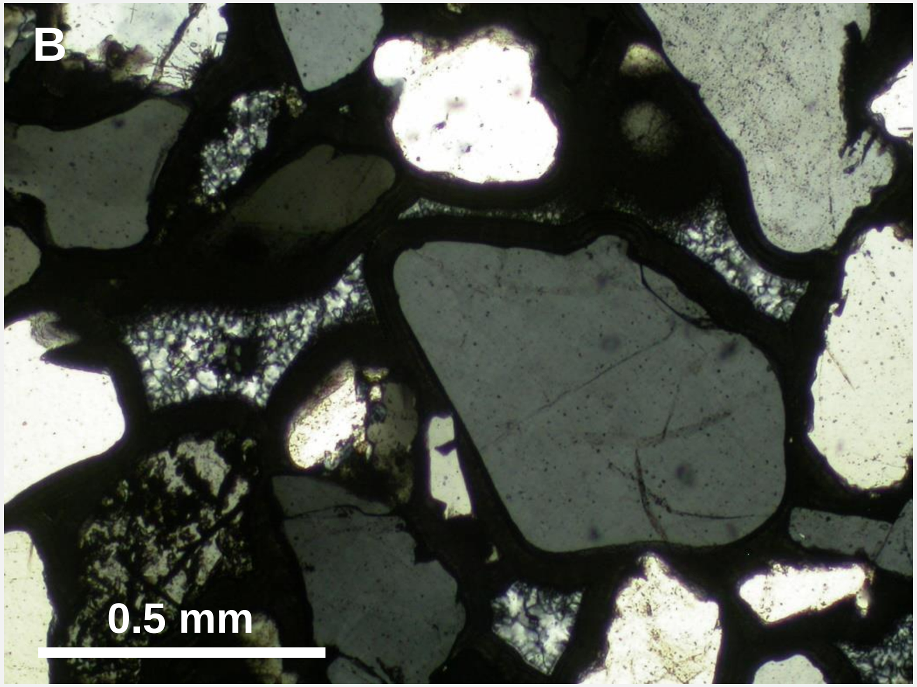
Section of sample LA1 from Palimpsest, ferruginous mottle.

The silcrete consists largely of monocrystalline quartz clasts enclosed in a matrix of dominantly opaline silica and later precipitated, minor microcrystalline quartz.

Ferruginous mottling predates the silcreting of the sediment with local redistribution of the iron oxide/oxyhydroxide.



Sample LA1 in plane polarised light.

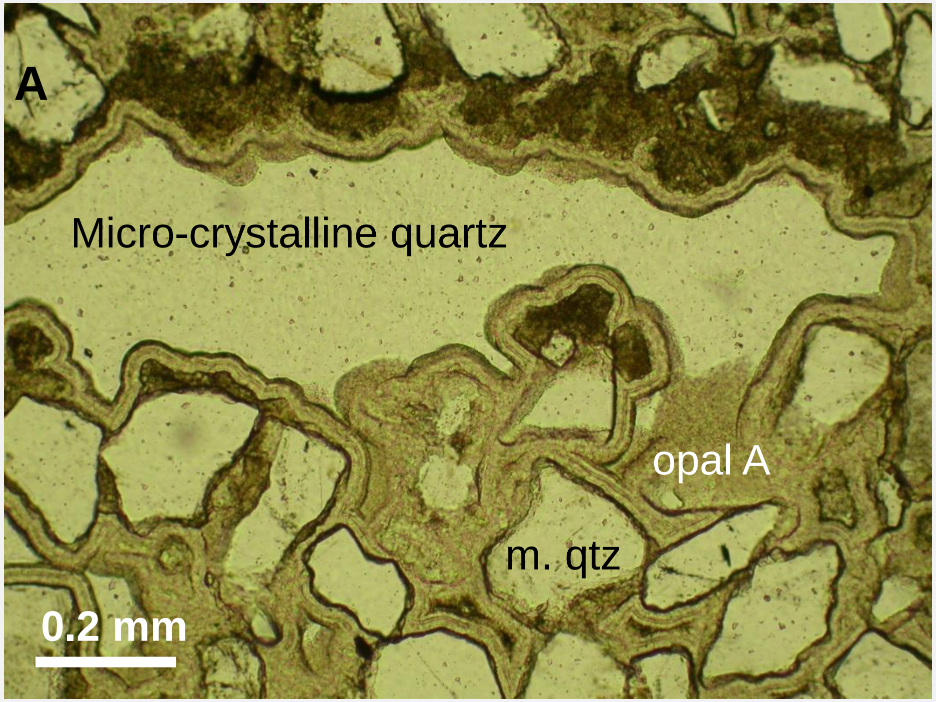


Same field in cross polarised light.

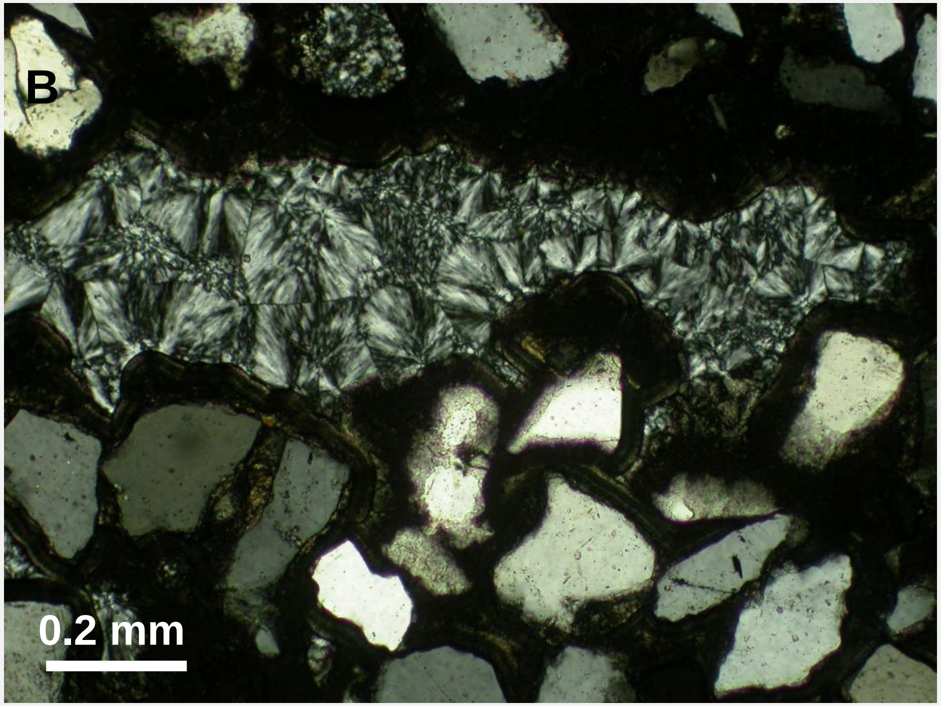
Two stages of silcrete matrix development:

Stage 1 – poorly crystalline opaline silica precipitated from early groundwater;

Stage 2 – micro-crystalline quartz as later infilling/ crystallisation.



Thin section of sample LA2 with carnotite.



Same field in cross polarised light.

Carnotite ($K_2(UO_2)_2V_2O_8$) appears to be associated with the Stage 1 opaline silica.

Carnotite deposits in semi-arid Australia are typically associated with calcretes, but alkaline groundwaters could transport U and V, then precipitate carnotite in the absence of calcrete under lower pH conditions, together with silcrete.

Conclusions

- Cretes are clearly an important component of many ‘chemical’ landscapes.

- Evolving and fluctuating groundwater compositions can lead to specific or sequential formation of different cretes by precipitation and replacement (sil-ferri-cal-crete).

- Landscapes of the Lake Eyre Basin demonstrate the interplay between ‘physical’ and ‘chemical’ landscapes as driven by long term climate change.

- The Lake Eyre Basin provides a potential, continental scale site for future research into chemical mass transfer aspects of landscape evolution.

Acknowledgements

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Photo James Vickers