# Paleoenvironmental history preserved in shoreline dunes of the Wimmera lake overflow system, Wotjobaluk Country, south-eastern Australia

– PICO Talk - GM6.2 - EGU 2026 –

**Victoria Schwarz**[1], Tobias Lauer[2], Andrew Gunn[1], Sumiko Tsukamoto[2,3], Barengi Gadjin Land Council Aboriginal Corporation[4], and Kathryn E. Fitzsimmons[1]

[1]Monash University (Australia), [2]University of Tübingen (Germany),
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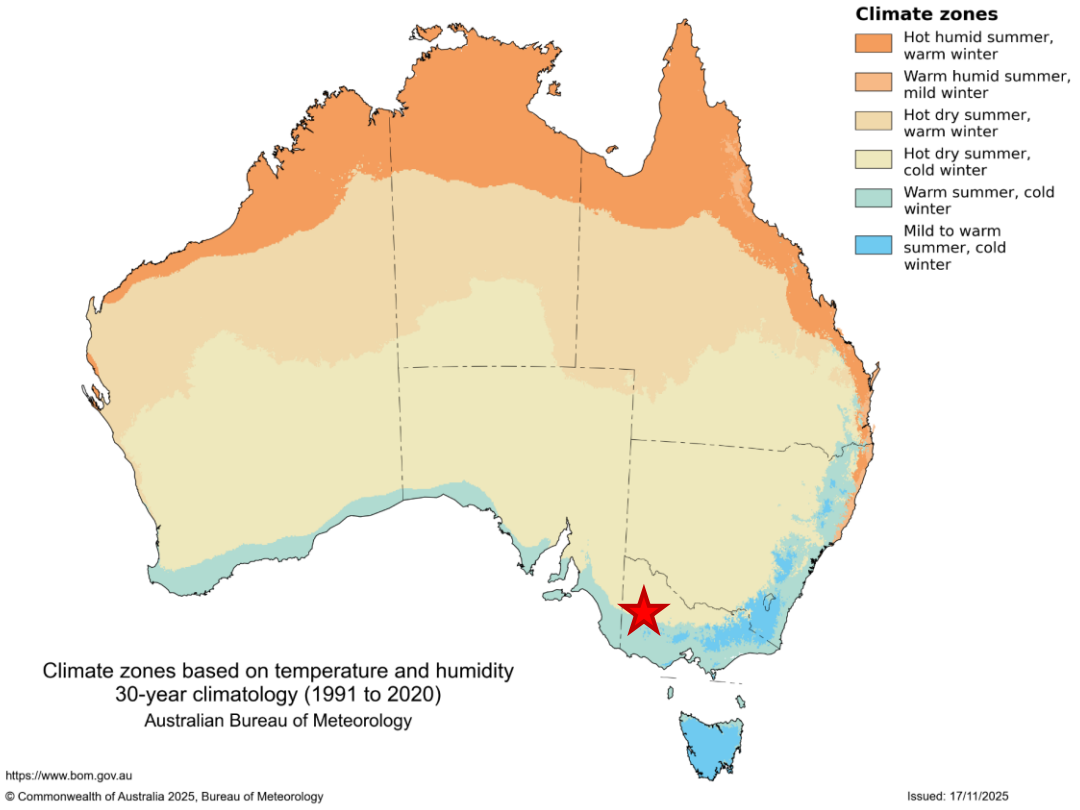
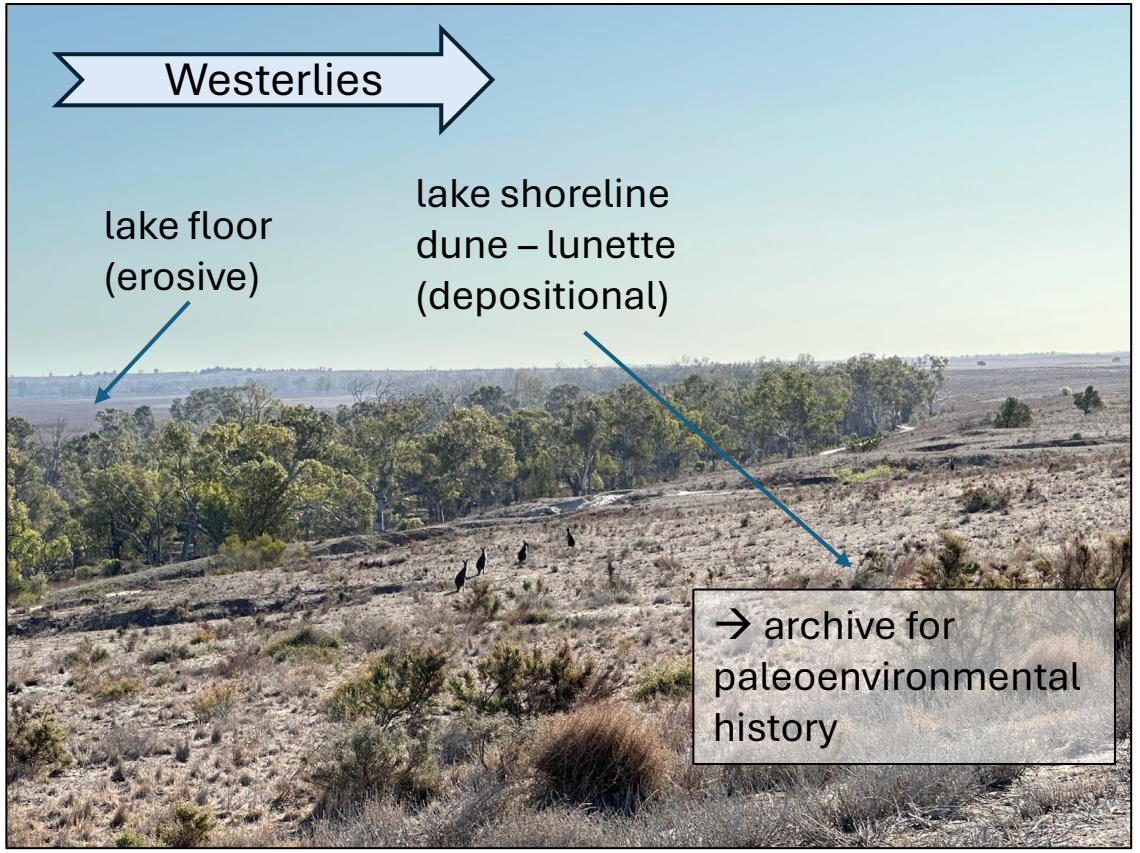
Sharing is encouraged

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

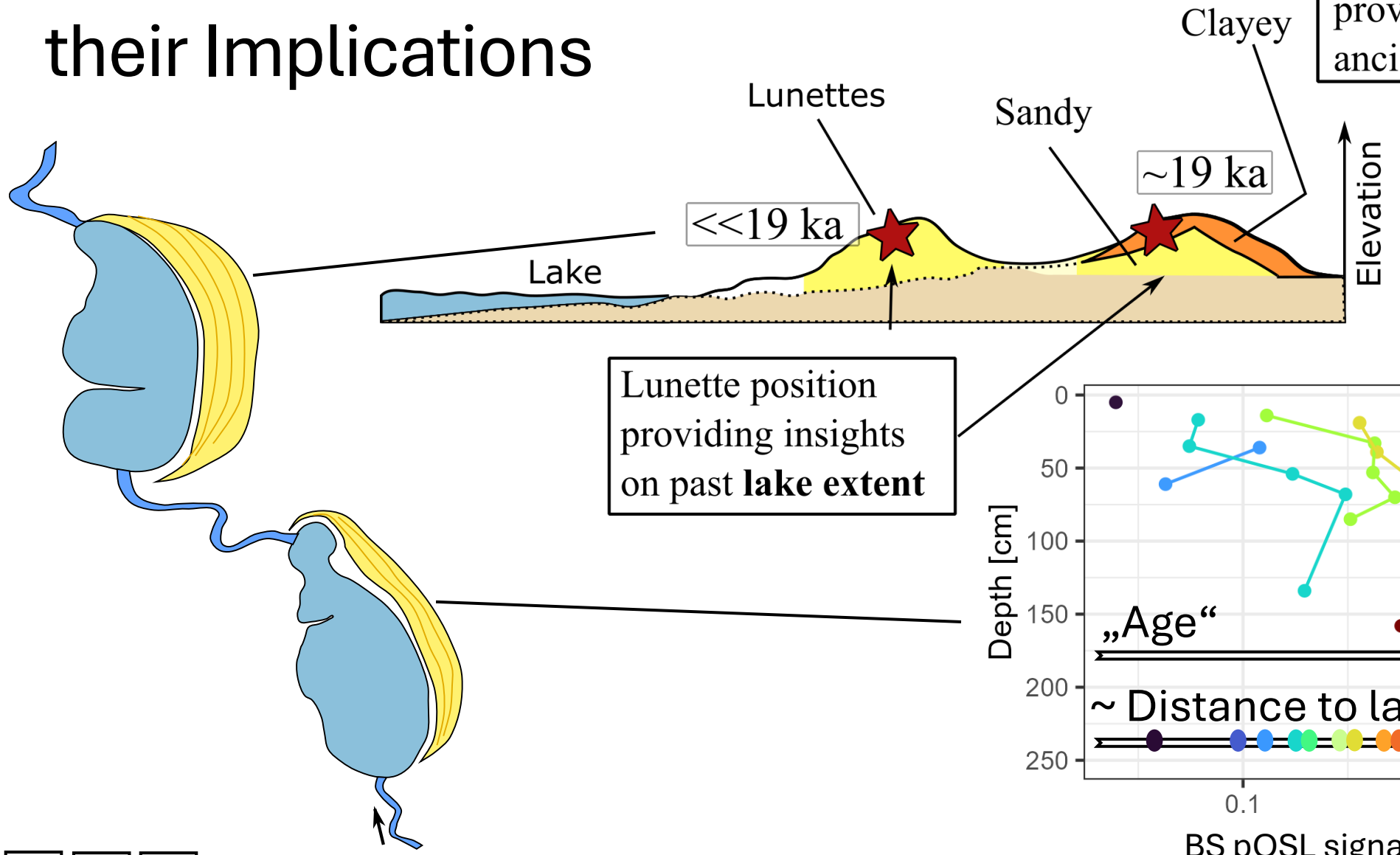
# Wimmera Catchment, Wotjobaluk Country



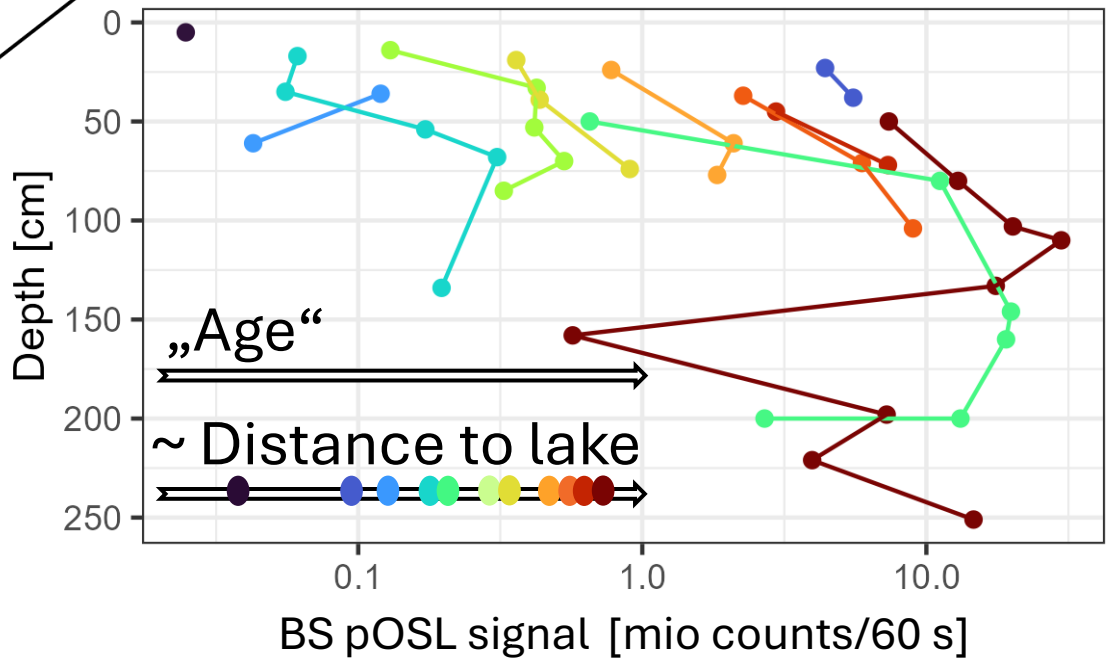
# Lake Shoreline Dunes and their Implications

Sediment characteristics providing insights on ancient **lake conditions**




Lunette position providing insights on past **lake extent**

**portable OSL**



# Thank you for your attention!


## Acknowledgement

**Help in the field:**

Josh Evans, Rory Ferguson, Leloba Jefferis, Anastasiia Kazakova, Cari Rand, Members of the Barengi Gadjin Land Council

**Cooperation and Access:**

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MONASH University

Deutsche Gesellschaft für Geomorphologie e.V. DGGM

VEAC Victorian Environmental Assessment Council

IAS

Barengi Gadjin LAND COUNCIL

# Paleoenvironmental history preserved in shoreline dunes of the Wimmera lake overflow system, Wotjobaluk Country, south-eastern Australia

## – PICO Discussion Slides - GM6.2 - EGU 2026 –

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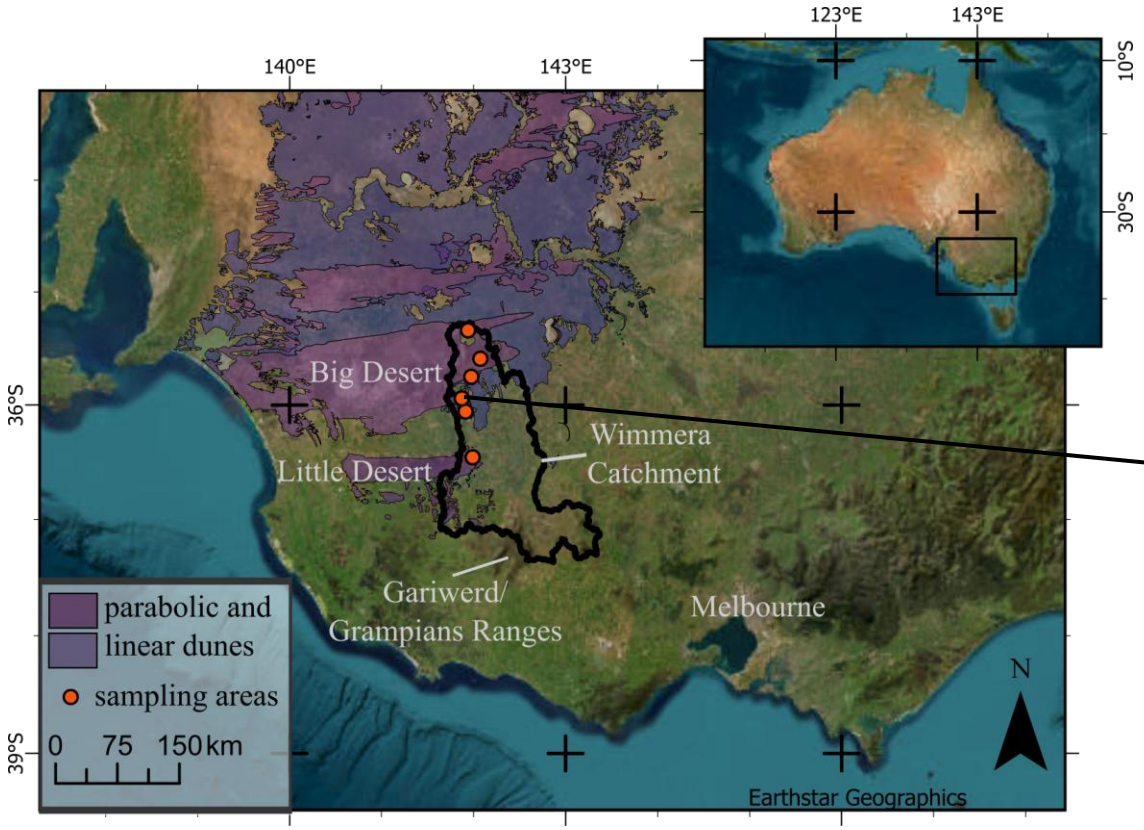
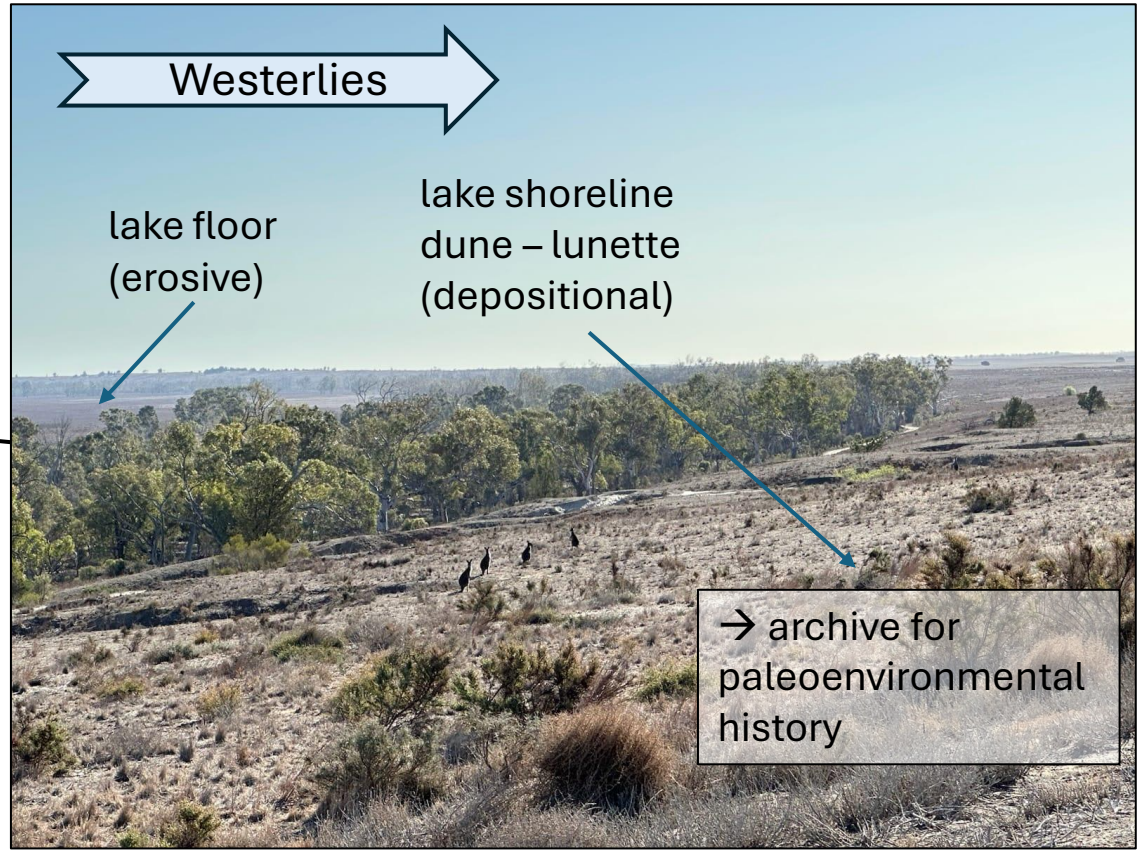
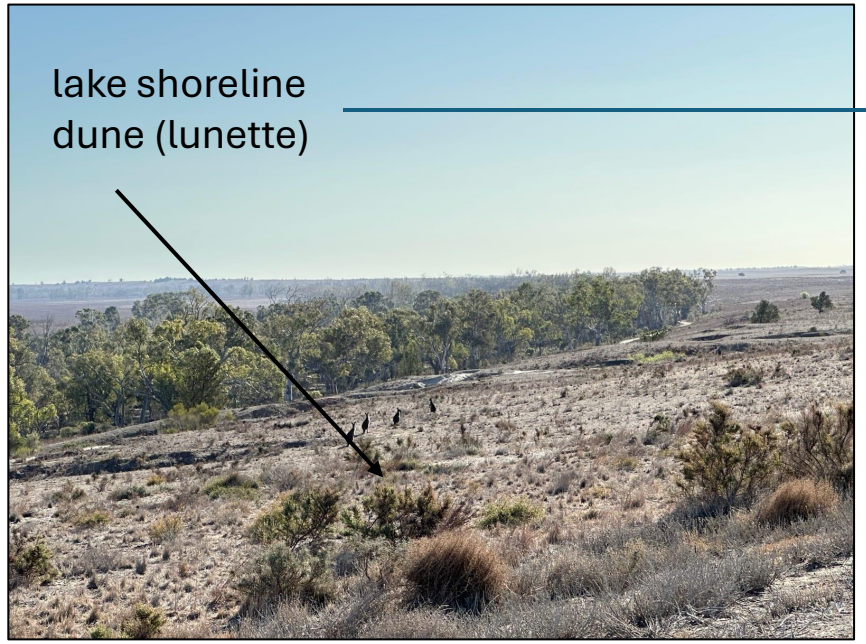
# Introduction




data from: Fitzsimmons and Mishra, accepted



# Why relevant?




insights on the lakes condition during deposition

informs on past water availability

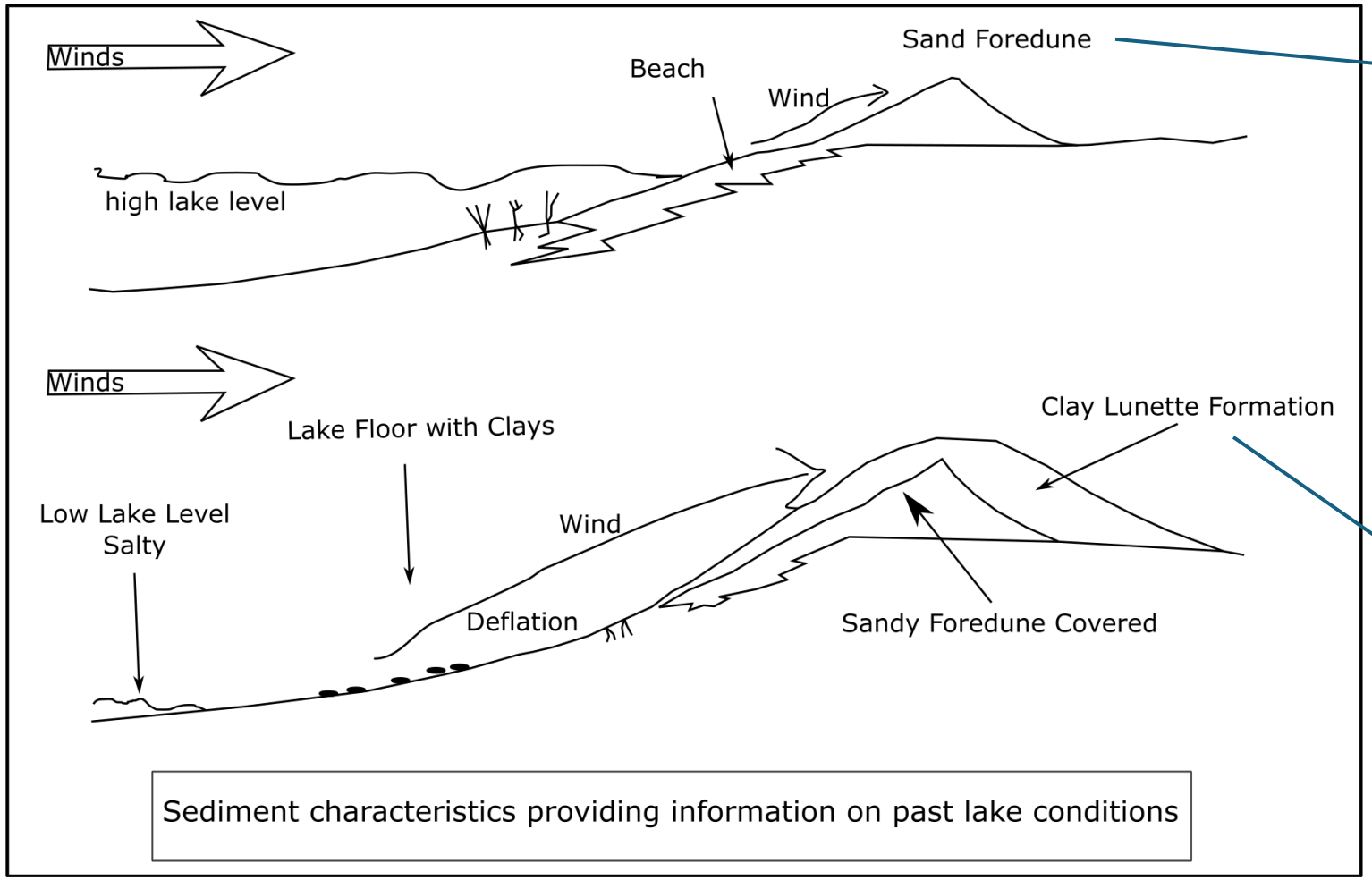
enables the reconstruction of past hydroclimatic parameters

informs on landscape reactivation thresholds in the past

insights in future environmental change triggered landscape responses

relevant for:

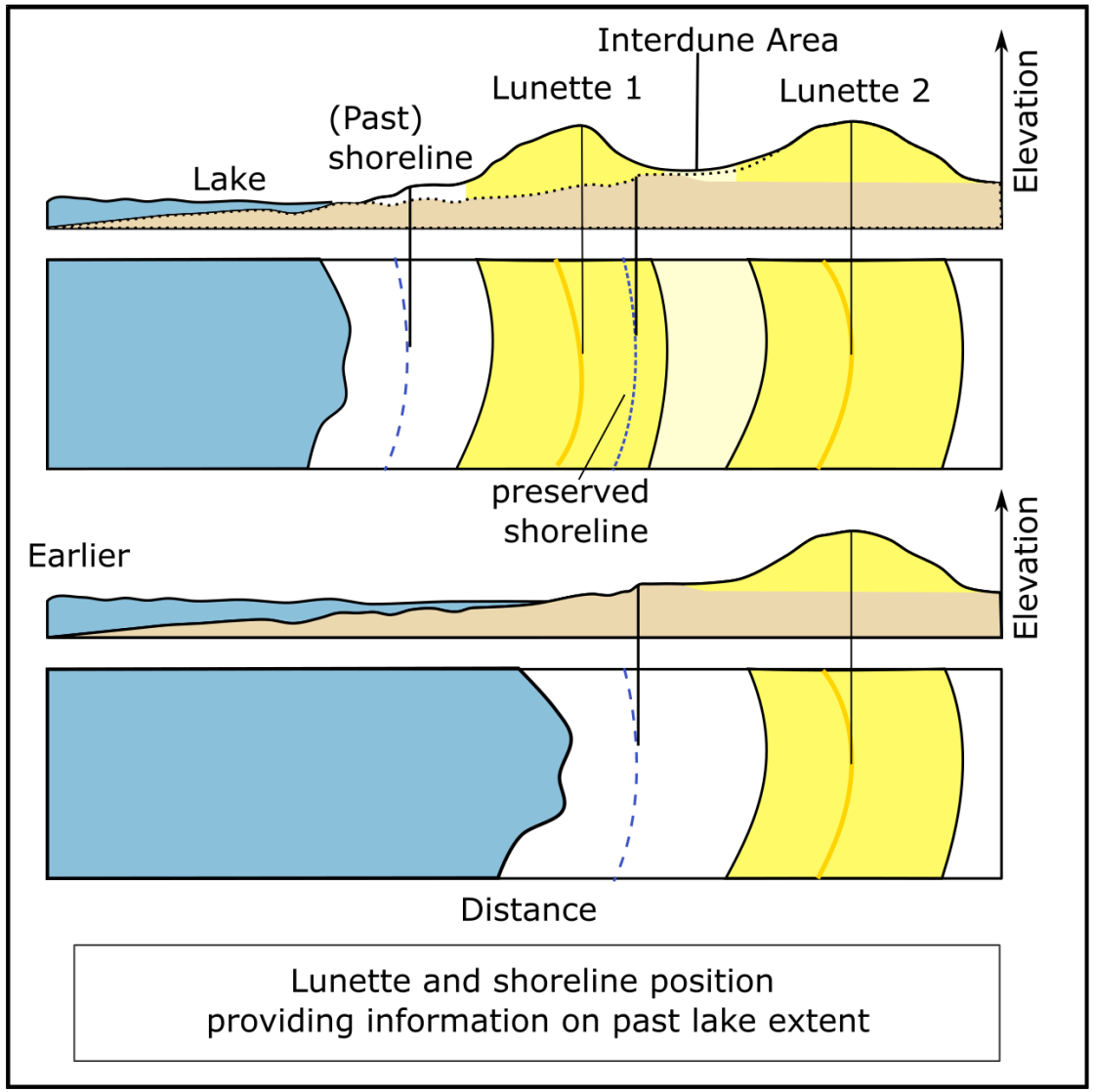

# What do lunettes tell us?




Sediment characteristics providing information on past lake conditions

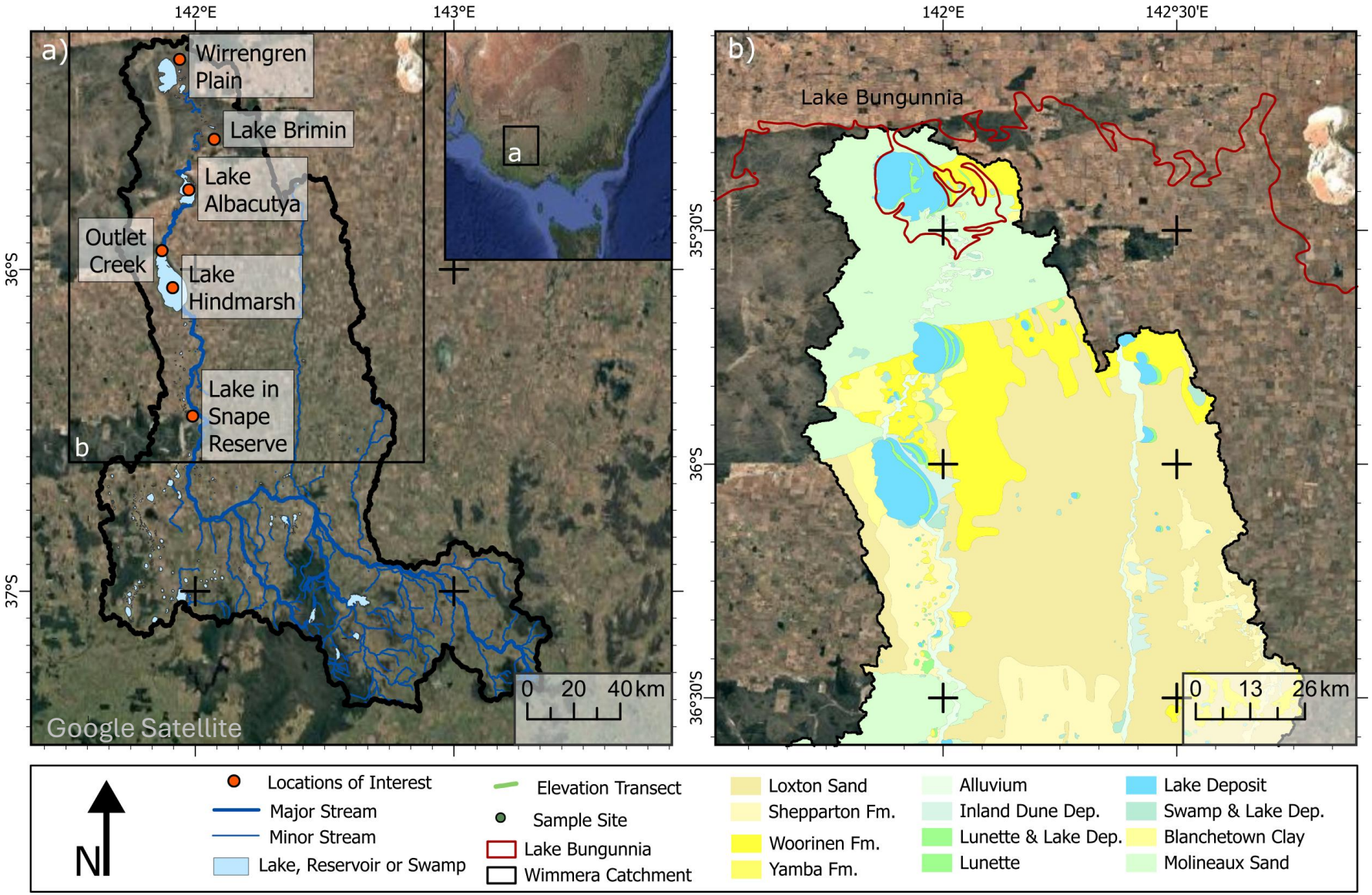
redrawn and modified from: Bowler, 1983

# What do lunettes tell us?

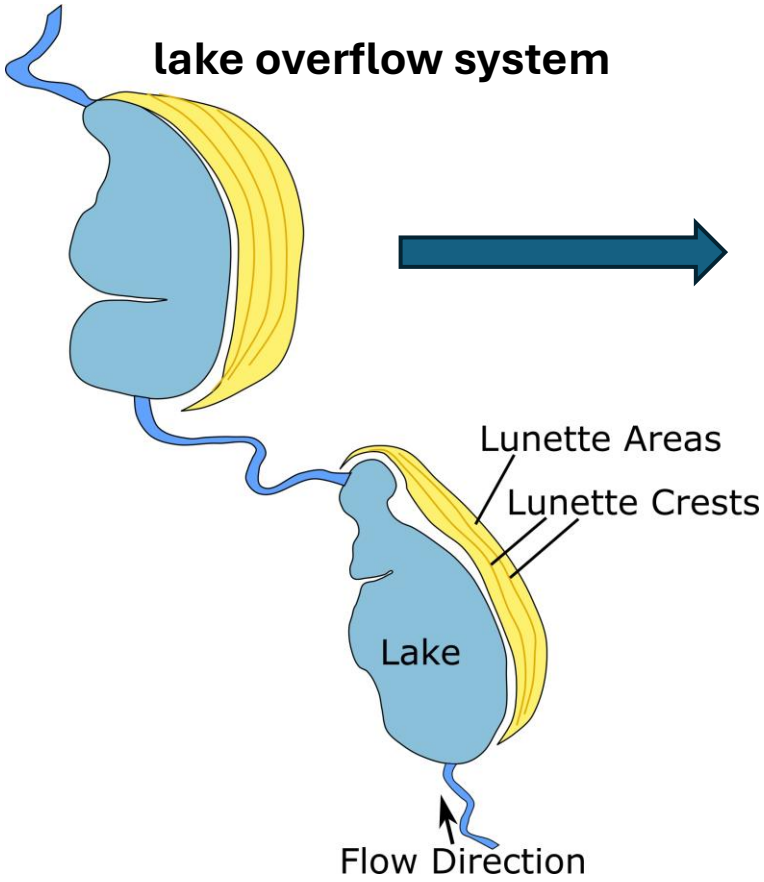


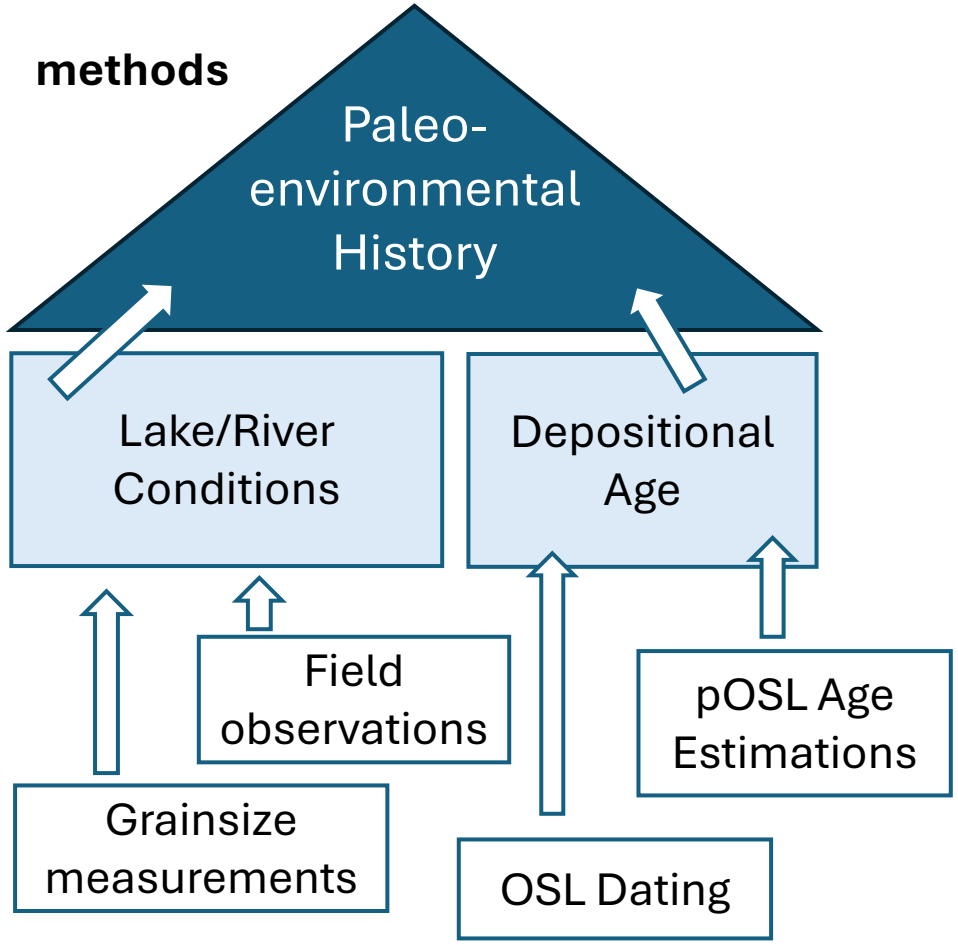

Lunette and shoreline position
providing information on past lake extent

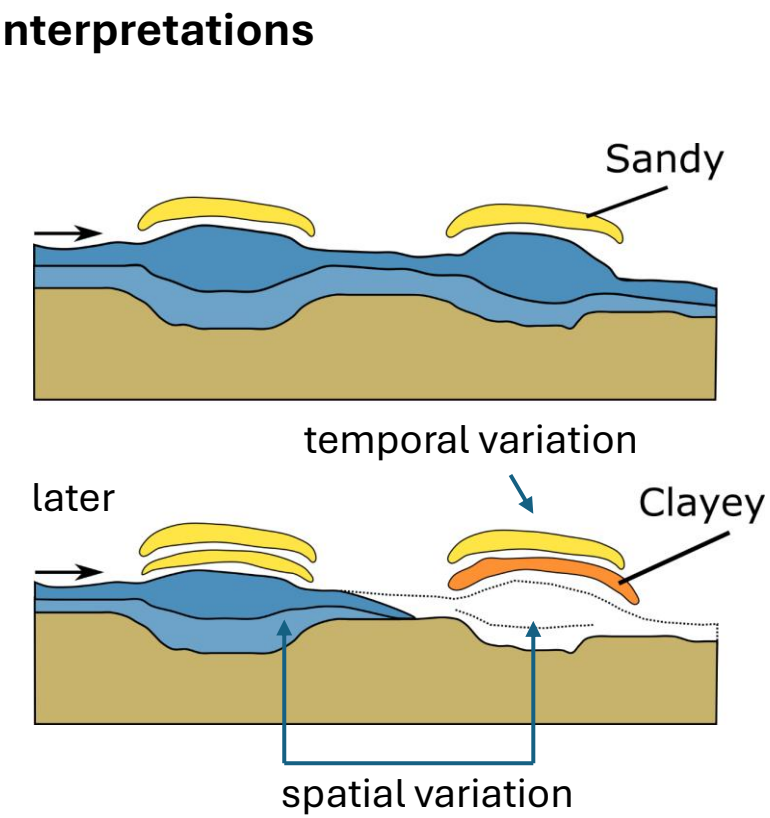
# The Study Region – Wimmera Catchment, Wotjobaluk Country



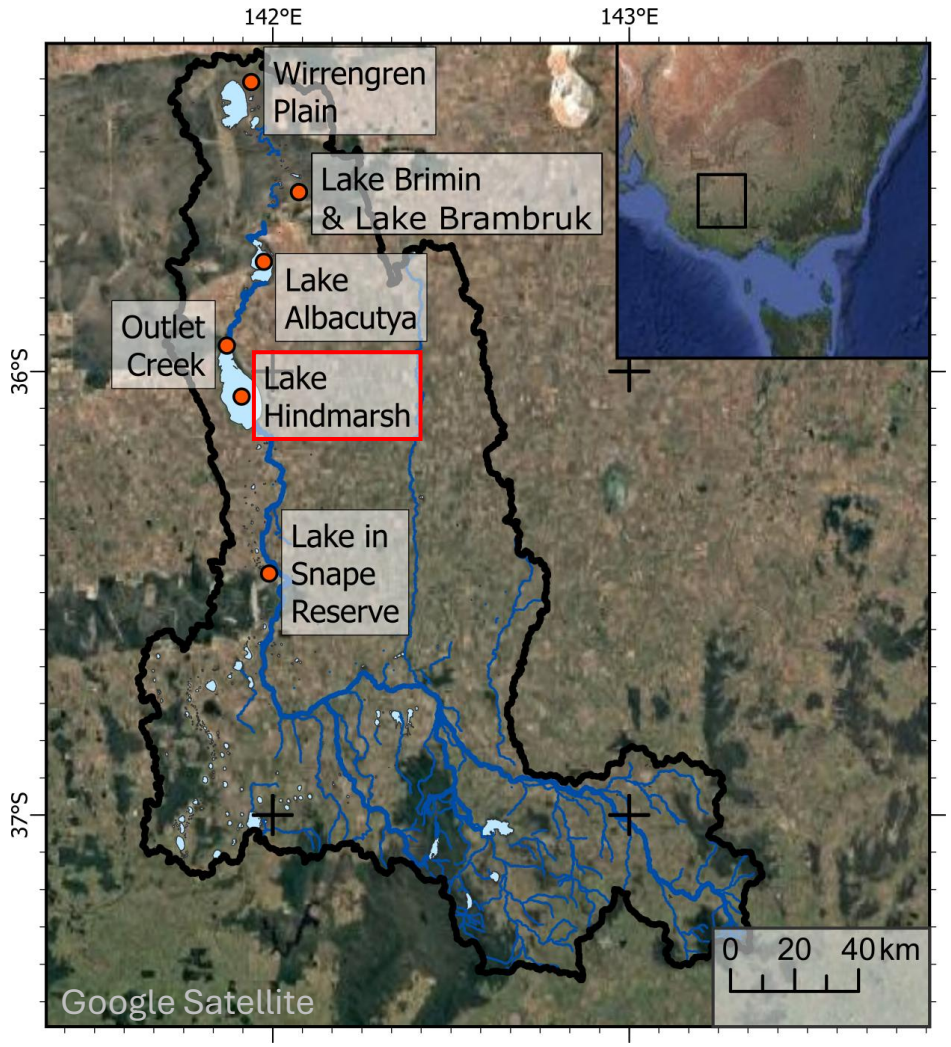
# The Reconstruction Concept

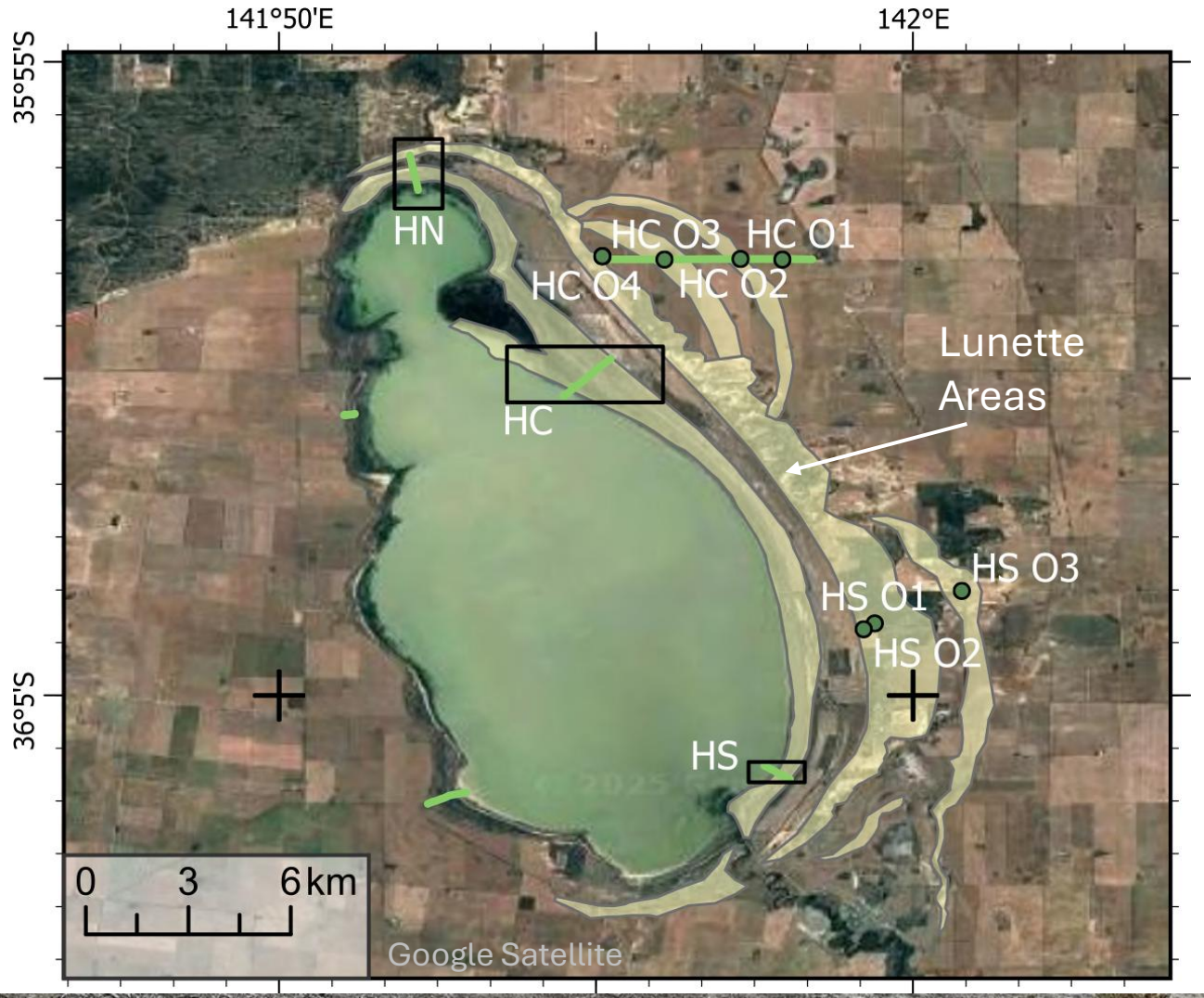


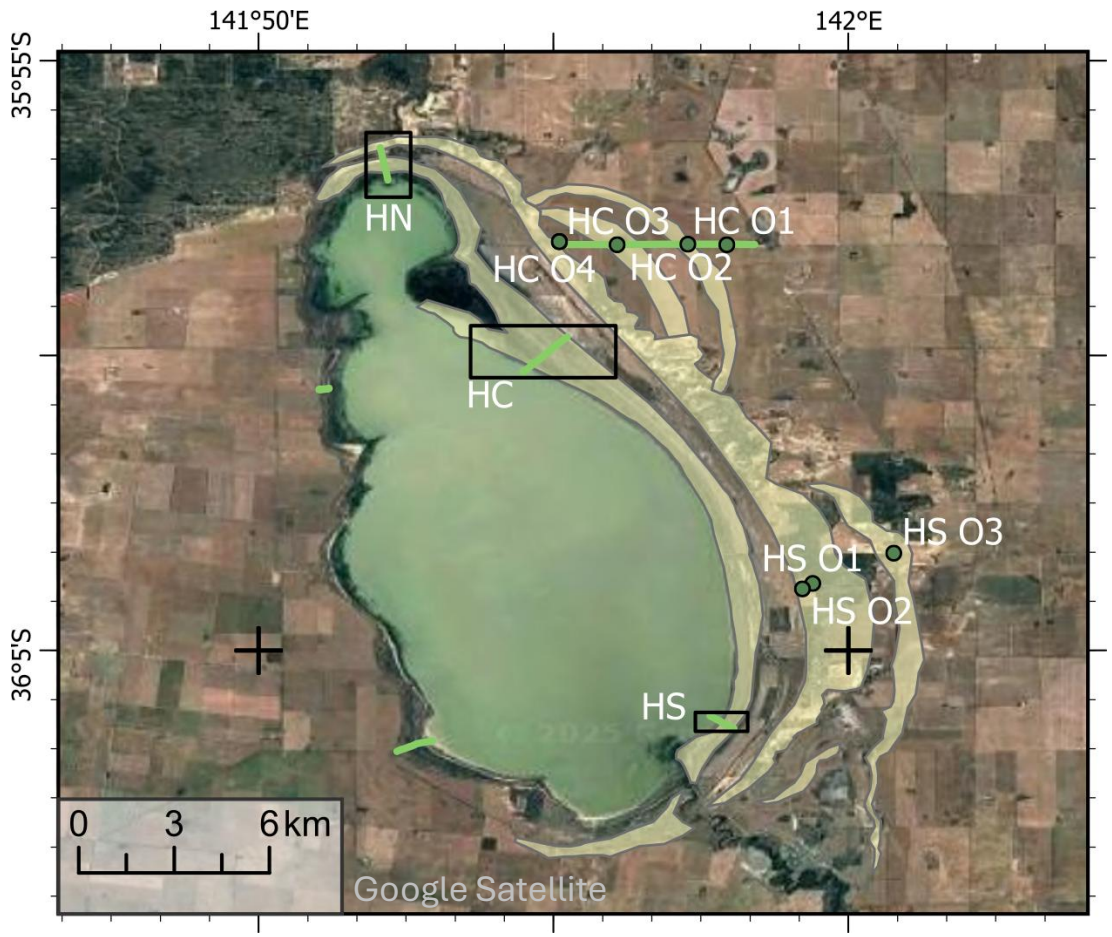



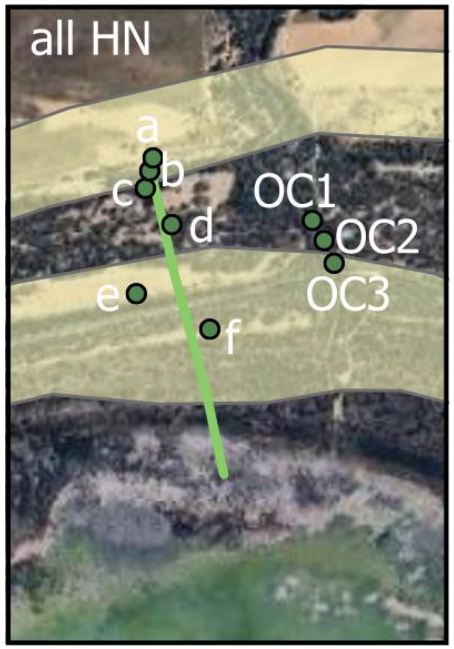
# Sampling Strategy – Example Lake Hindmarsh

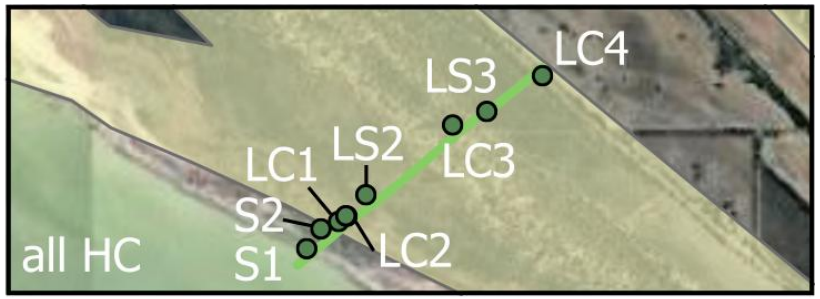


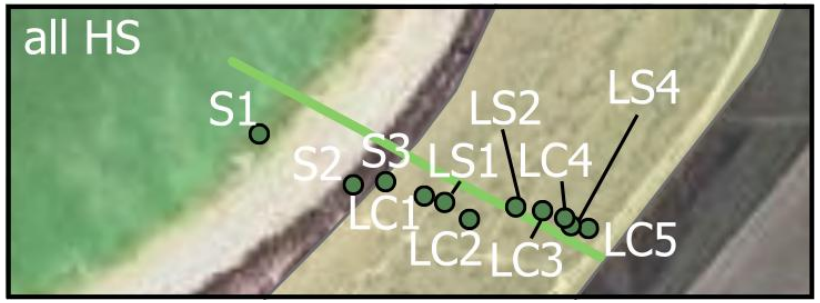



# Sampling Strategy – Example Lake Hindmarsh

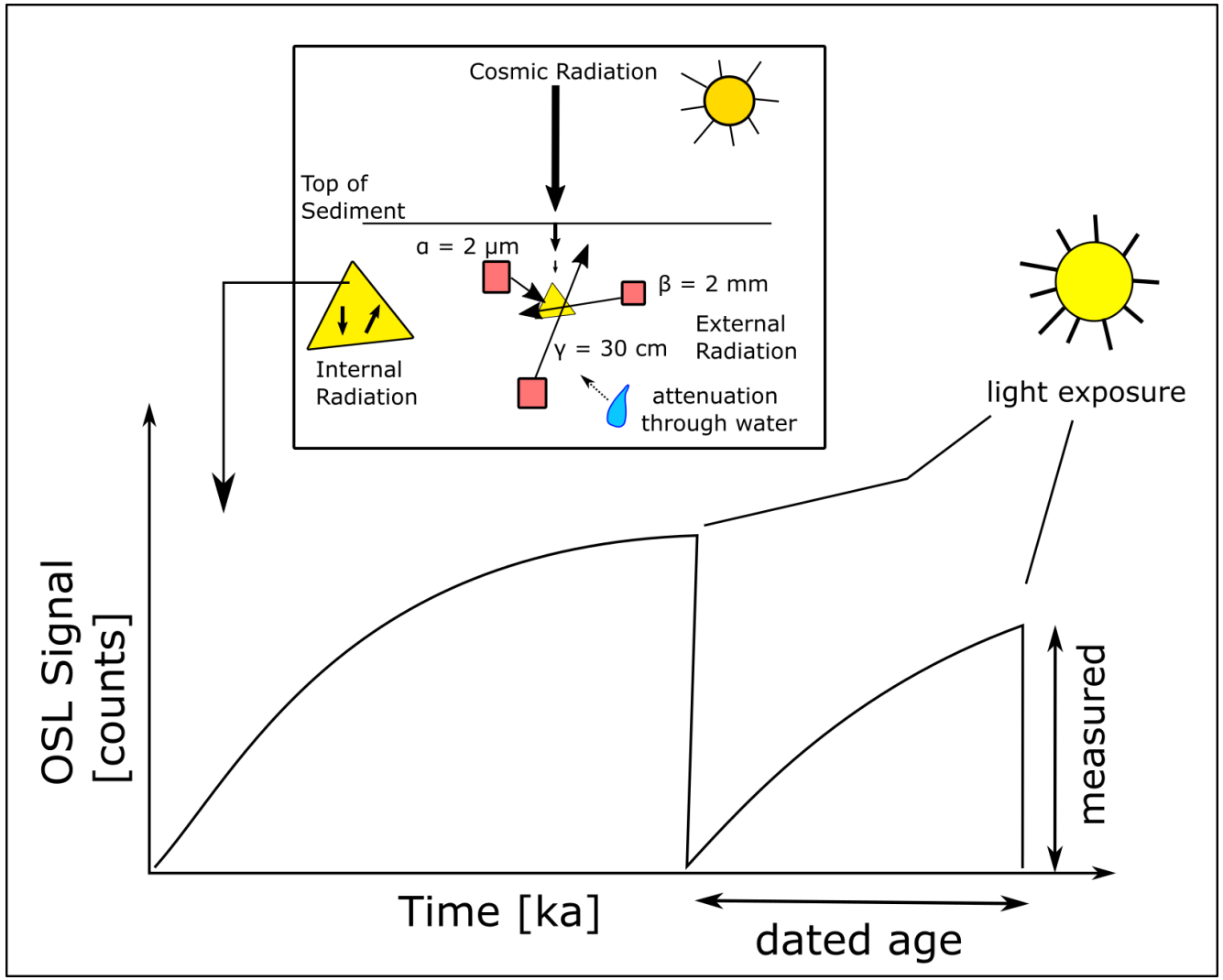


# Luminescence Dating

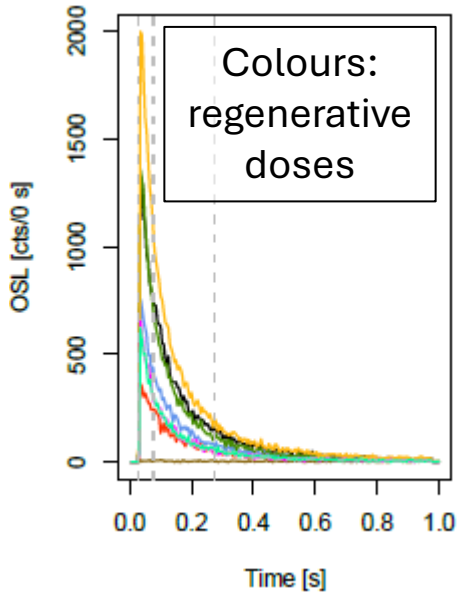



Inset: adapted from: Preusser et al., 2008

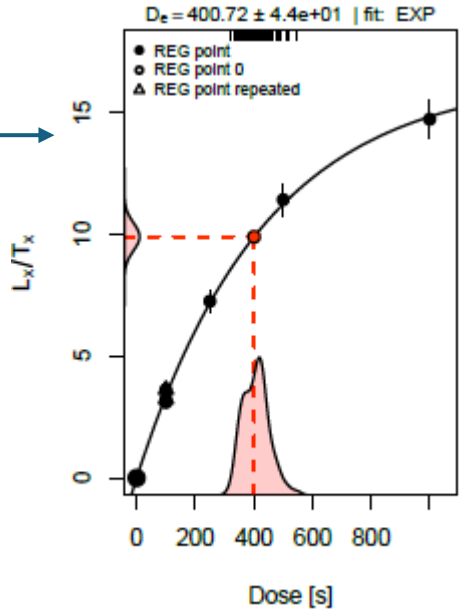
# Luminescence Dating

Sample Collection & Preparation

Luminescence Signal Measurement (SAR Protocol)




Dose response curve




Acceptance Criteria

Statistical Age Model

$$\textbf{Age [ka]} = \frac{\text{De [Gy]}}{\text{Dose Rate } [\frac{\text{Gy}}{\text{ka}}]}$$

Calculated Cosmic Dose Rate

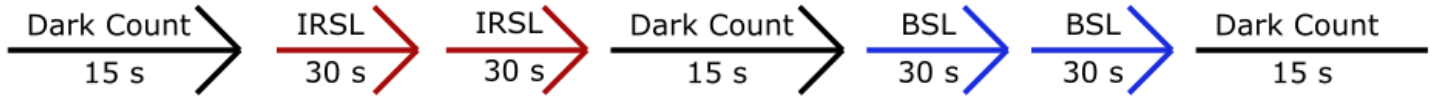
Radionuclide concentrations measured with gamma spectrometry

R luminescence package used (Kreutzer et al., 2012, 2023)

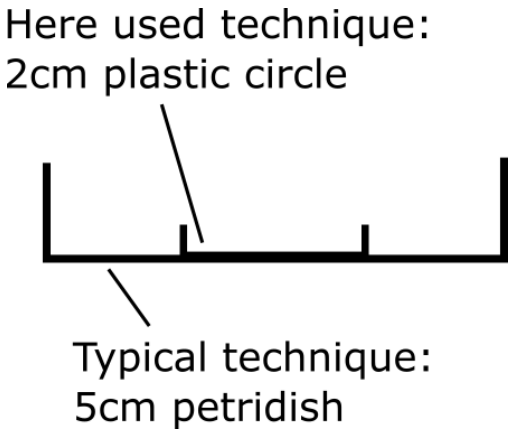
→ absolute chronology for lunette deposition

# Portable OSL (pOSL) Measurements

- >250 samples
- SUERC reader
- sequence (Sanderson & Murphy, 2010):

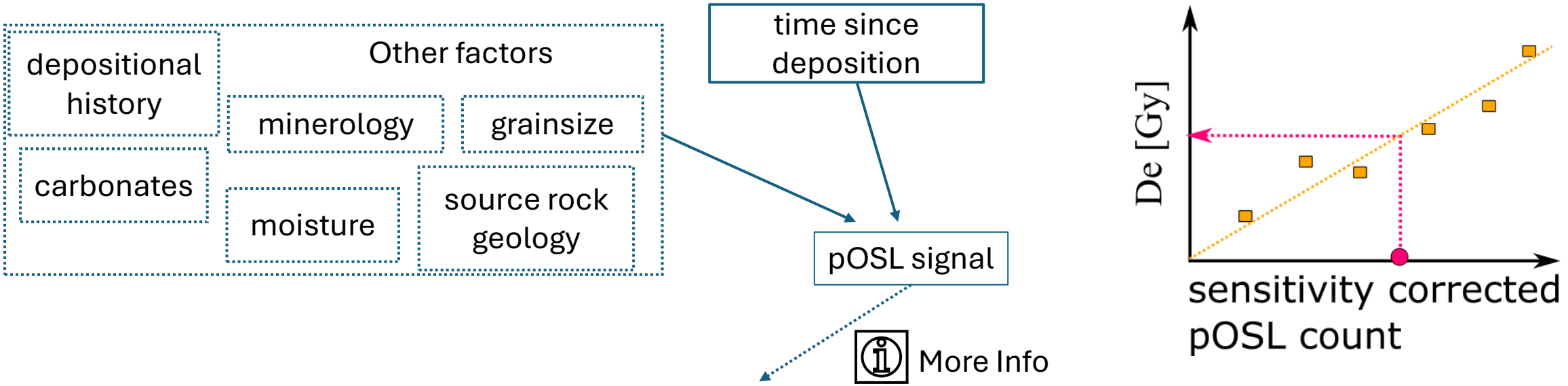



- reduction of necessary sample material:




→ dark count corrected cumulative **photon count** of first 30 sec blue stimulation

# Portable OSL Age Estimation Approach




**In Progress:**
correction of portable OSL signal for region dependent variation in luminescence sensitivity

→ transfer function from sensitivity normalised pOSL signal to De

→ possibility to generate age estimates from pOSL counts

# Facies Analyses

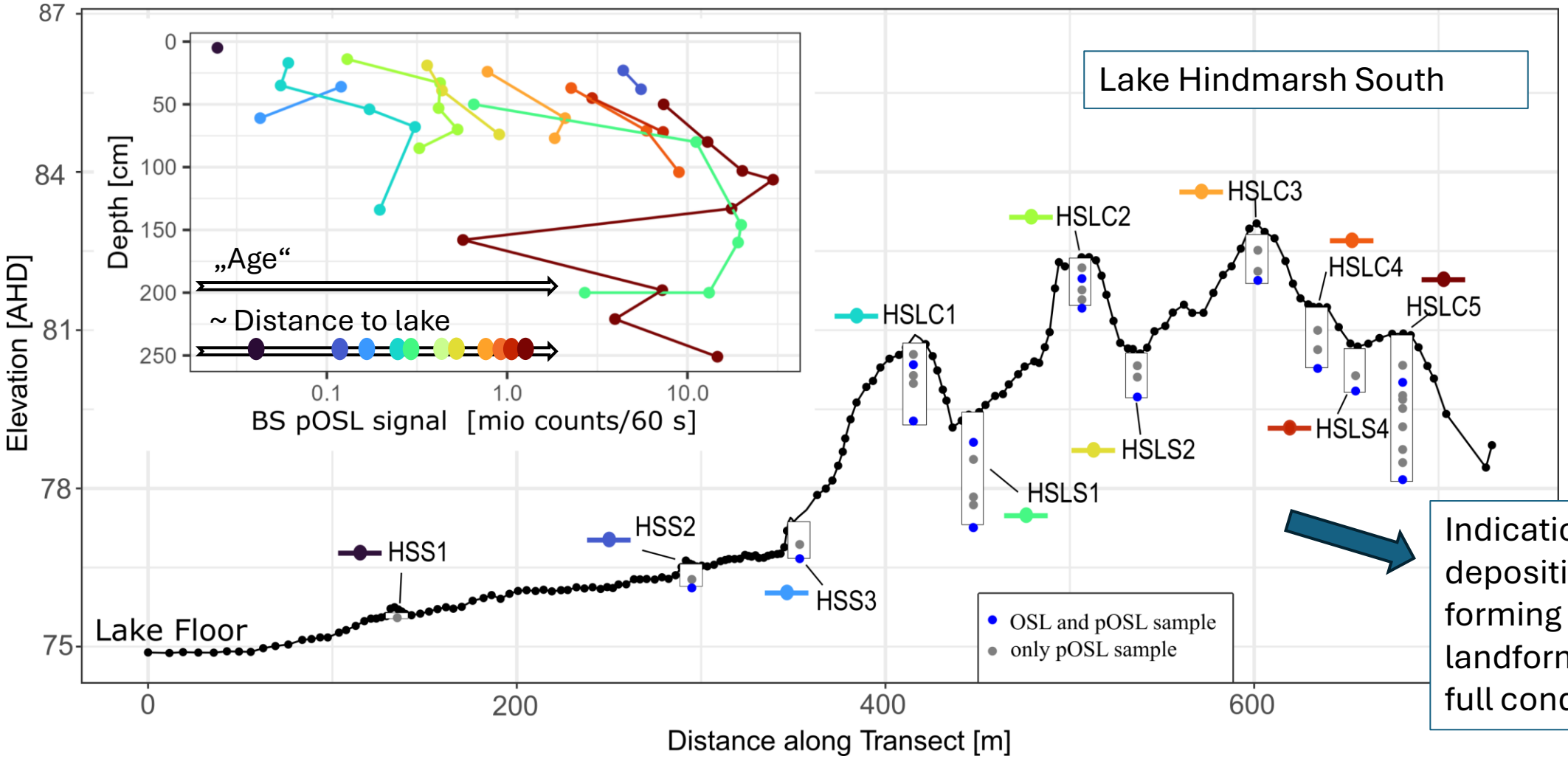
Field observations

In Progress:

- grainsize measurements (>900 sediment samples)
- thin section analyses

→ insights on the depositional environment and the lake conditions during deposition

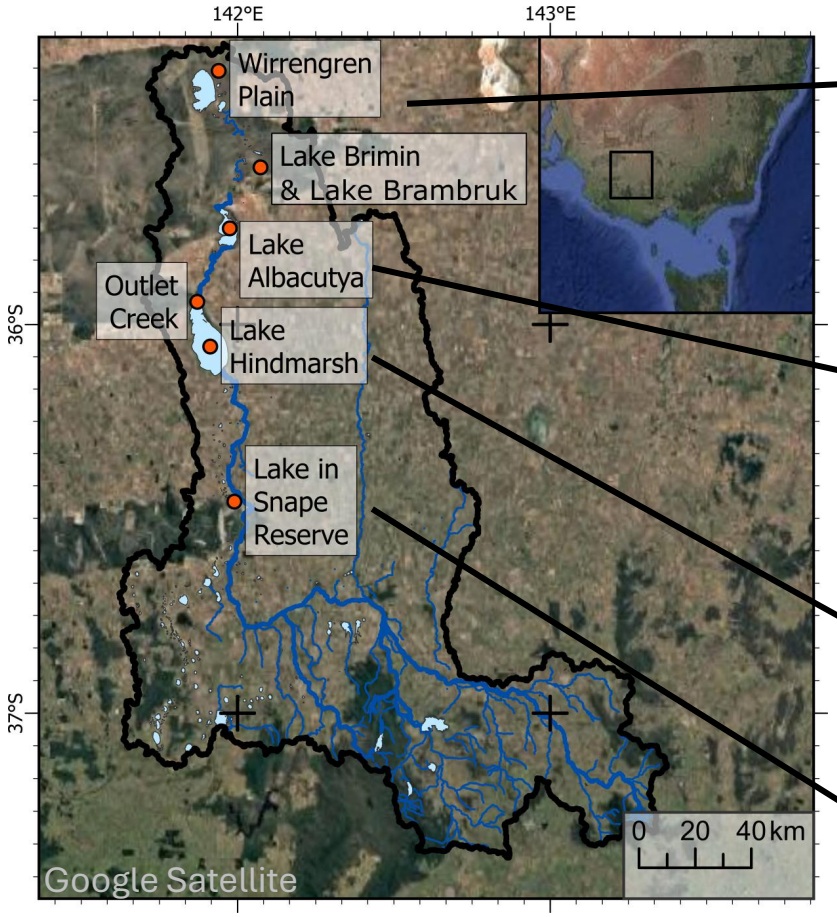
# Relative Chronology of Stacked Lunettes




Site Map

Indication for distinct depositional phases forming stacked lunette landforms during lake full conditions

# Spatial Variation in Lunette Characteristics

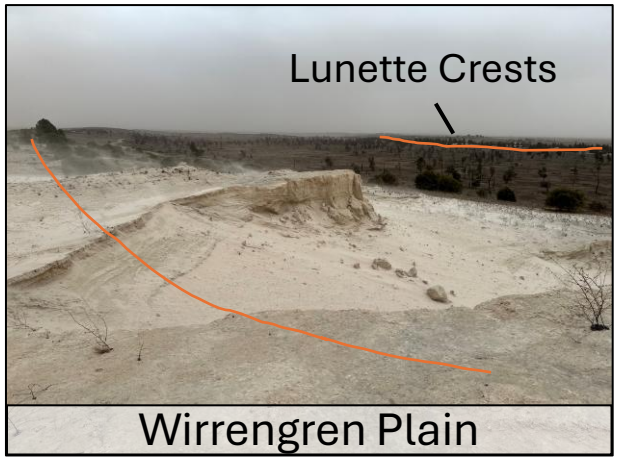



complex system of **subbasins** with **associated lunette** dunes of mostly **sandy** character, incorporating **carbonates** and higher **silt** fractions

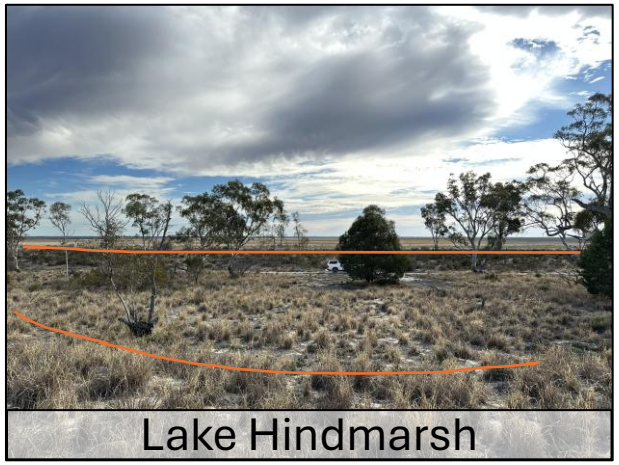
**inner sandy** lunettes, followed by **massive clay** rich dune and three **outer sandy lunettes** providing evidence for a greater lake extent in the past

**inner sandy stacked** lunettes, major **outer lunette** dunes indicating extended lake area

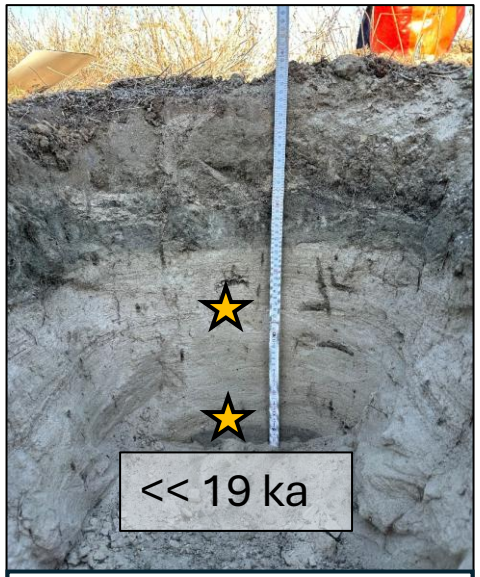
**thin drape** lunette on top of flood plain deposits



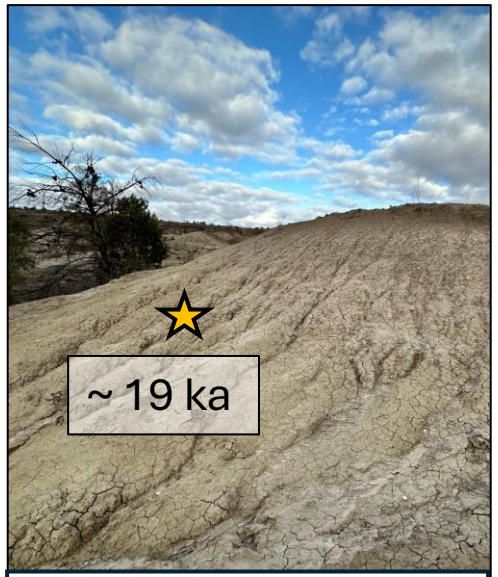
Wirrengren Plain


Lake Hindmarsh

# First Insights on the Palaeoenvironmental History

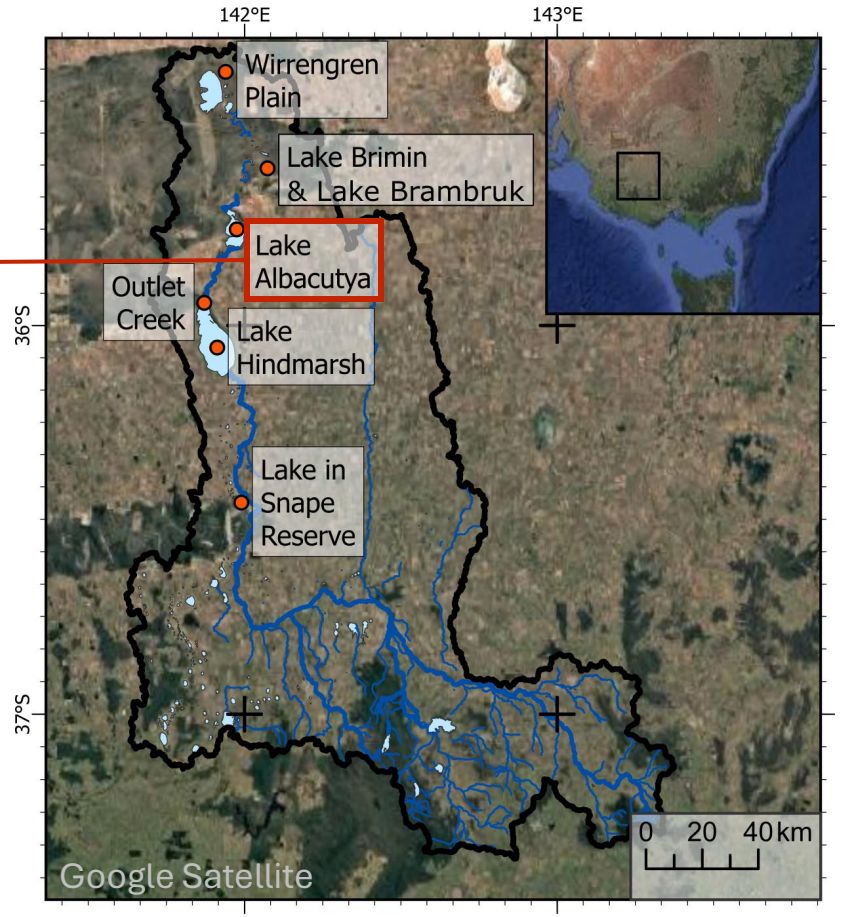



Inner Sandy Lunette




Outer Clayey Lunette

Lake Albacutya under drying lake conditions at ~19 ka, followed by a later full lake phase



# Conclusion

- complex overflow-lake lunette system forming a valuable archive for past environmental conditions
- will improve the understanding of the interconnection of surface water availability and landscape reactivation

# Outlook of the Research Project

- confinement of the **absolute chronology** of lunette deposition based on 94 OSL ages
- improvement of chronologic **resolution** by calculating **pOSL age estimates**
- confinement of facies interpretation through **grainsize** quantification and micromorphological **thin section** analyses
- linkage of the lake conditions to hydroclimatic parameters through **hydroclimatic surface water flux model**

# References

Bowler, J. M. (1983). Lunettes as indices of hydrologic change: A review of Australian evidence. *Proceedings of the Royal Society of Victoria. New Series*, *95*(3), 147--168.

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Kreutzer, S., Burow, C., Dietze, M., Fuchs, M. C., Schmidt, C., Fischer, M., Friedrich, J., Mercier, N., Smedley, R. K., Christophe, C., Zink, A., Durcan, J., King, G. E., Philippe, A., Guérin, G., Riedesel, S., Autzen, M., Guibert, P., Mittelstrass, D., … Galharret, J.-M. (2023). *Luminescence: Comprehensive Luminescence Dating Data Analysis* (Version 0.9.23) [Computer software]. Zenodo. https://doi.org/10.5281/zenodo.10069779

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Sanderson, D. C. W., & Murphy, S. (2010). Using simple portable OSL measurements and laboratory characterisation to help understand complex and heterogeneous sediment sequences for luminescence dating. *Quaternary Geochronology, 12th International Conference on Luminescence and Electron Spin Resonance Dating (LED 2008)*, *5*(2), 299–305. https://doi.org/10.1016/j.quageo.2009.02.001

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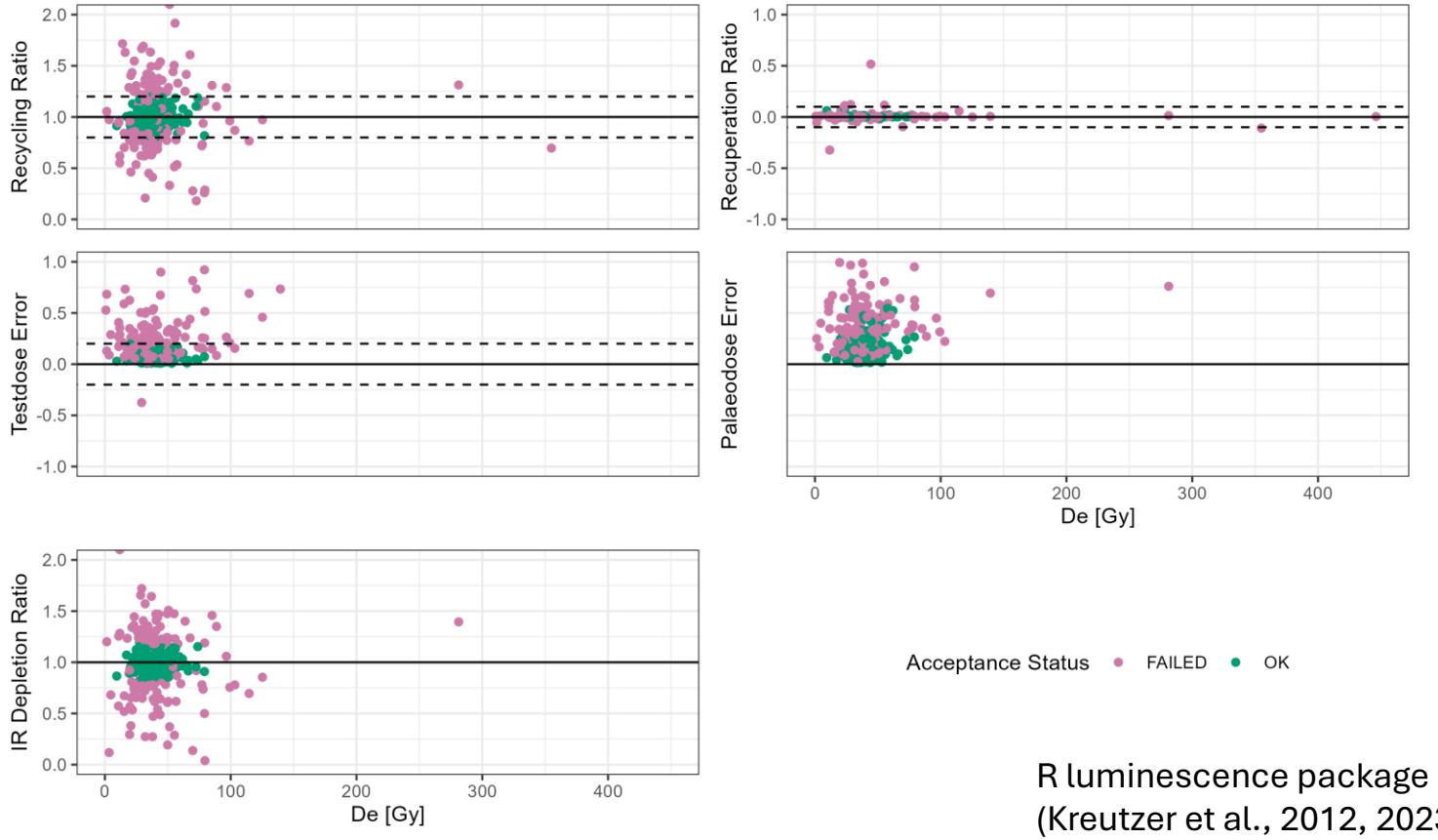
**Funding:** Monash University, Victorian Environmental Assessment Council, International Association for Sedimentology, German Society for Geomorphology

# Additional Information – Luminescence Dating Acceptance Criteria

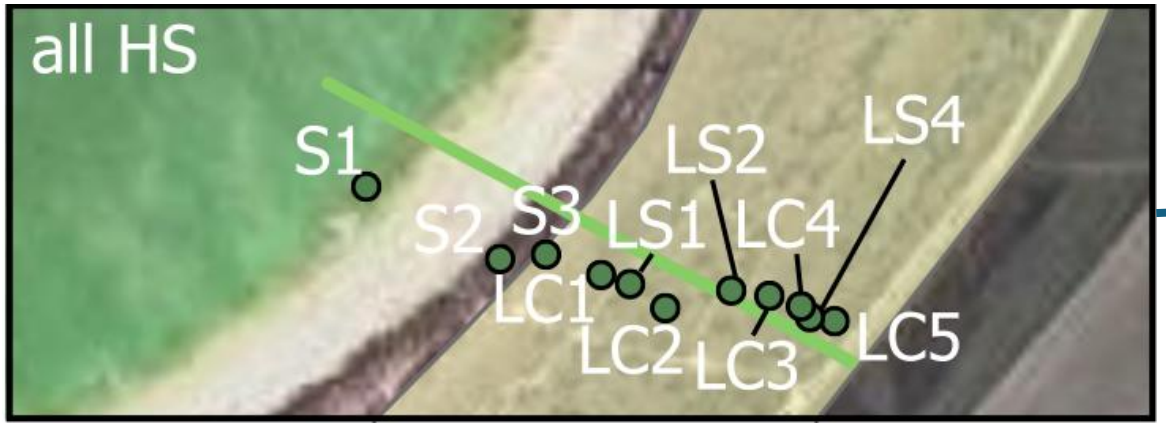
- acceptance criteria:
  - 20% Recycling Ratio
  - 10% Recuperation relative to highest dose point
  - 20% testdose error

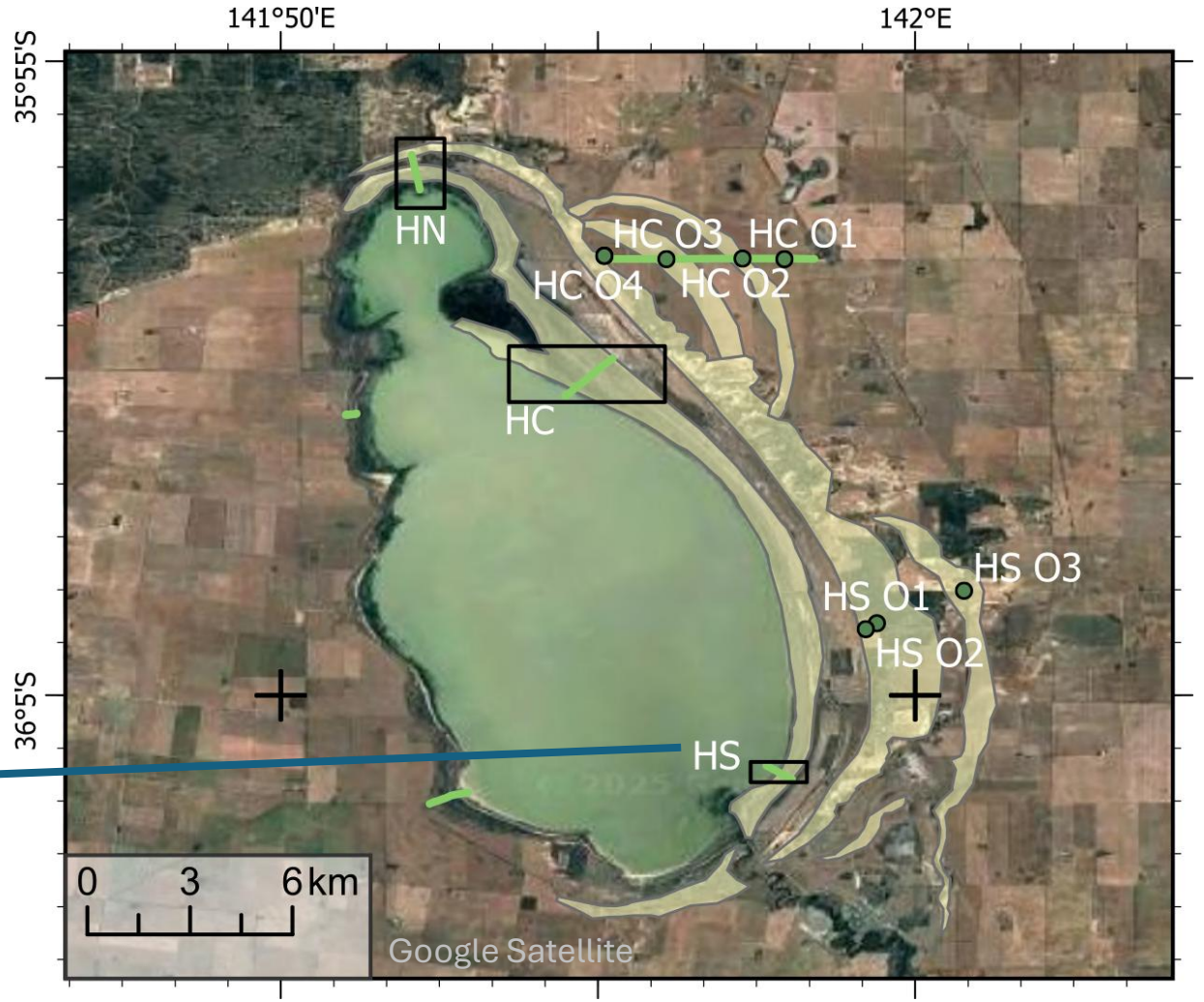
Example L-Tu 247 (Lake Albacutya)




R luminescence package used (Kreutzer et al., 2012, 2023)

# Additional Information – Hindmarsh South

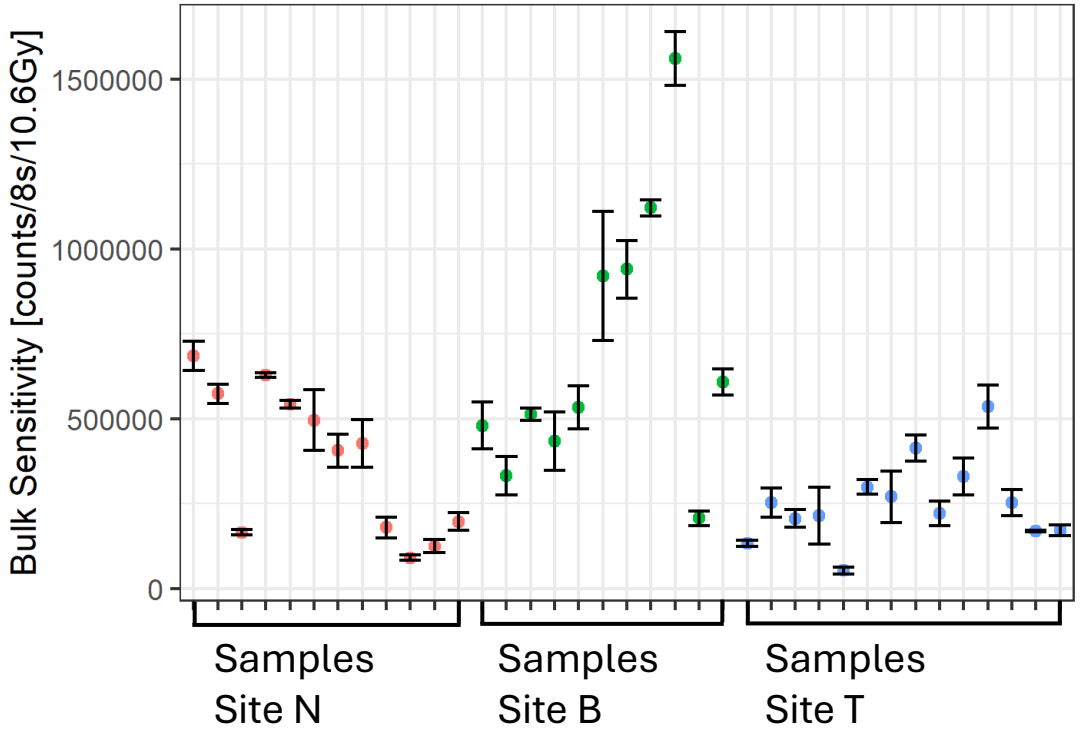


# Additional Information – bulk OSL / pOSL age estimation approach

**Earlier investigations showed:**

- region and sample dependent variation in luminescence sensitivity of shoreline dune samples causes pOSL signal variability

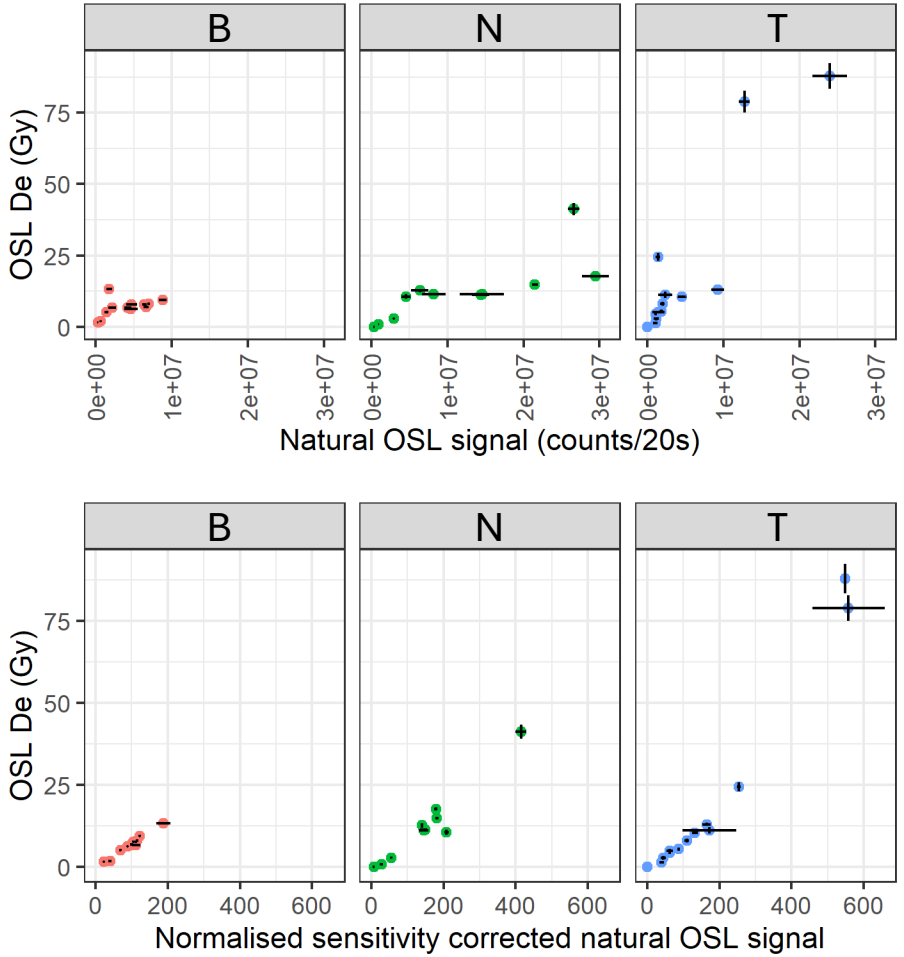



data from shoreline dune fieldsites in southeastern Australia (Schwarz et al., in prep.)

# Additional Information – bulk OSL / pOSL age estimation approach

## Earlier investigations showed:

- sensitivity correction of bulk OSL data through the measurement of the bulk sensitivity improves the relationship between OSL De and bulk OSL data




data from shoreline dune fieldsites in southeastern Australia (Schwarz et al., in prep.)

a similar approach will be used to correct the pOSL data of this study for sensitivity variability, facilitating the development of a transfer function from the pOSL signal to equivalent dose