

Floral and environmental variation in the post-extinction Bowen Basin

Alexander Wheeler

Advisory team: Joan Esterle, Patrick Moss and Annette Götz
Vale-UQ Coal Geosciences Group
UQ School of Earth and Environmental Sciences

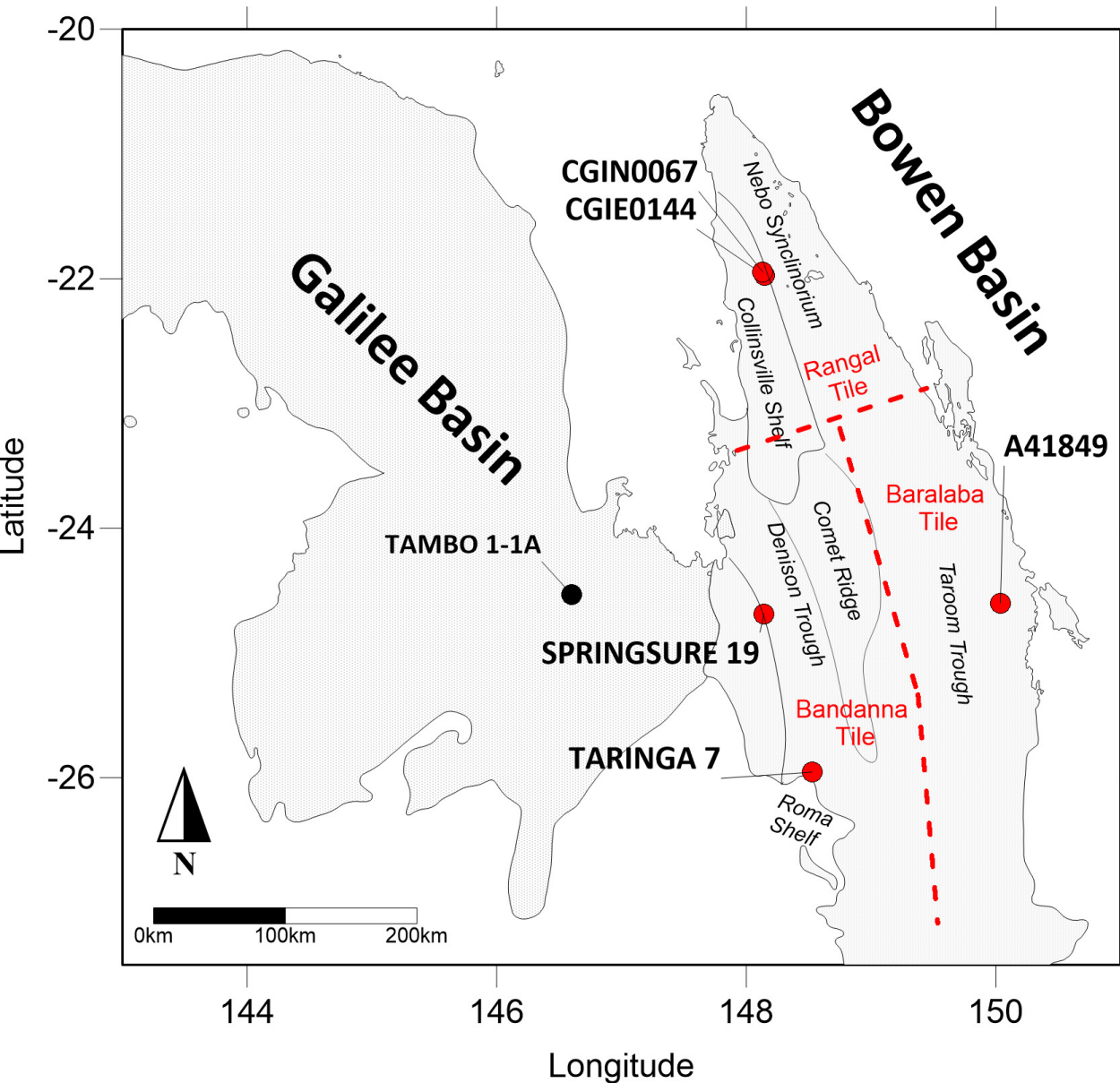


Figure 2: Localities of boreholes sampled for this study. Previous work was conducted at Tambo 1-1A in the Galilee Basin (Wheeler et al., 2020).

Introduction

The *Glossopteris*-flora that was ubiquitous across eastern Australia and the entire continent of Gondwana was significantly affected during the end-Permian extinction (EPE) (Fig. 1). *Glossopteris* itself suddenly became extinct and coal formation ceased across the globe for several million years after the event.

The aim of this study was to sample the earliest Triassic interval across several localities in the Bowen Basin to identify possible variation within the surviving flora along with environmental indicators of the post-extinction environmental conditions (Fig. 2).

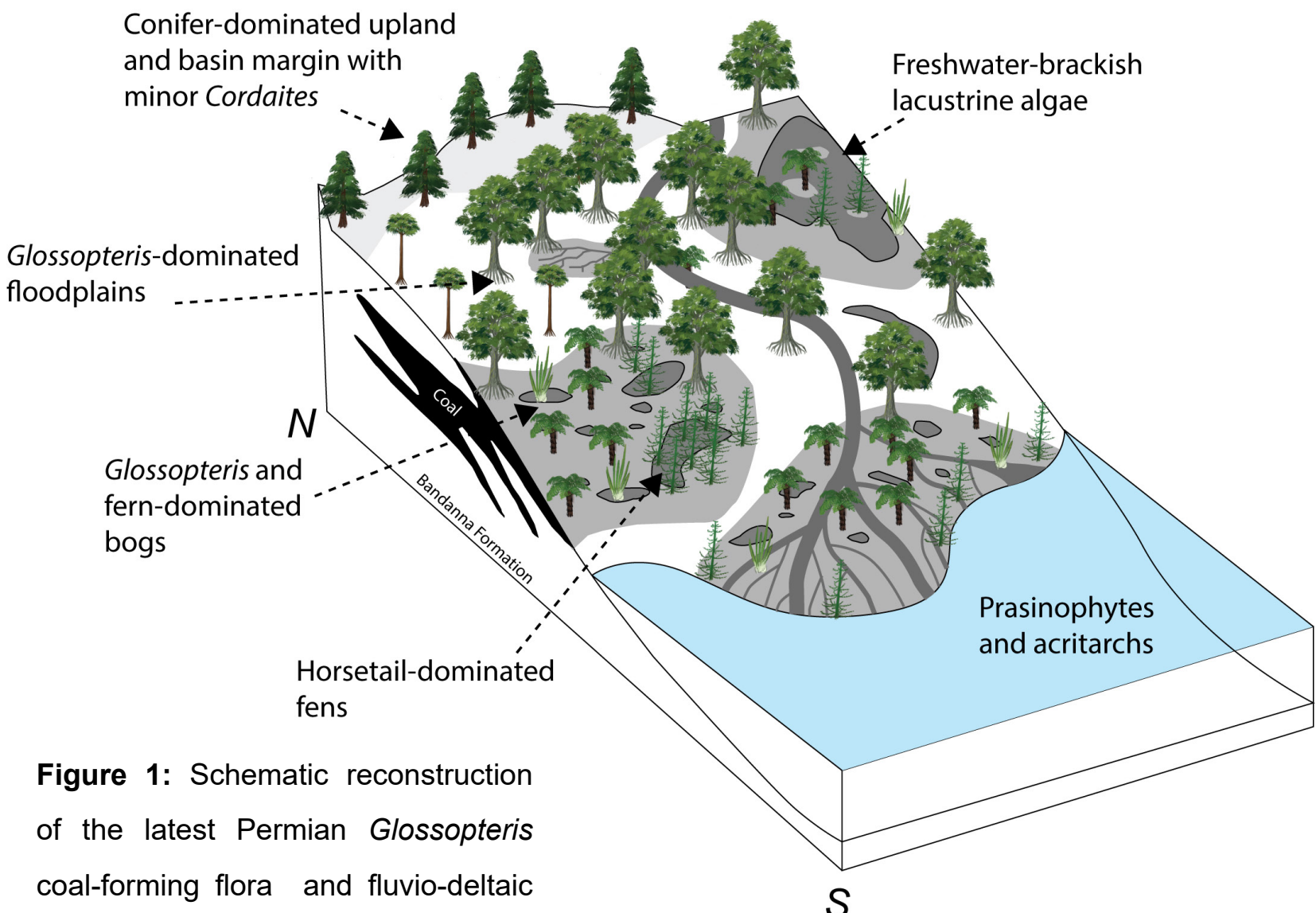


Figure 1: Schematic reconstruction of the latest Permian *Glossopteris* coal-forming flora and fluvio-deltaic environment of the Bowen Basin.

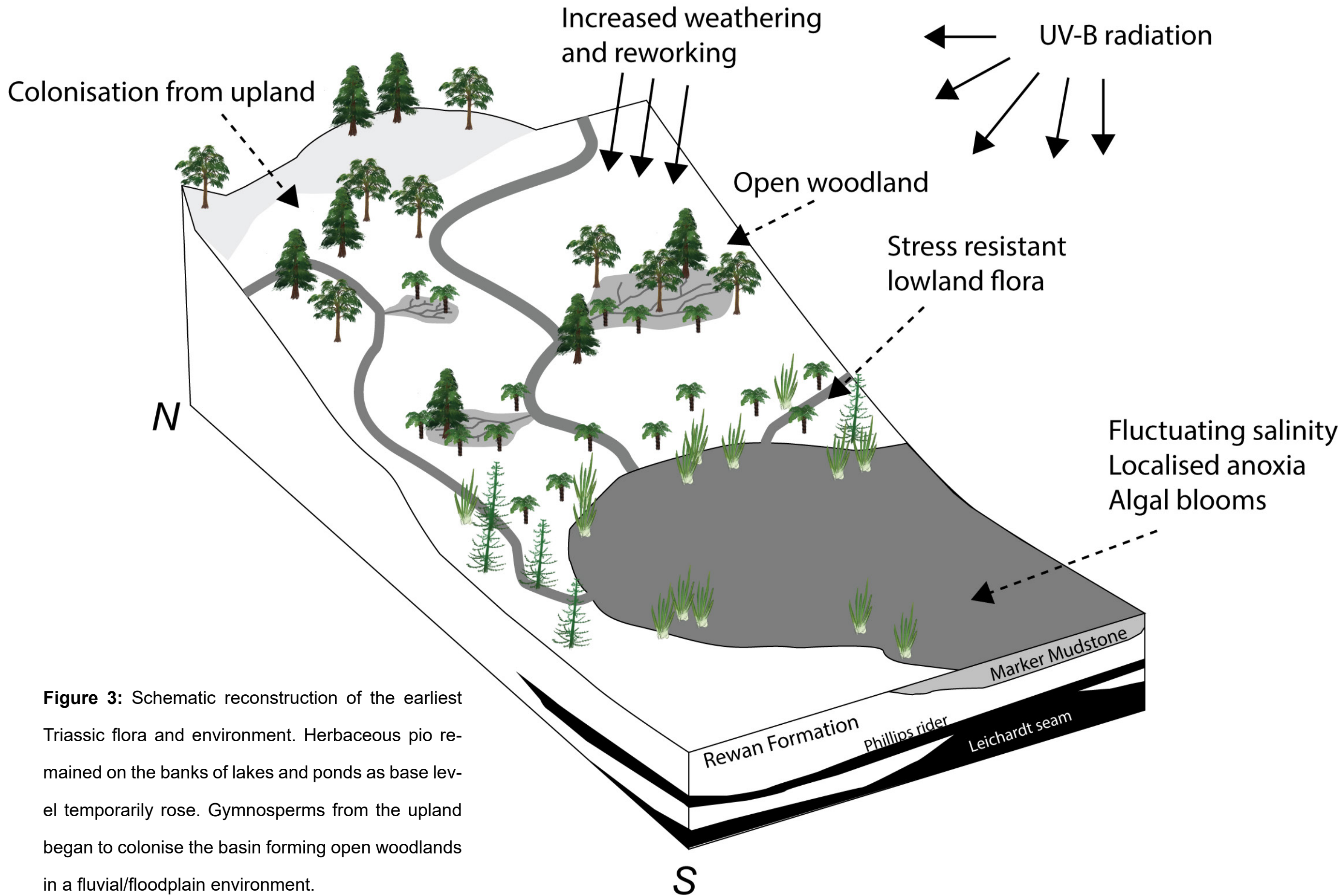


Figure 3: Schematic reconstruction of the earliest Triassic flora and environment. Herbaceous plants remained on the banks of lakes and ponds as base level temporarily rose. Gymnosperms from the upland began to colonise the basin forming open woodlands in a fluvial/floodplain environment.

The post-extinction flora

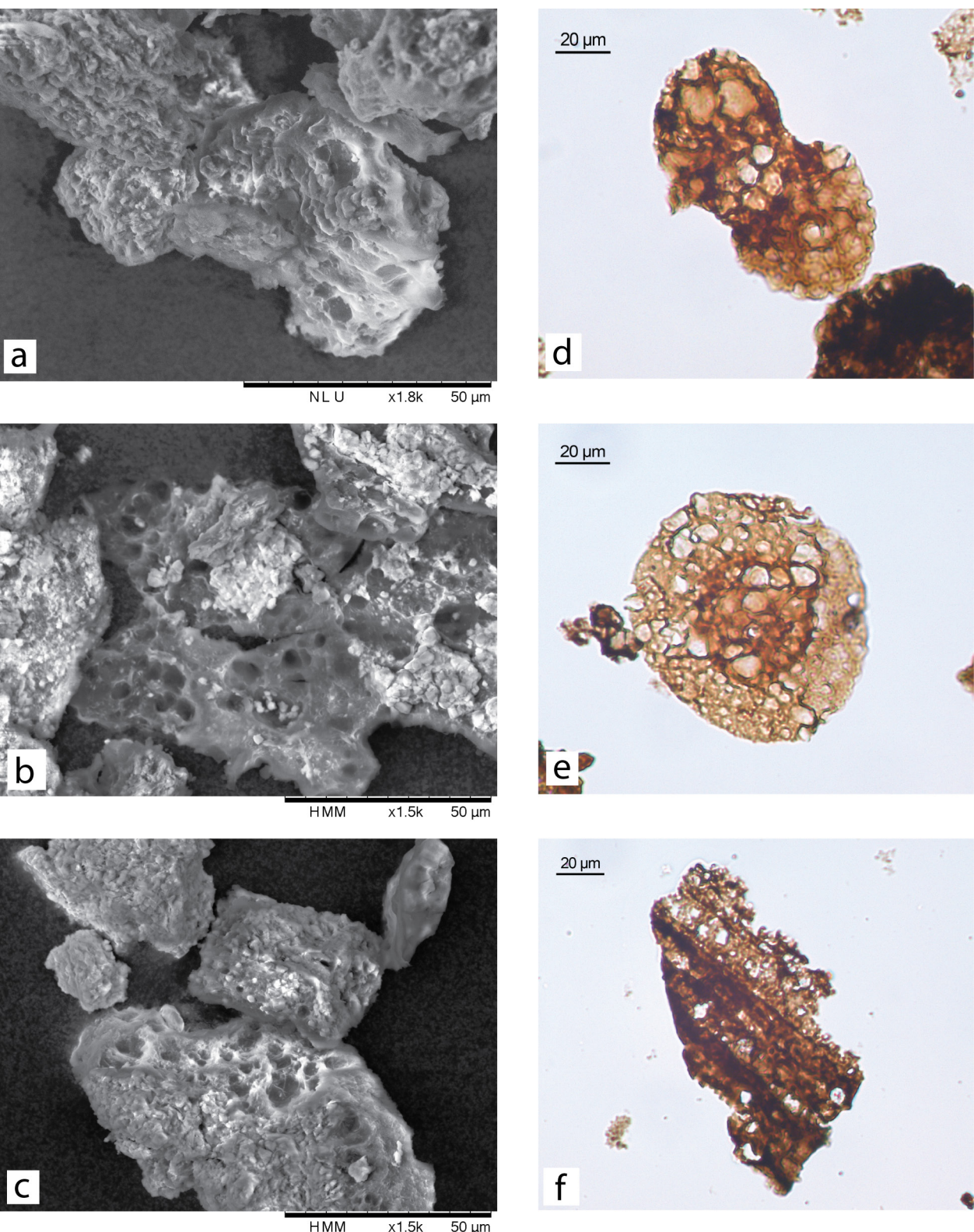
Based on palynological assemblages obtained from all studied boreholes, two palaeofloras were identified:

- 1) A predominantly herbaceous pioneer flora made up of species that were able to survive the end-Permian extinction (Fig. 3). This flora consists mainly of ferns, horsetails and isoetalean lycopods. Lycopods such as *Isoetes beestonii* were resistant to environmental change and semi-aquatic and thus became prevalent in the earliest Triassic as base level rose forming large ponds and lakes.
- 2) An open woodland flora dominated by gymnosperms such as the Voltzlean conifers and peltasperms like *Lepidopteris* (Fig. 3). This flora likely represents colonisation from the upland that took advantage of the absence of *Glossopteris* and grew in better drained environments such as the sandy banks of rivers and on the floodplain.

The post-extinction environment

Moderate abundances of fungal spores were observed at Springsure 19, suggestive of the global fungal spike that occurred soon after the EPE (Eshet et al., 1995) (Fig. 4). Samples featured minor abundances of algae (Fig. 4), which along with sedimentological evidence marks a rising base level and fluctuating salinity (Wheeler et al., 2020). Unseparated spore tetrads and mutated tetrasaccate pollen (Fig. 4) were observed at multiple localities and are indicative of increased UV-B radiation caused by Siberian Traps volcanism (Foster & Afonin, 2005).

Figure 5: Pyritically degraded pollen grains (a-b), spores (e), and wood fragments (b-c, f) from bore hole A41849.



References
Eshet, Y., Rampino, M. R., & Visscher, H. (1995). Fungal event and palynological record of ecological crisis and recovery across the Permian-Triassic boundary. *Geology*, 23(11), 967-970.
Foster, C. B., & Afonin, S. A. (2005). Abnormal pollen grains: an outcome of deteriorating atmospheric conditions around the Permian-Triassic boundary. *Journal of the Geological Society*, 162(4), 653-659.
Srivastava, S. C., Srivastava, A. K., Bhattacharyya, A. P., & Tewari, R. (1999). Degraded Permian palynomorphs from North-East Himalaya, India. *Permian*, 33, 32-36.
Wheeler, A., Van de Wetering, N., Esterle, J. S., & Götz, A. E. (2020). Palaeoenvironmental changes recorded in the palynology and palynofacies of a Late Permian Marker Mudstone (Galilee Basin, Australia). *Palaeoworld*, 29(2), 439-452.

Figure 4: Indicators of the latest Permian/earliest Triassic palaeoenvironment: a) Unseparated spore tetrad; b) Tetrasaccate pollen grain; c) *Quadrisporites horridus*; d) *Reduviasporonites chalastus*; e) *Botryococcus*; f) *Cymatiosphaera gondwanensis*

Pyritically-degraded palynomorphs and wood fragments appear limited to the eastern part of the Bowen Basin (Fig. 5). This has also been previously observed in fungal spores and may be indicative of localised anoxia or euxinia (Srivastava et al., 1999).

Conclusions

Environmental indicators suggest an unstable and challenging conditions at both a local and on a basinal scale. Nevertheless, herbaceous pioneers and colonising gymnosperms were able to establish themselves very quickly after the EPE in both flooded lowland areas and fluvial-dominated areas experiencing high levels of weathering and erosion after the extinction of *Glossopteris*.