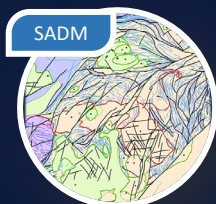


Effect of the early structures on tectonic evolution of the Mount Woods Domain, Gawler Craton

Rashed Abdullah and Mark Pawley | 21.11.2024

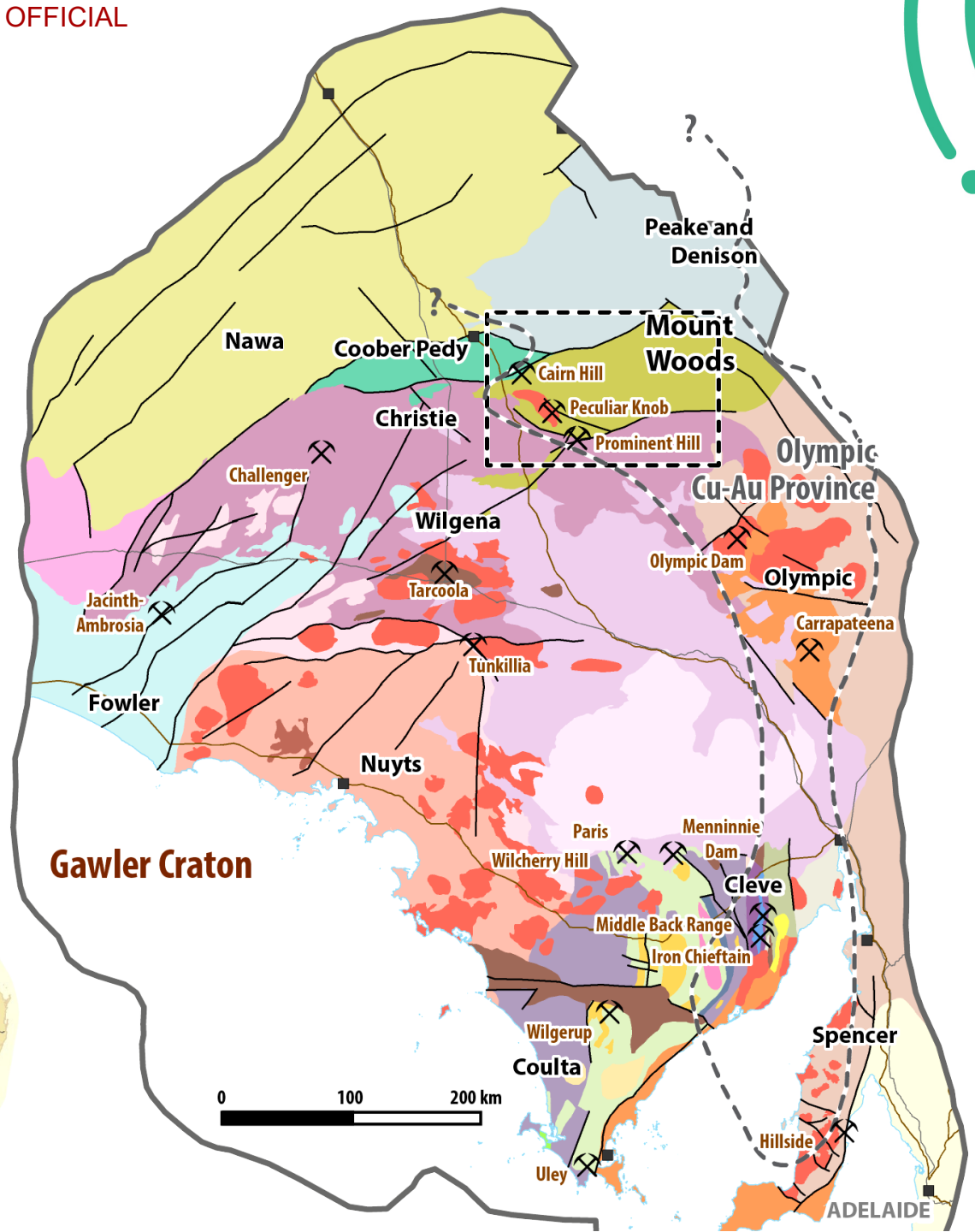




The Mount Woods

- The Gawler Craton in the South Australia has a complex geological history of sedimentation, poly-phase deformation, magmatism, and metamorphism since the Mesoarchean.
- This complexity is particularly obvious in the Mount Woods Domain in the northern Gawler Craton which preserves the Paleo-to Mesoproterozoic tectonic processes.

Figure 1. Gawler Craton and its tectonic subdivisions.





Why Mount Woods

- The Mount Woods Domain is located to the north of the Christie and Olympic domains. More specifically, the area occupies a key position to the north of the Olympic Cu-Au province in the Gawler Craton (existing mines include the Prominent Hill, the Peculiar Knob and the Cairn Hill).
- Despite numerous recent studies (Betts et al., 2003; Tiddy et al., 2020; Morrissey et al., 2023), there is still uncertainty about the tectonic evolution of the region.
- Solving this knowledge-gap may help in understanding the tectonic processes and deformation history of the entire craton.

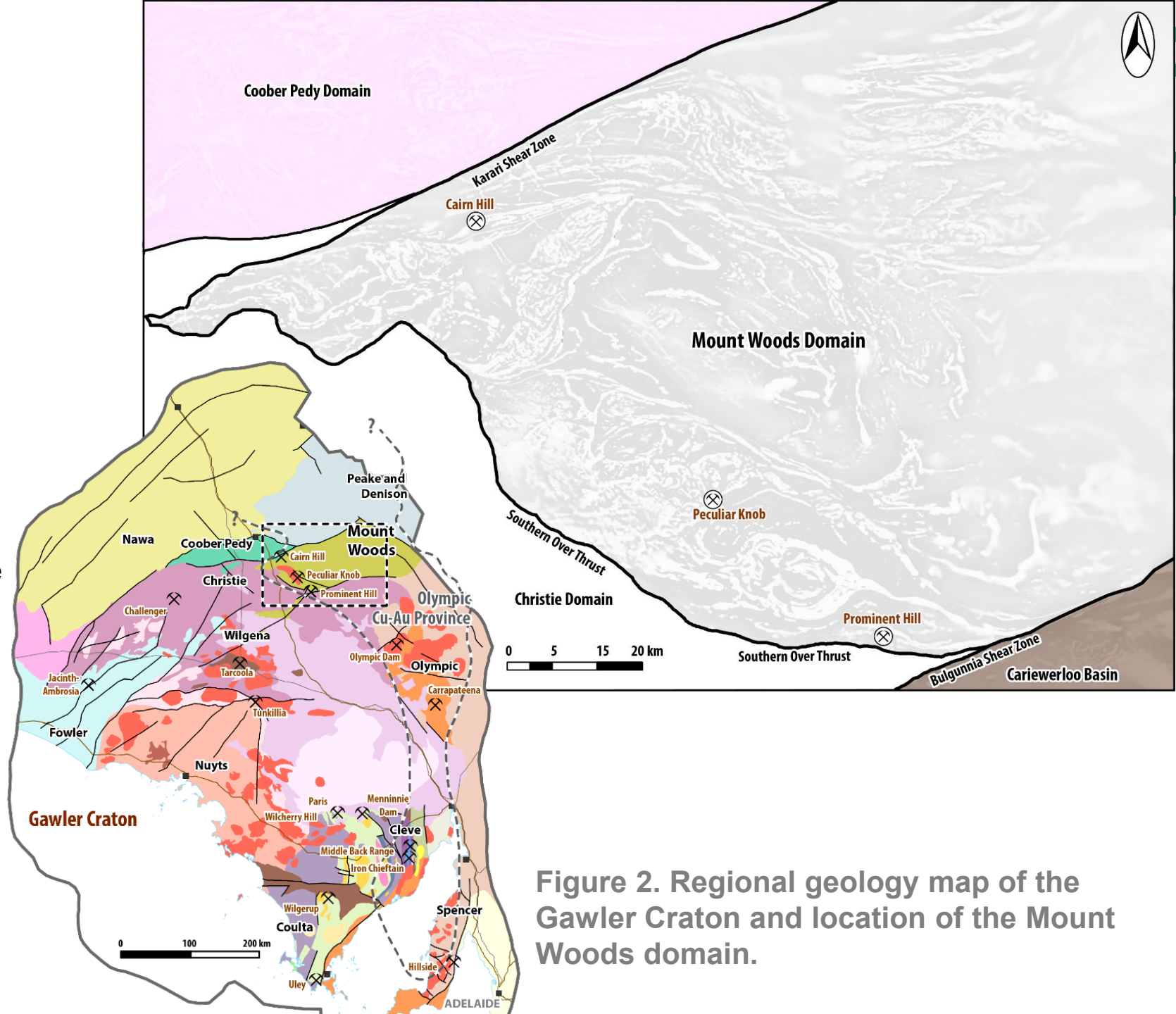


Figure 2. Regional geology map of the Gawler Craton and location of the Mount Woods domain.





Questions?

Q 1: What are the kinematics and 3D geometry of the major structures or shear zones in the Mount Woods? i.e., the style of deformation?

Q 2: How did these structures or shear zones evolve in time and space? i.e., timing or reactivation history of the shear zones and their relationship to regional stress regime during the tectonic event(s)?

Q 3: How does this structural mapping of the Mount Woods can help in understanding the tectonic evolution of the northern Gawler Craton?

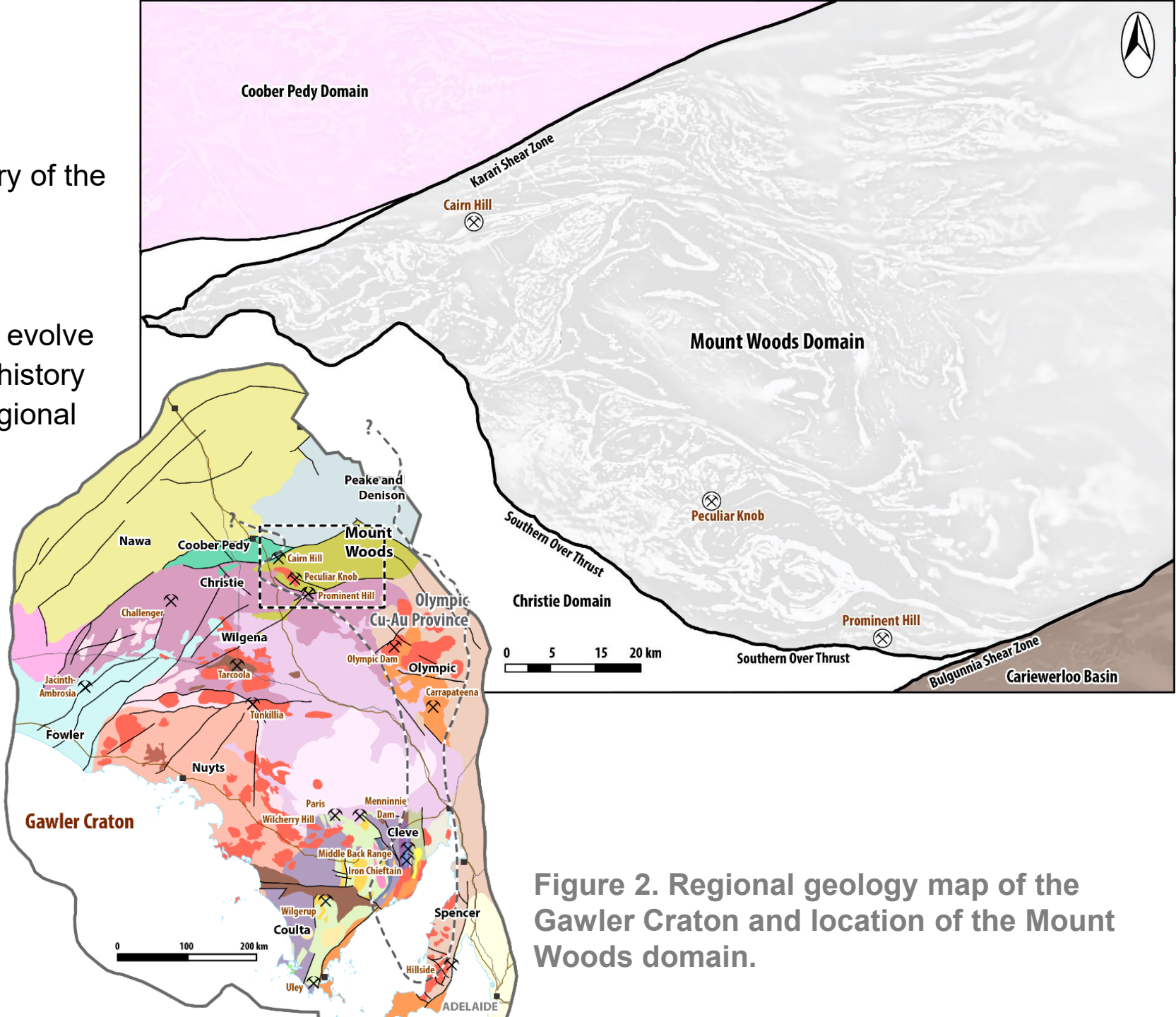


Figure 2. Regional geology map of the Gawler Craton and location of the Mount Woods domain.





Working Strategies

- We aimed at generating a systematic, high-resolution (1:25,000) geological map of the poorly exposed Mount Woods Domain.
- Outcropping basement rocks are rare in the Mount Woods Domain. Therefore, geological mapping is mainly based on geophysical data, existing geochronology, borehole information, published maps and literature.
- Using this map, we establish overprinting geological processes to constrain the timing and kinematic histories of the major shear zones which allow us to relate these structures to specific tectonic event in different time-slices.

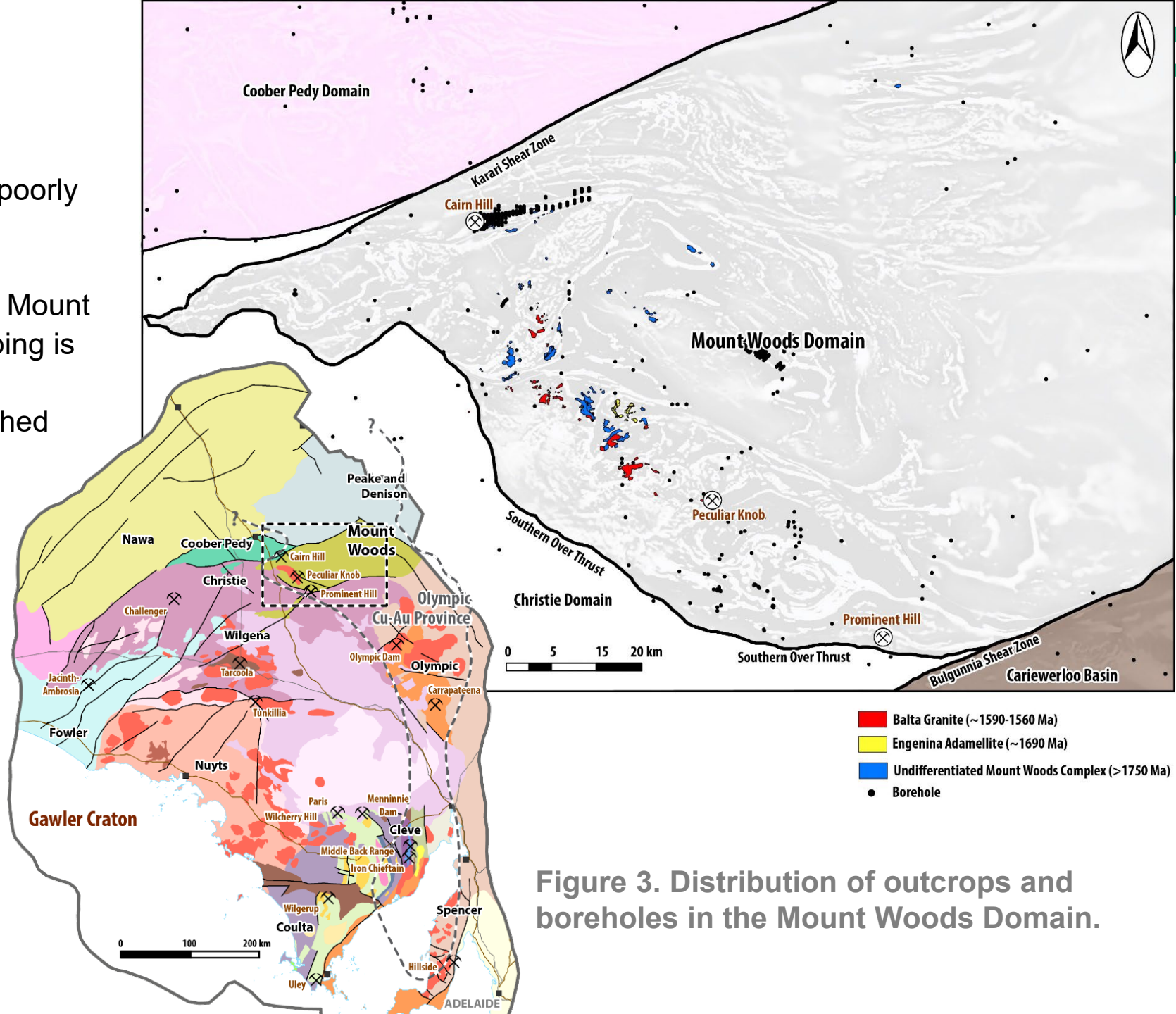
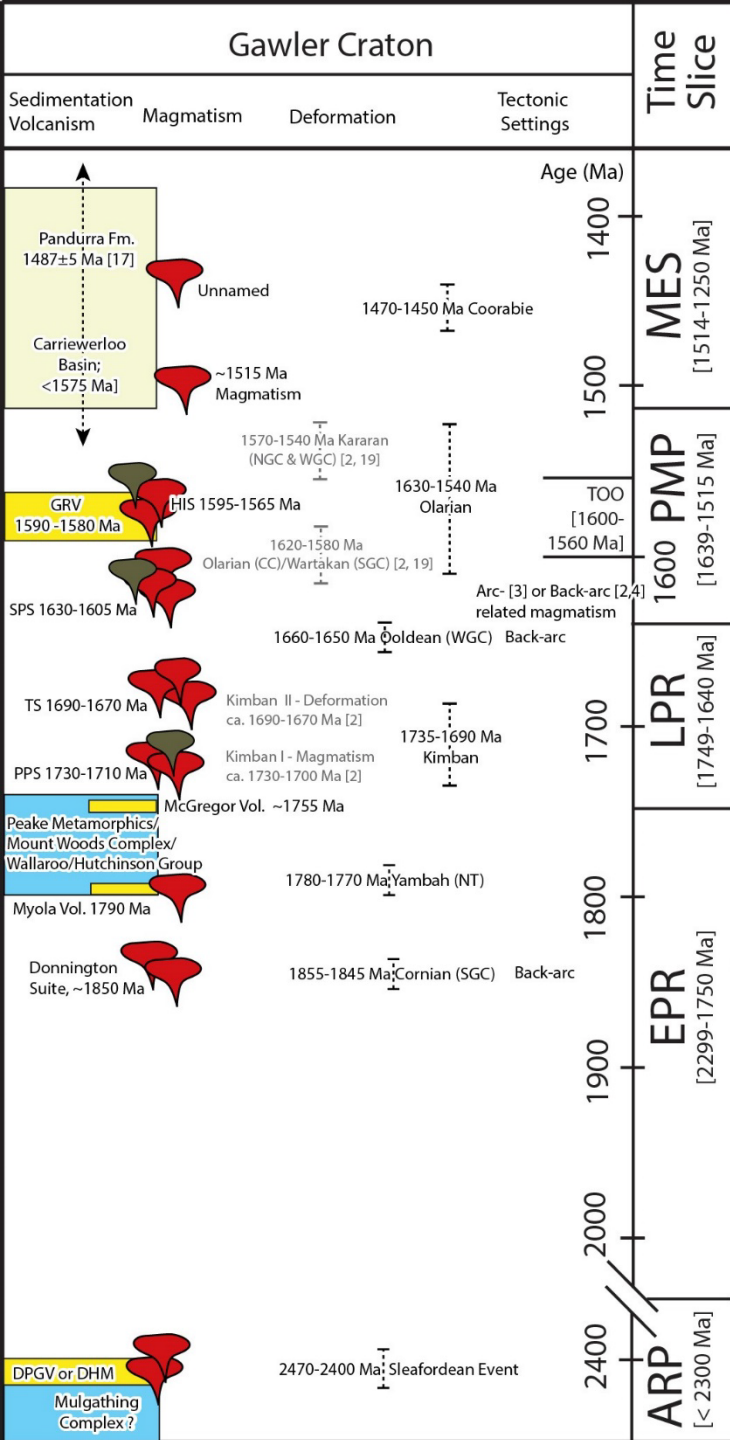


Figure 3. Distribution of outcrops and boreholes in the Mount Woods Domain.





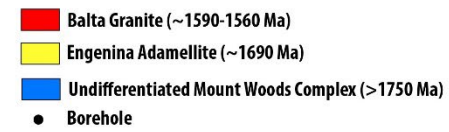
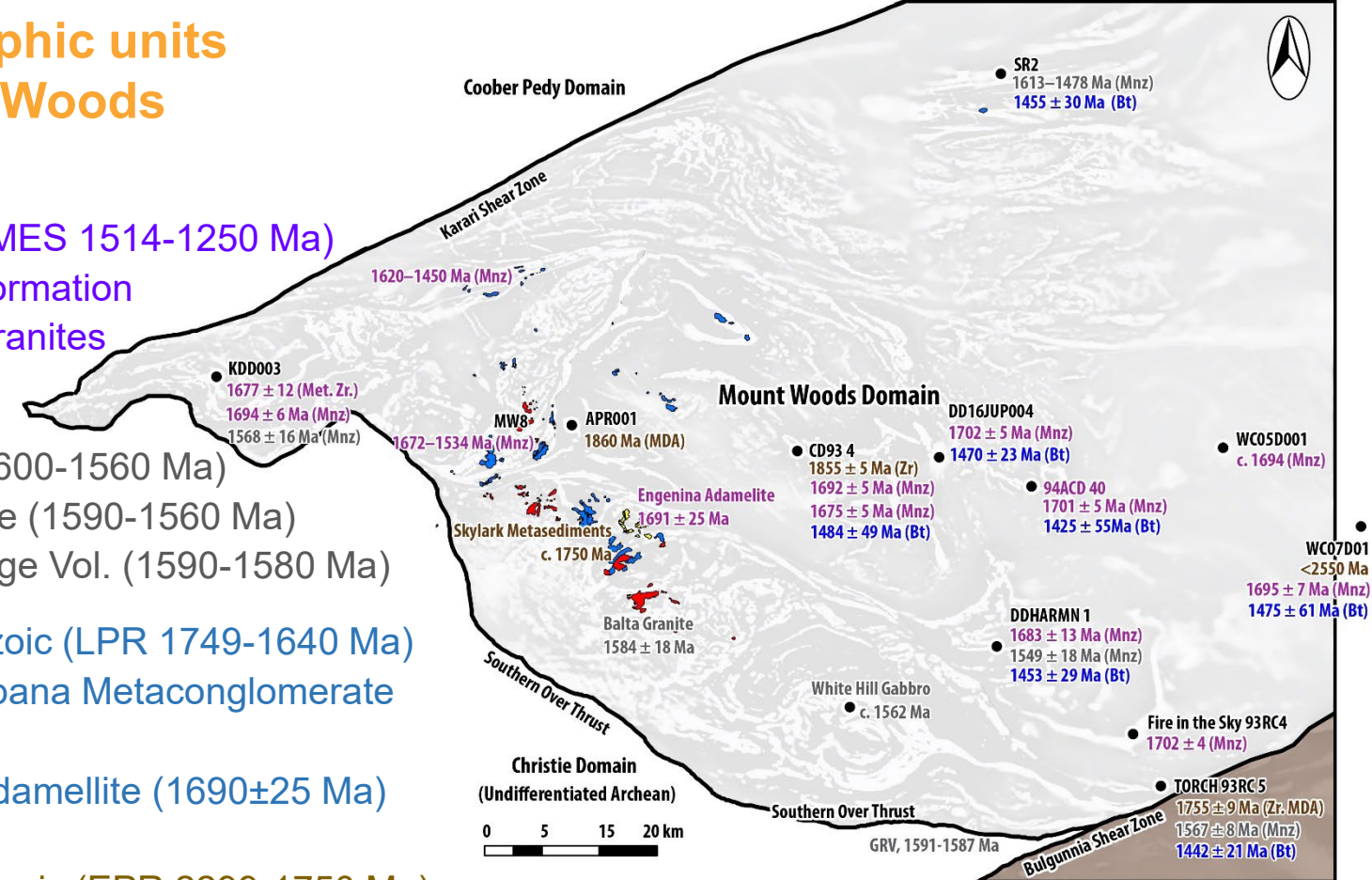
Key stratigraphic units of the Mount Woods

Mesoproterozoic (MES 1514-1250 Ma)
 a. Pandurra Formation
 b. Unnamed granites

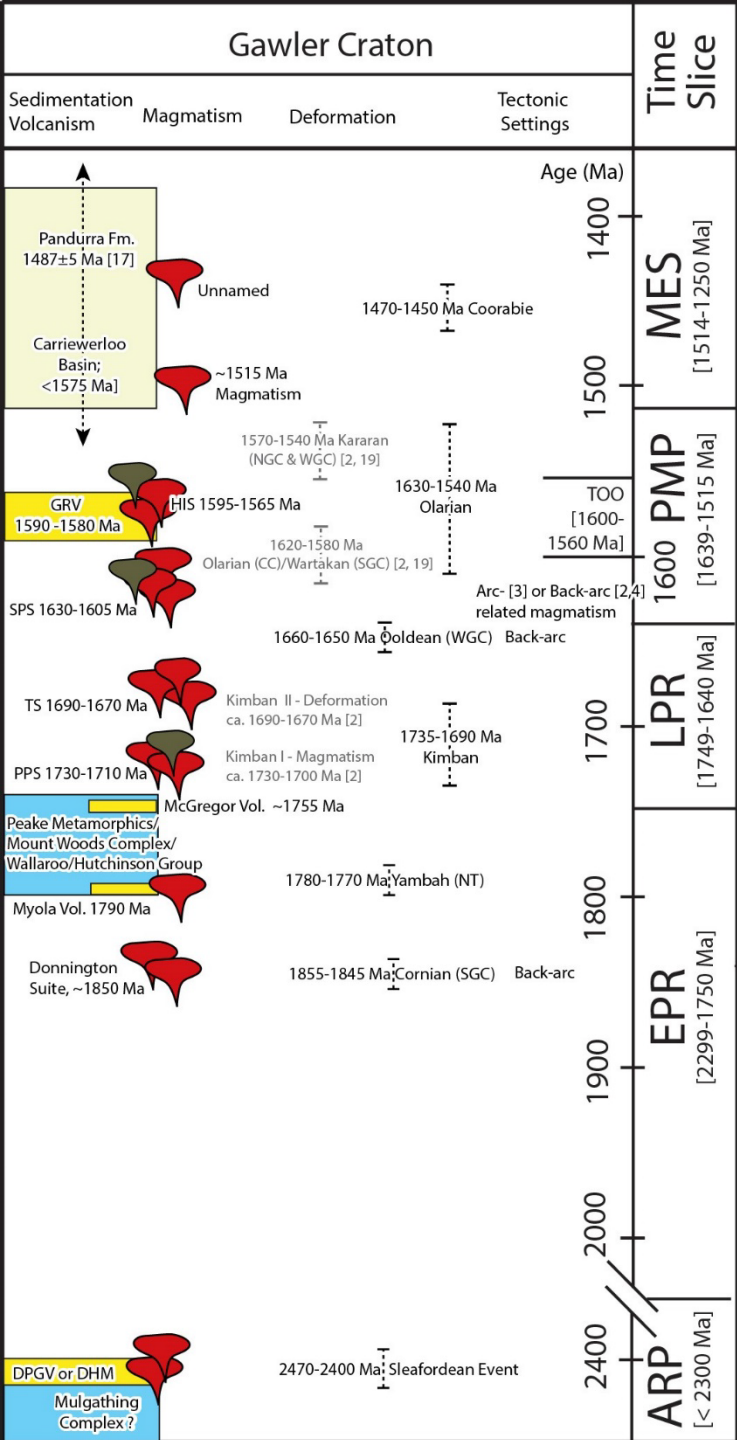
Toondulya (TOO 1600-1560 Ma)
 a. Balta Granite (1590-1560 Ma)
 b. Gawler Range Vol. (1590-1580 Ma)

Late Paleoproterozoic (LPR 1749-1640 Ma)
 a. Coodnambana Metaconglomerate (1690 Ma)
 b. Engenina Adamellite (1690±25 Ma)

Early Paleoproterozoic (EPR 2299-1750 Ma)
 Mount Woods Complex
 a. Mount Woods Complex Unit 1 and 2
 b. Skylark Metasediments (~1750 Ma or older)



References: 1. Fanning et al. (2007); 2. Stewart and Betts (2010a); 3. Betts and Giles (2006); 4. Payne (2008); 5. Teasdale (1997); 6. Daly et al. (1998); 7. Reid et al. (2008); 8. Tomkins et al. (2004); 9. Stewart et al. (2009); 10. Hand et al. (2007); 11. Belperio et al. (2007); 12. Fanning (1993); 13. Finlay (1993); 14. Jagodzinski et al. (2007); 15. Allen et al., 2016; 16. Tiddy et al. (2020); 17. Beyer et al. (2018); 18. Betts et al. (2003); 19. Stewart and Betts (2010b); 20. Yu et al. (2024b); 21. Jagodzinski and Reid, 2017; 22. Yu et al. (2024a); 23. Morrissey et al. (2023); 24. Hopper (2001); 25. Ambrose et al. (1981)

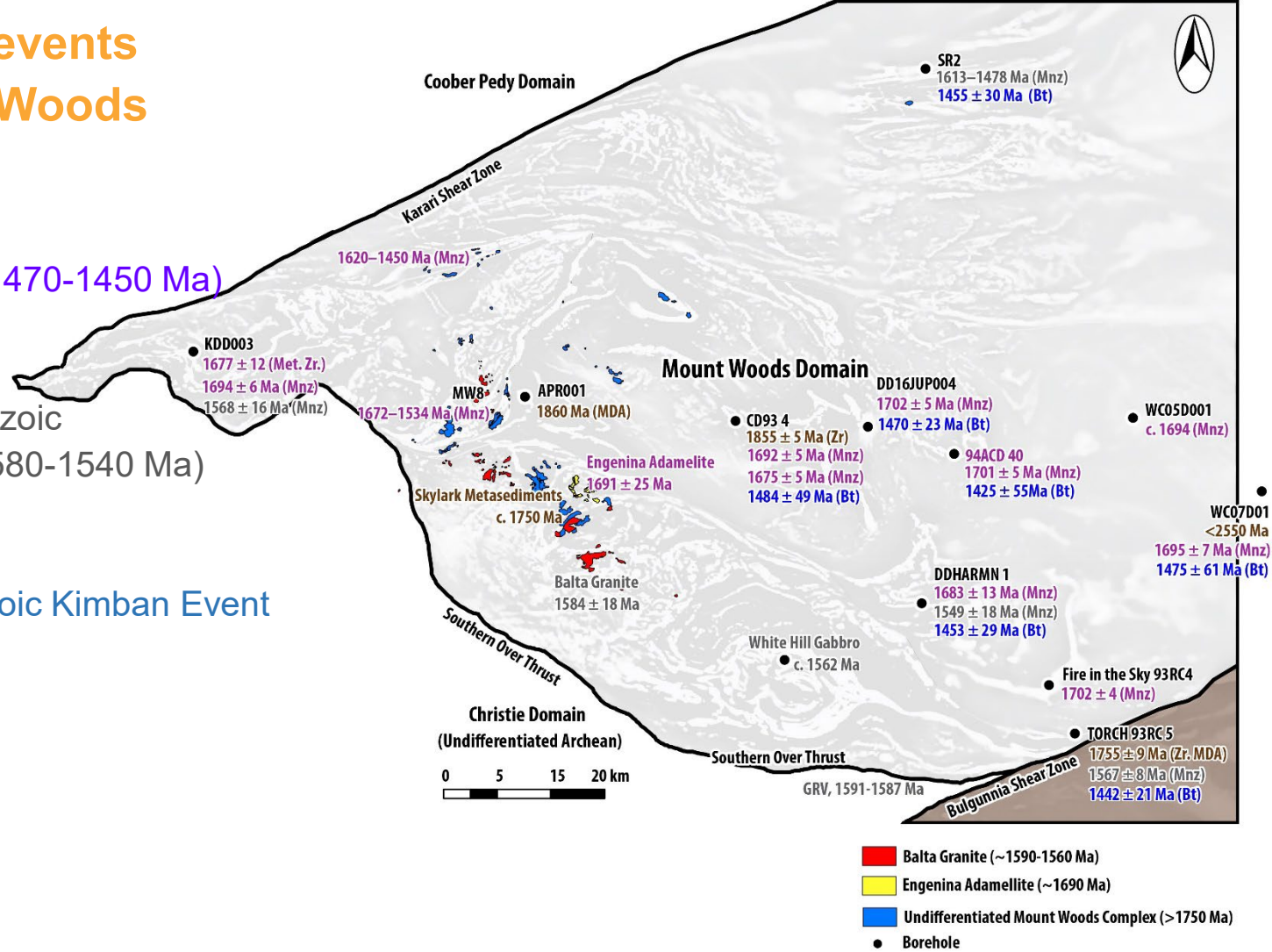


Key tectonic events of the Mount Woods

Mesoproterozoic Coorabie Event (~1470-1450 Ma)

Paleo-Mesoproterozoic Kararan Event (~1580-1540 Ma)

Late Paleoproterozoic Kimban Event (~1735-1690 Ma)



References: 1. Fanning et al. (2007); 2. Stewart and Betts (2010a); 3. Betts and Giles (2006); 4. Payne (2008); 5. Teasdale (1997); 6. Daly et al. (1998); 7. Reid et al. (2008); 8. Tomkins et al. (2004); 9. Stewart et al. (2009); 10. Hand et al. (2007); 11. Belperio et al. (2007); 12. Fanning (1993); 13. Finlay (1993); 14. Jagodzinski et al. (2007); 15. Allen et al., 2016; 16. Tiddy et al. (2020); 17. Beyer et al. (2018); 18. Betts et al. (2003); 19. Stewart and Betts (2010b); 20. Yu et al. (2024b); 21. Jagodzinski and Reid, 2017; 22. Yu et al. (2024a); 23. Morrissey et al. (2023); 24. Hopper (2001); 25. Ambrose et al. (1981)

Interpretation

- The Bouguer gravity image shows that the Mount Woods Domain is broadly a gravity high.
- Geophysical data interpretation using Bouguer gravity also helps in mapping major crustal-scale shear zones.
- Based on these major shear zones, the Mount Moods Domain can be divided into three main sub-domains (Tiddy et al., 2020, Morrissey et al., 2023).

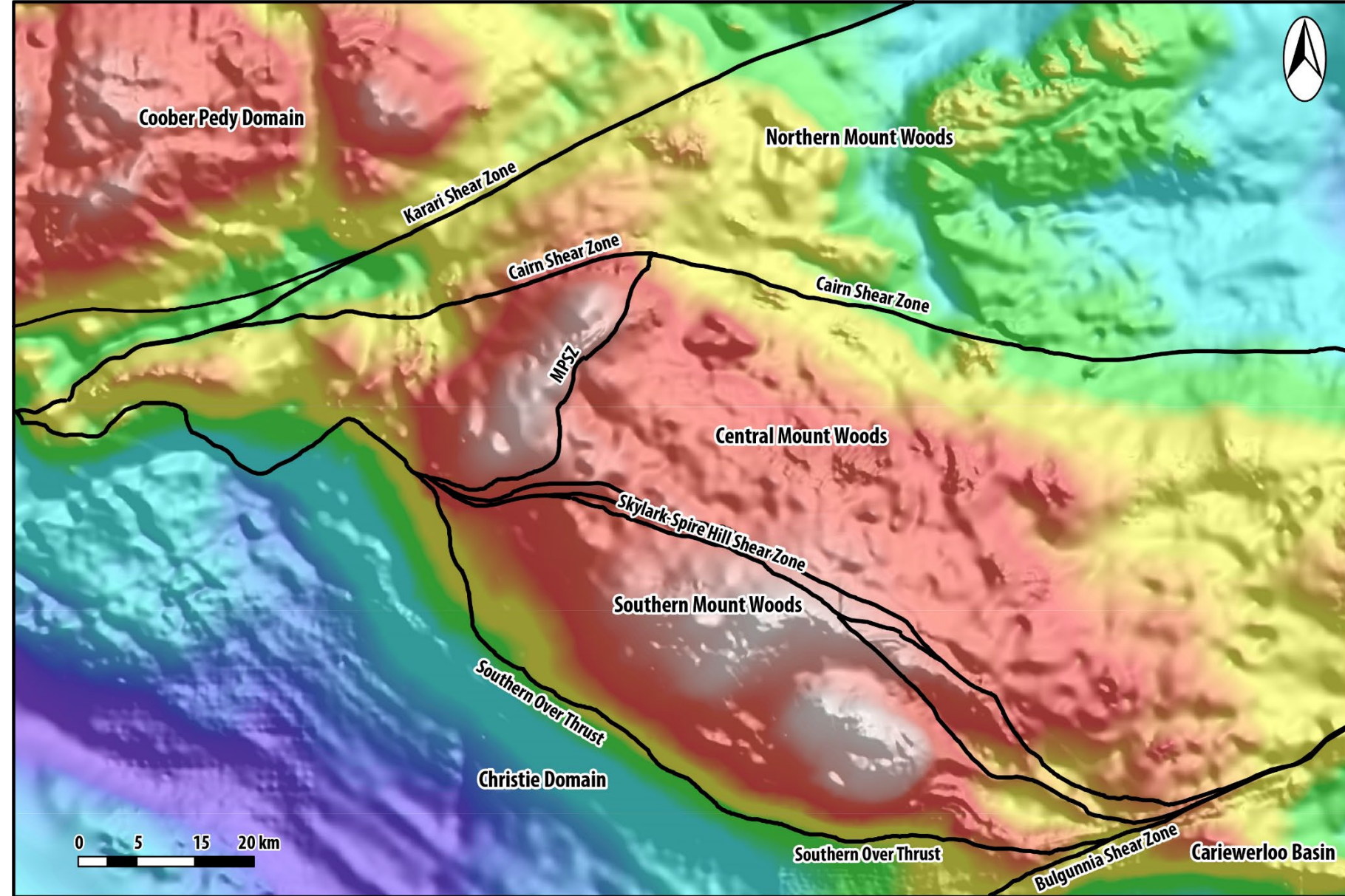


Figure 4. Bouguer gravity image is showing location of the major shear zones of the Mount Woods Domain [MPSZ - Moonlight-Panorama Shear Zone].

Interpretation

- Structural mapping and kinematic analysis of the major shear zones are done using aeromagnetic data.
- Structural mapping and kinematics analysis show presence of very complex structures in the Mount Woods Domain.
- Structural complexities, kinematics and possibly timing of activation of the major shear zone are not uniform across the Mount Woods Domain.
- Some of the shear zones show evidence for multiple reactivations with different kinematics.

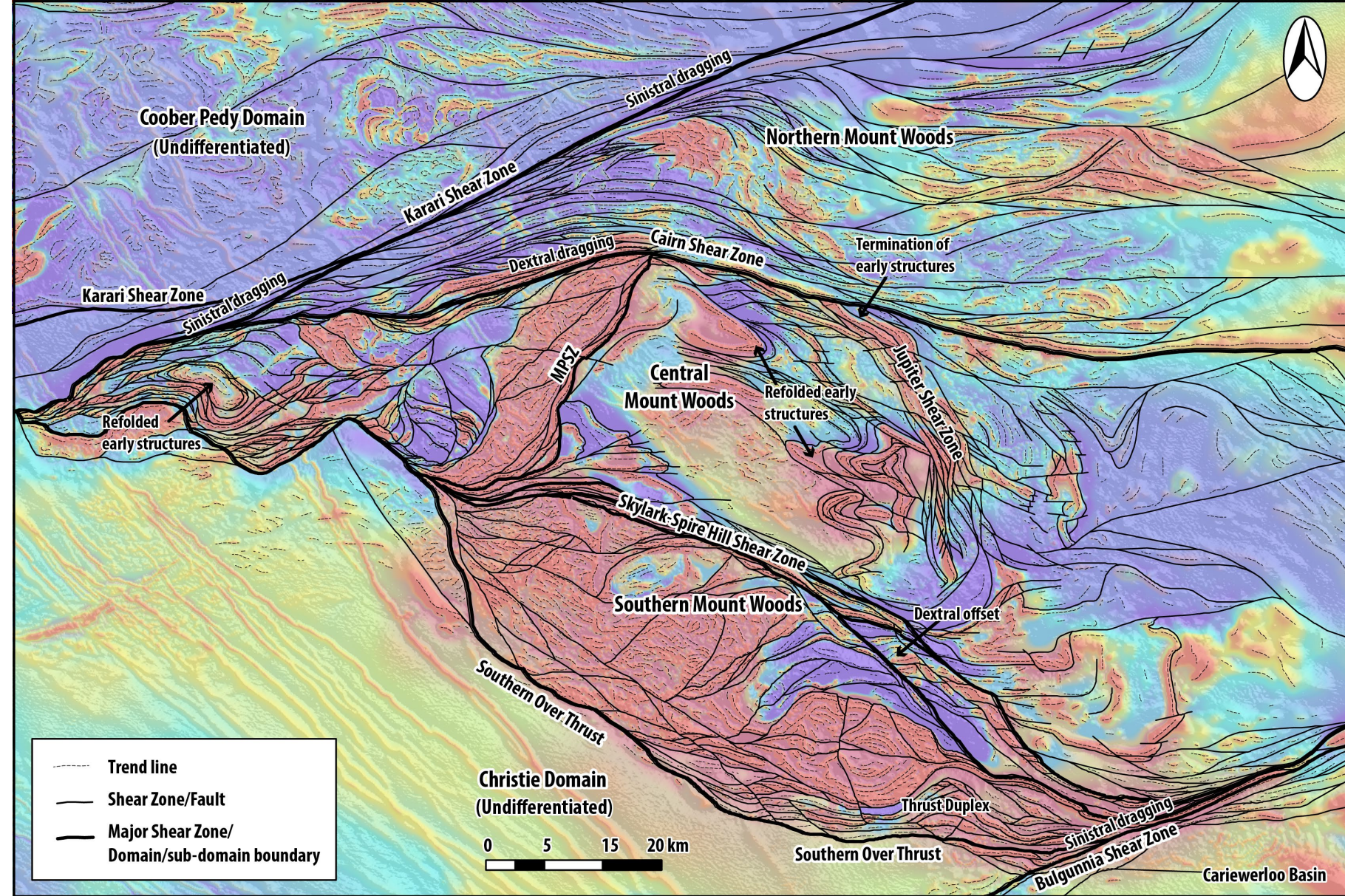


Figure 5. RTP (50% transparent) above 1VD of RTP image is showing the interpreted structures in the Mount Woods Domain [MPSZ - Moonlight-Panorama Shear Zone].

Interpretation

- Based on the structural mapping and information on basement rock distribution, we constructed a new solid geology map of the Mount Woods Domain.
- To unravel this basement complexities, this new solid geology map can be further presented in different time slices which allow us to show progressive geological evolution of the area.

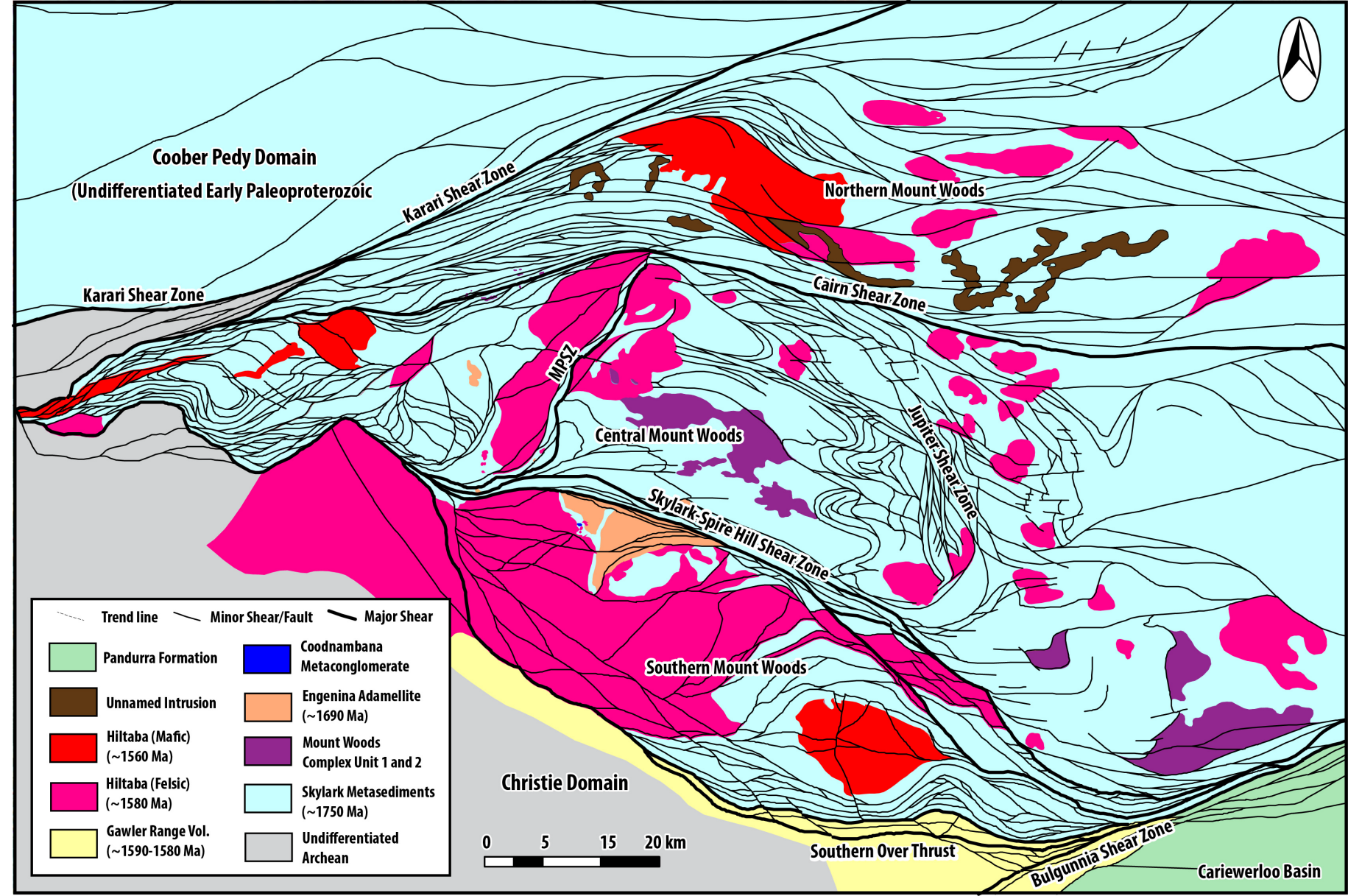


Figure 6. Solid Geology map of the Mount Woods showing the major shear zones and ERP to MES basement rocks in present day [MPSZ - Moonlight-Panorama Shear Zone].



Early Paleoproterozoic Extension

- Tectono-stratigraphic relationship between the Christie and Mount Woods Domain indicate that the Early Paleoproterozoic time was dominated by an extensional event.
- The E-W-trending, N-dipping Southern Over Thrust and Karari Shear Zone preserved the Early Paleoproterozoic extensional deformation and sedimentation in the Mount Woods and in the Coober Pedy to the north of the Archean Christie Domain.
- Skylark-Spire Hill and Cairn shear zones were possibly developed as extensional structures at about the same time.

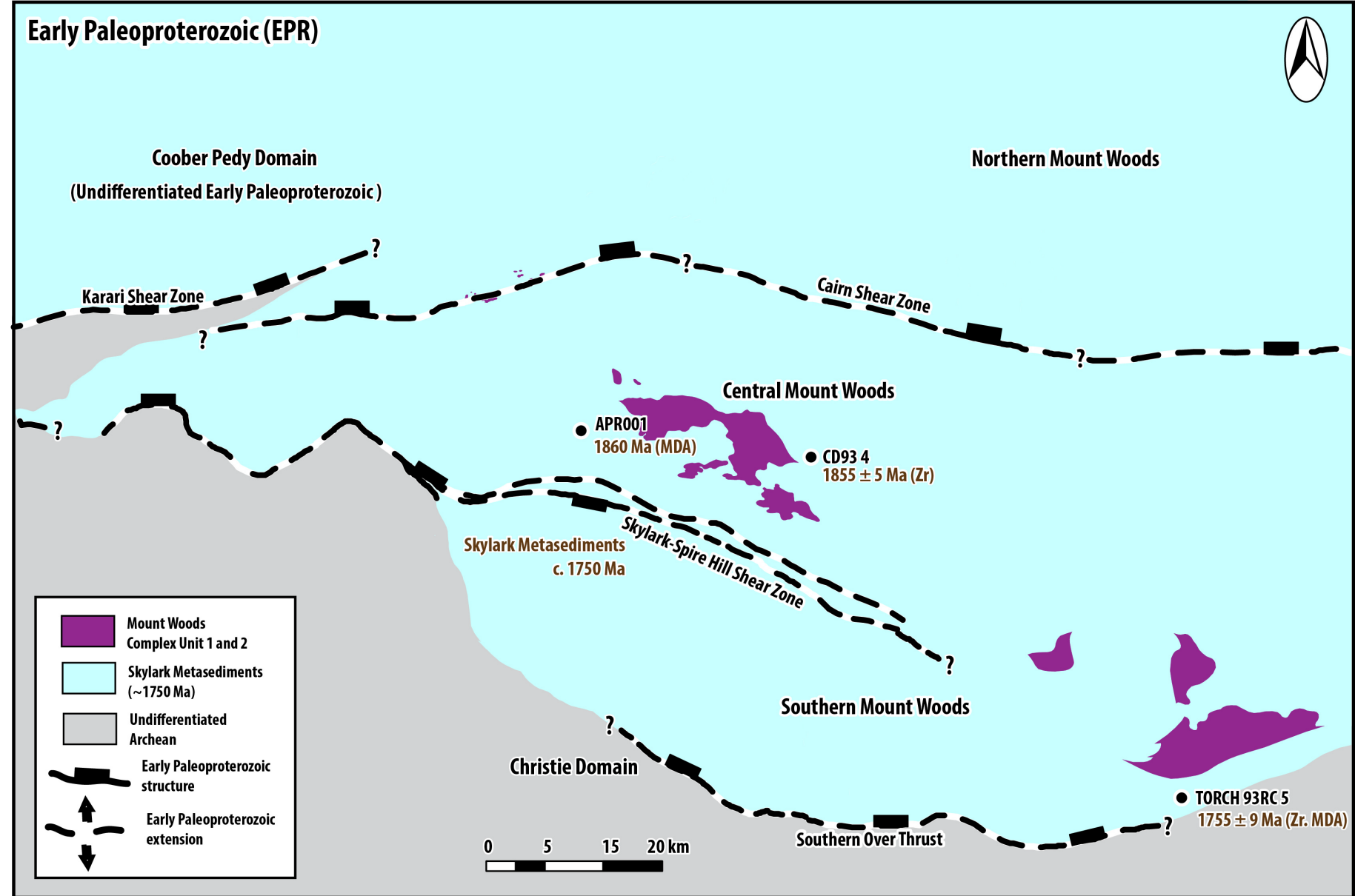


Figure 7. Solid Geology map of the Mount Woods Domain during Early Paleoproterozoic extension.

Late Paleoproterozoic Kimban Event

- During the Late Paleoproterozoic Kimban Event, deformation-metamorphism-magmatism related processes stopped the extensional basin formation in the Mount Woods.
- The Kimban event is poorly defined and is only preserved in the central Mount Woods.
- End of the Kimban is marked by emplacement of ~1690 Ma Engenina Adamellite and development of an erosional unconformity marked by the Coodnambana Metaconglomerate.

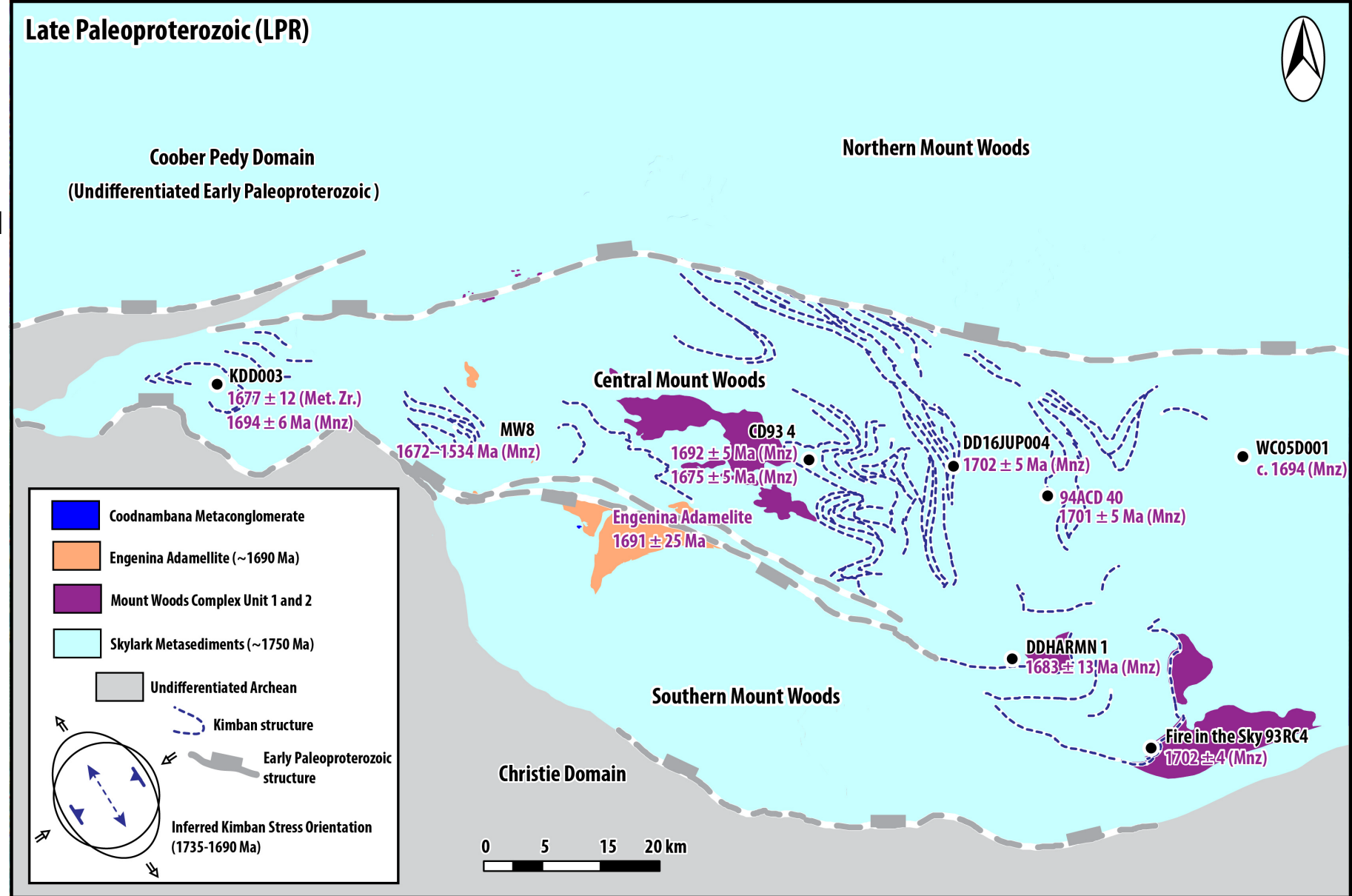


Figure 8. Solid Geology map of the Mount Woods Domain during Late Paleoproterozoic Kimban Event.

Toondulya Magmatic event

- Toondulya Time Slice represents magmatism and volcanism in the Mount Woods Domain.
- Hiltaba equivalent Balta granites are widespread in the area. In contrast, Gawler Range Volcanics occurs only to the south of southern over thrust.
- The Toondulya magmatic event immediately followed by the Kararan event.

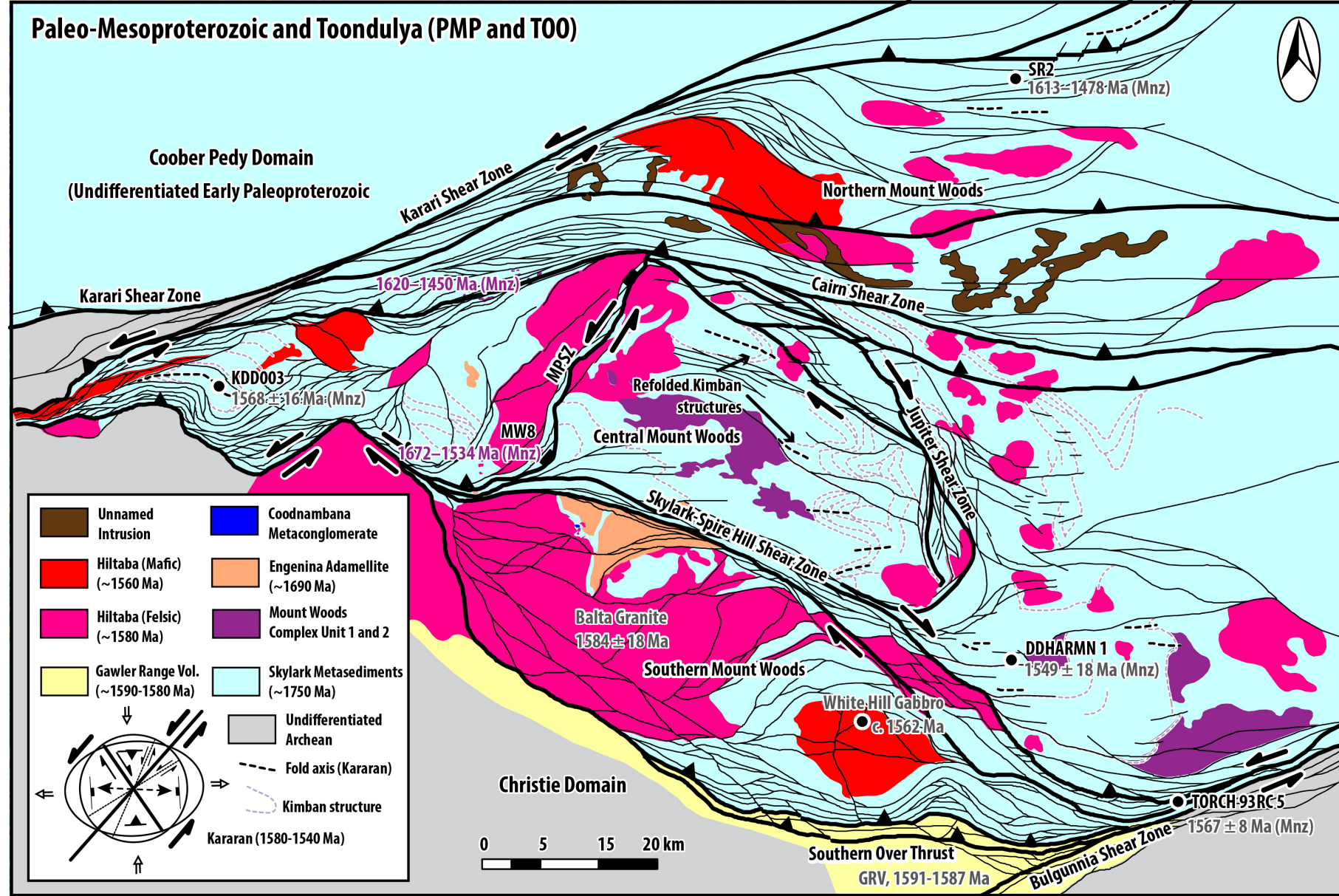


Figure 9. Solid Geology map of the Mount Woods Domain during Paleoproterozoic and Toondulya time slices [MPSZ - Moonlight-Panorama Shear Zone].

Paleo-Mesoproterozoic Kararan Event

- The Kararan Event affected the entire Mount Woods and led to the activation or reactivation of the major shear zones.
- The event also resulted refolding of the earlier Kimban-aged structures in the central Mount Woods.
- Kinematics and structural analysis along the major shear zones suggest an approximately N-S shortening was associated with the Kararan Event.

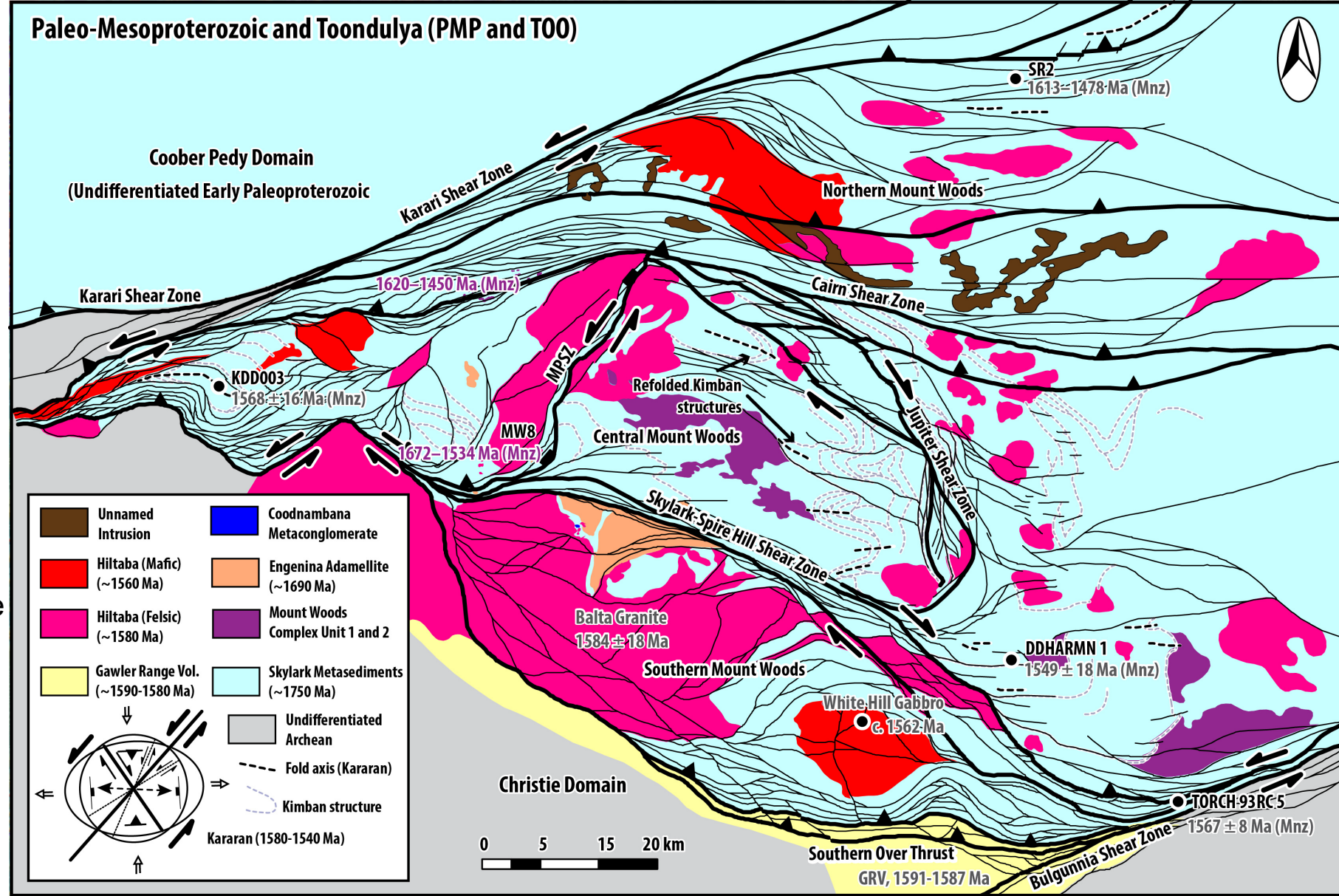


Figure 9. Solid Geology map of the Mount Woods Domain during Paleoproterozoic and Toondulya time slices [MPSZ - Moonlight-Panorama Shear Zone].

Summary

- New solid geology of the Mount Woods through the SAMD project can help in unravelling basement complexities using different time-slices.
- Structural geometry, kinematics and timing of activation or reactivation of the major shear zones can be linked to the stress orientations of the different tectonic events.
- Orientation of the pre-existing structures and possibly the basement architecture played a key role in the reactivation history of the major shear zones in the Mount Woods Domain.
- The time slice system helps to understand the changing kinematics during reactivation, highlighting the controls on fluid flow, and consequently the mineral potential of the area.

