

PETROLEUM SYSTEMS

PERTH BASIN

INTRODUCTION

- The Perth Basin covers an area of about 100 000 km² in the southwest of Western Australia (Fig. 1)
- It contains mainly Permian–Cretaceous sedimentary rocks (Fig. 2)
- Exploration drilling started in the early 1950s and since then over 368 onshore and 61 offshore wells have been drilled
- Several commercial oil and gas fields and numerous other significant discoveries within tight-sand have been discovered (Fig. 3)

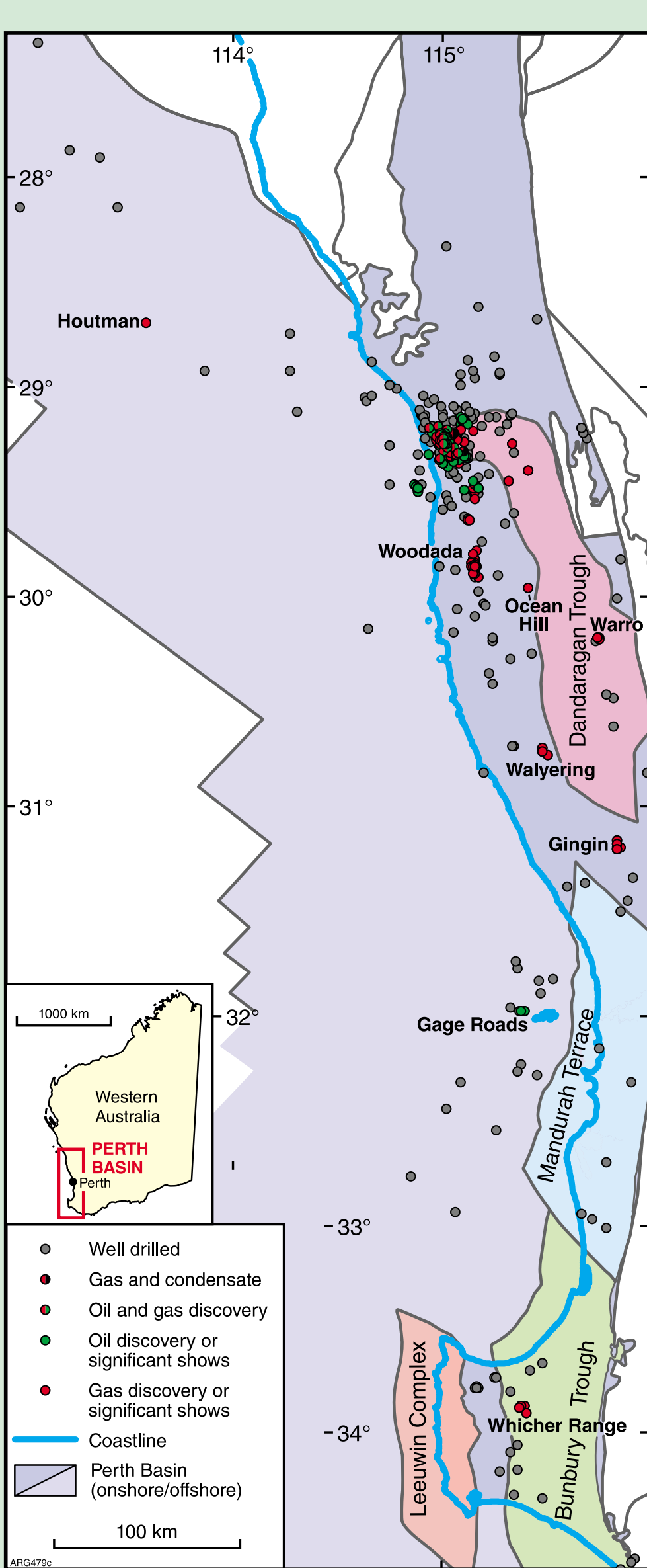


Figure 1. Tectonic units, exploration wells and petroleum discoveries of the Perth Basin

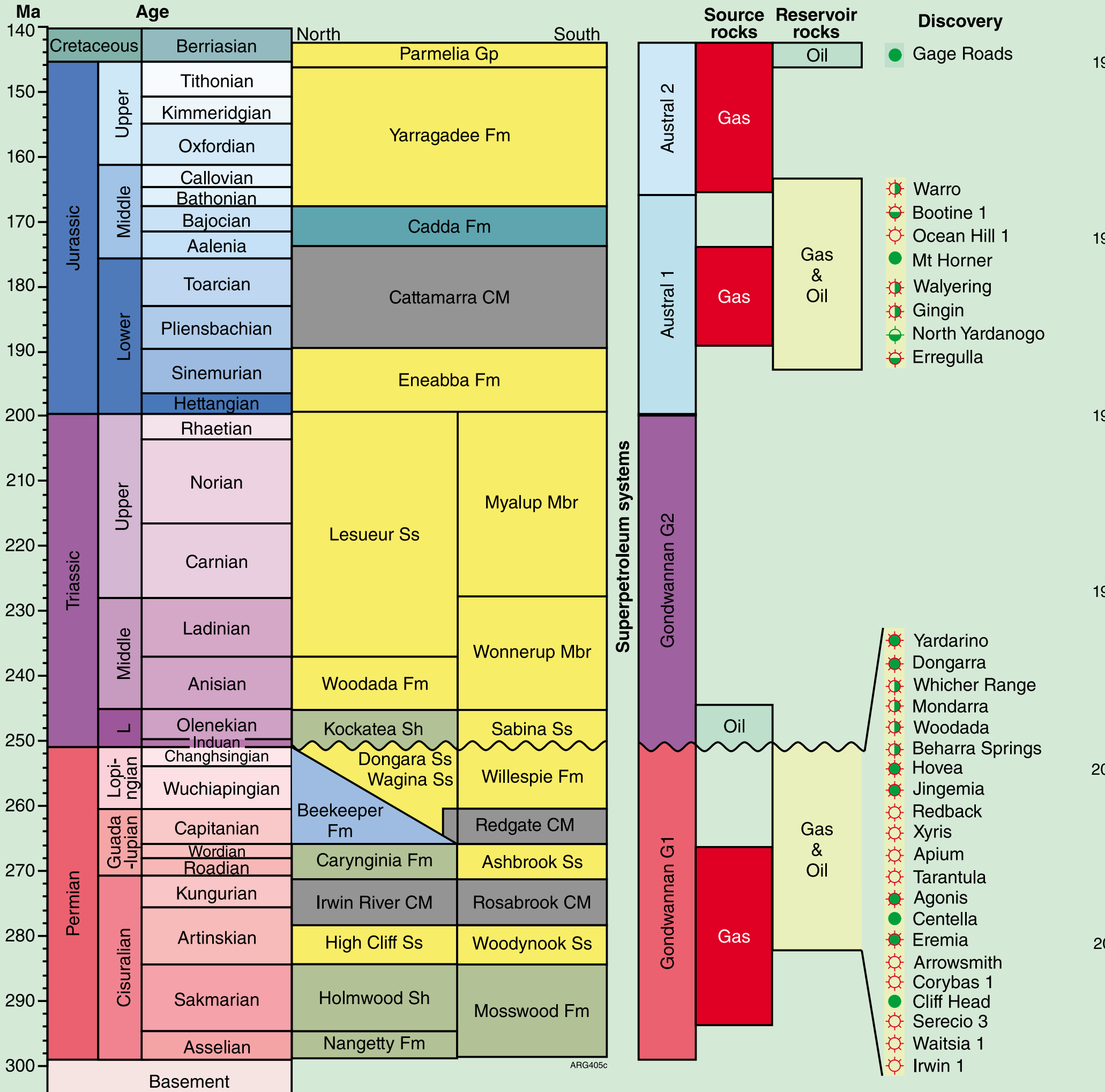


Figure 2. Stratigraphy, petroleum sources, reservoirs, systems and discoveries of the Perth Basin

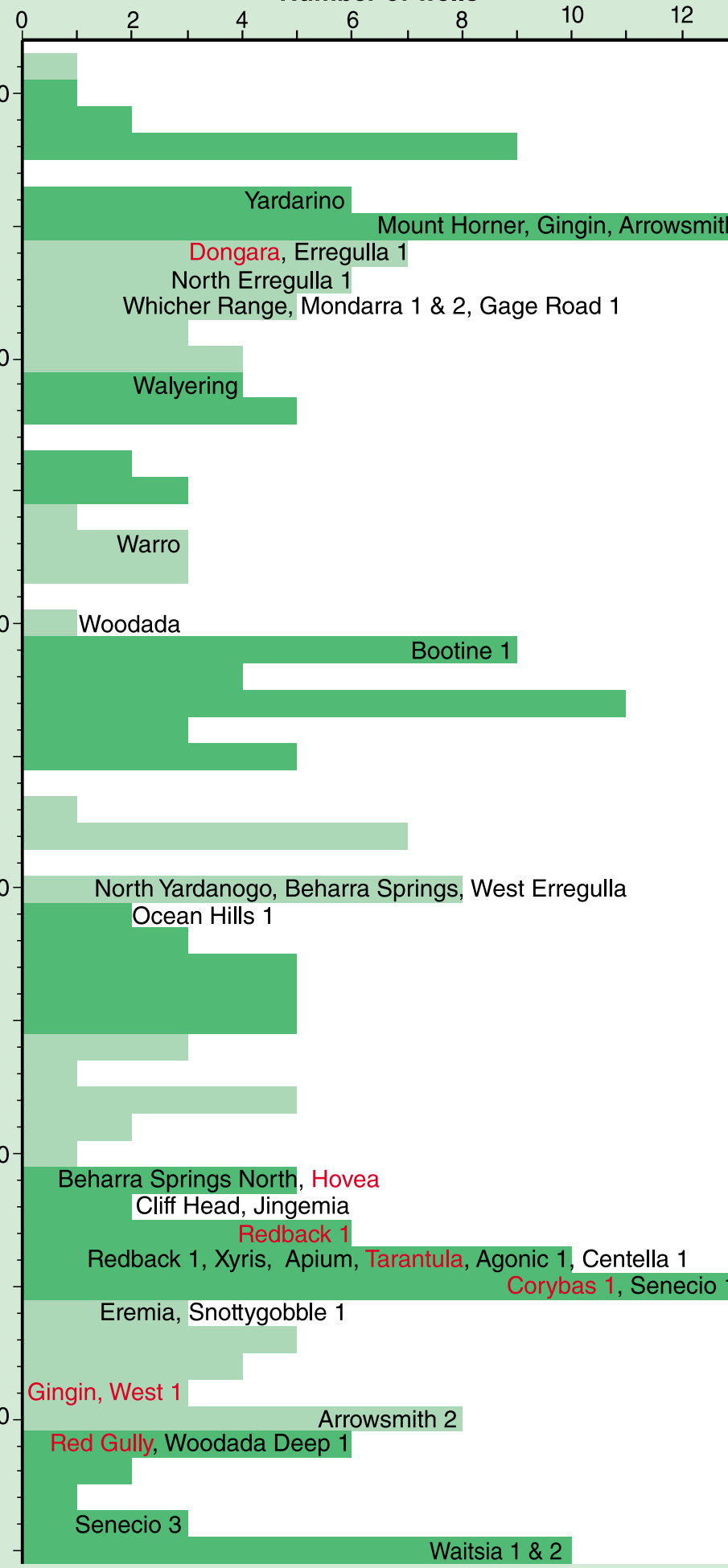


Figure 3. Petroleum discovery history of the Perth Basin

PRODUCTION

- The Perth Basin has produced oil and gas-condensate from conventional reservoirs
- 194 790 L oil, 19 087 980 L condensate and 260 855 806 m³ gas was produced in the basin in 2015
- The Perth Basin is the second highest petroleum producer after the Carnarvon Basin within the Western Australian jurisdiction and its produced and estimated conventional and tight-reservoir resources are high (Figs 4 and 5).

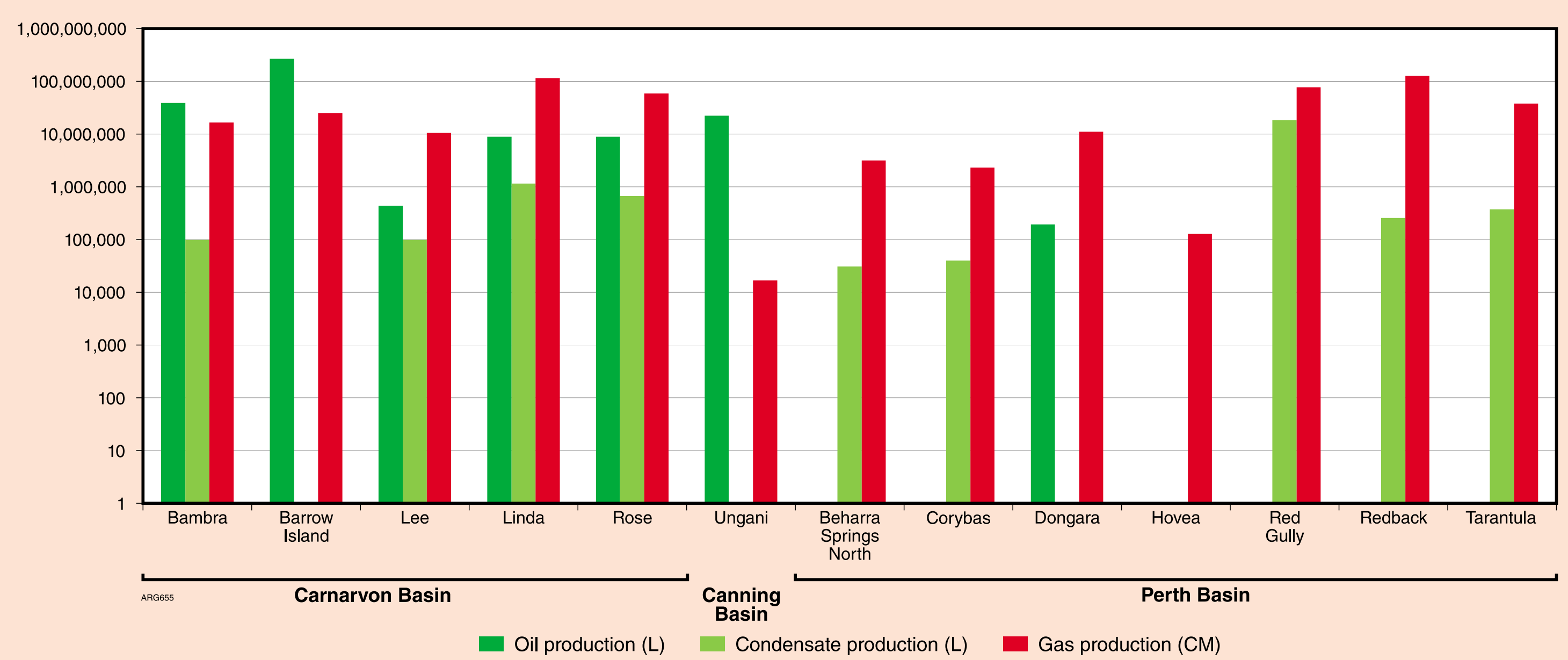


Figure 4. Petroleum production in 2015 within the Western Australian jurisdiction

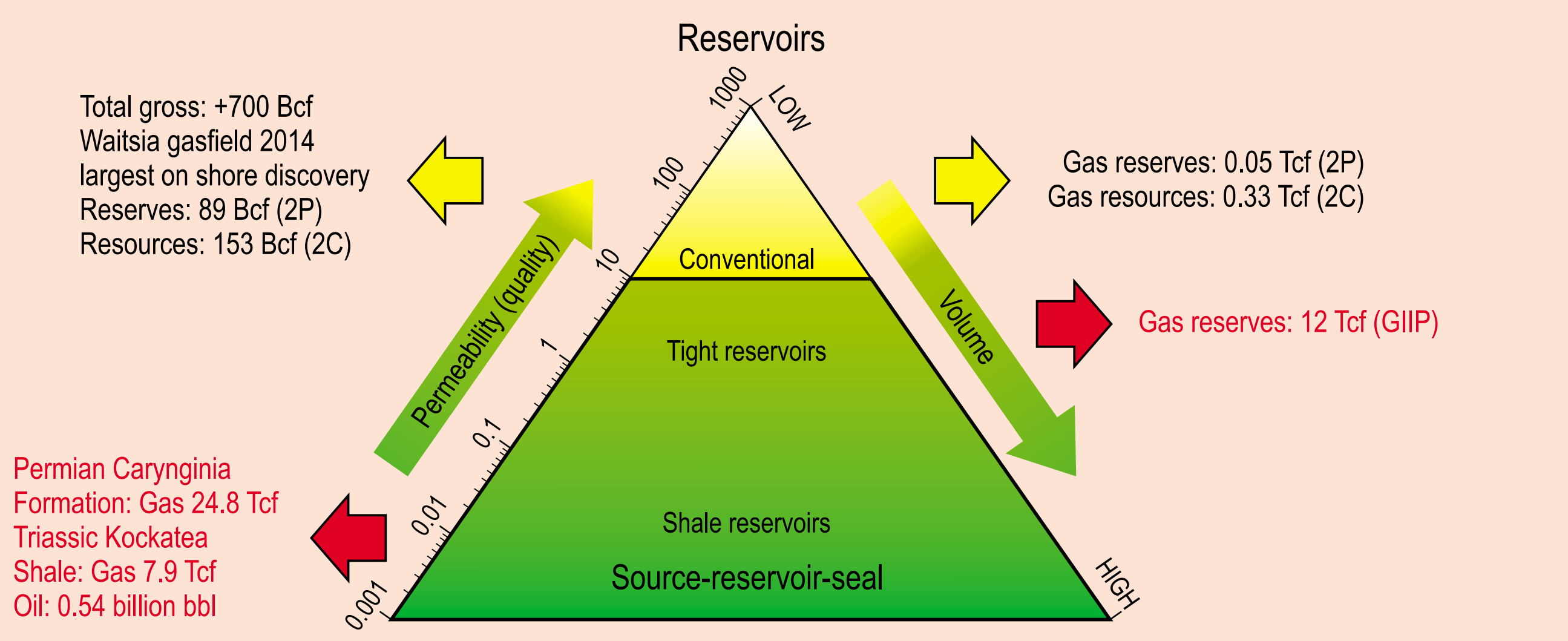


Figure 5. Estimated conventional and tight-reservoir petroleum resources of the Perth Basin

PETROLEUM SYSTEMS

- Petroleum geochemistry, organic petrology, apatite fission track analysis (AFTA), heat-flow, subsurface temperature and other exploration data from the onshore Perth Basin are used to evaluate conventional and tight-reservoir petroleum systems
- A total of 60 wells have source-rock analysis data that were modelled using Platte River Associates' latest release of the Petroleum Systems Suite of software 2017
- TOC and Rock-Eval data from the modelled wells have been filtered using the REESA (Rock Eval Expert System Analysis) Rules
- These modelled Rock-Eval data are used to generate trend maps and cross-sections to show the geographic and subsurface distribution of measured TOC and measured and calculated Rock-Eval parameters S₂, hydrogen index, production index, and T_{max}
- Petroleum systems analysis for the Carynginia Formation, Kockatea Shale, and Cattamarra Coal are summarized in Figs 6 and 7 and for the Kockatea Shale in Figs 8 to 13
- These surface map are computer generated without any manual editing and may extend in areas where data is lacking

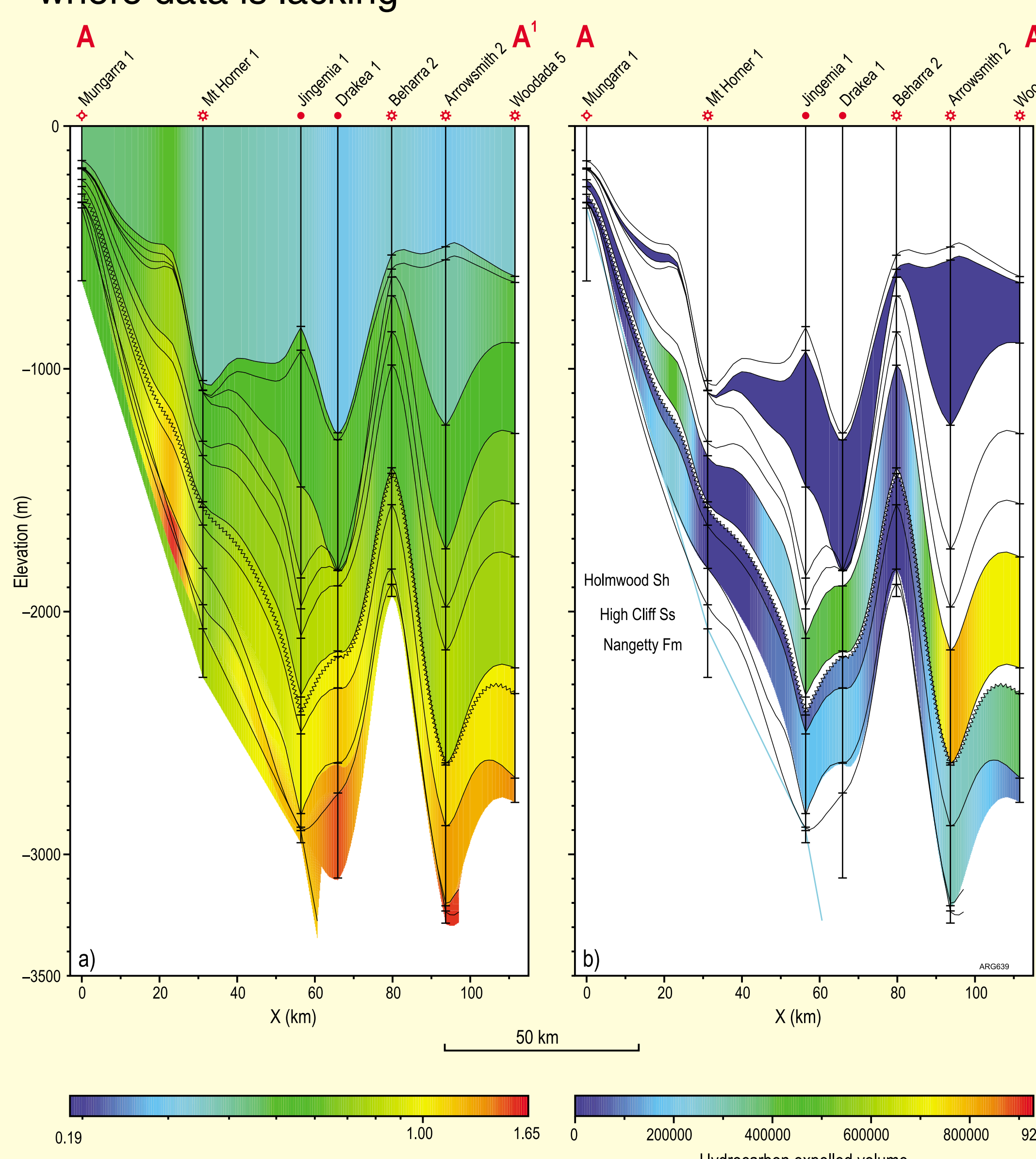


Figure 7. A–A' (Fig. 8) north to south cross-section (Mungarra 1–Woodada 5) showing: a) vitrinite reflectance (%R_o) maturity; b) hydrocarbon volume for the Jurassic Cattamarra Coal Measures, Triassic Kockatea Shale, and Permian Carynginia Formation and Irwin River Coal Measures source beds. Maximum expulsion was within the Arrowsmith area followed by the Woodada area, based on BasinView modelling

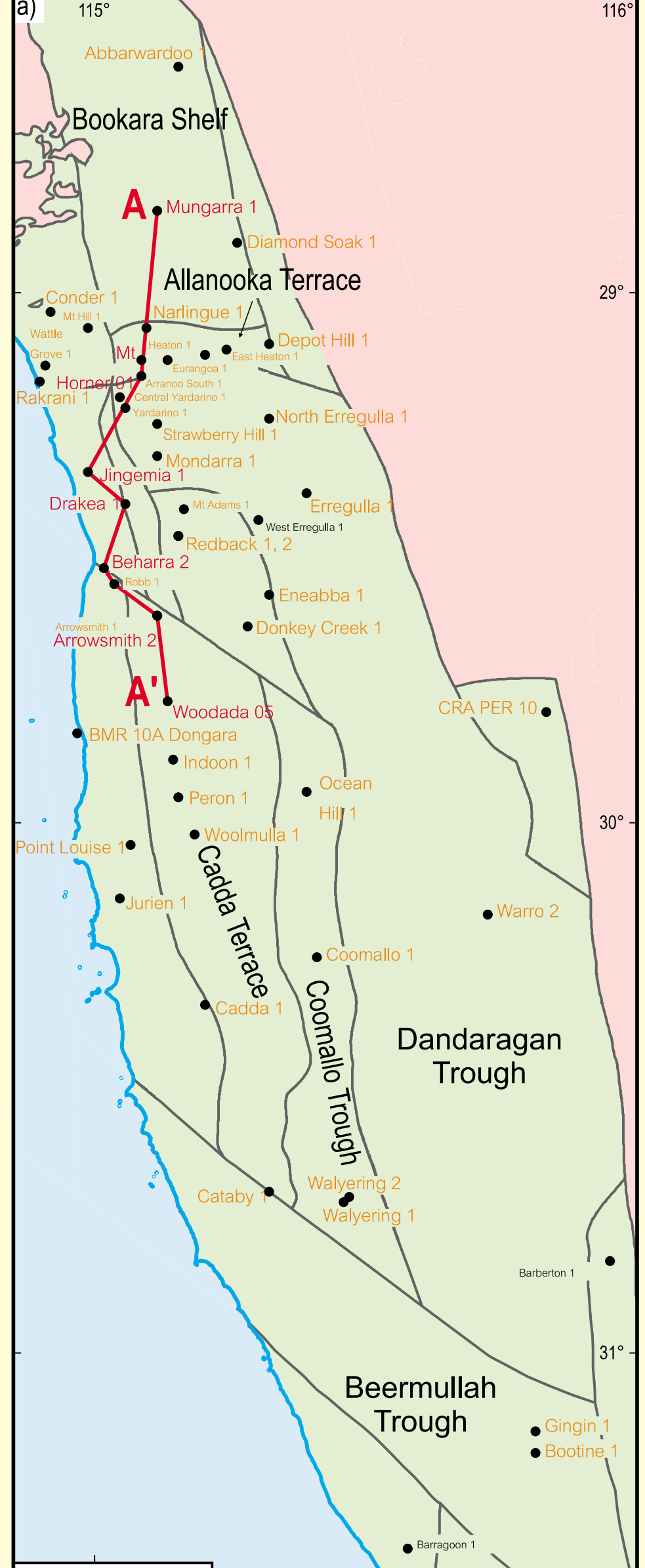


Figure 8. Perth Basin map showing structural elements and wells within the northern onshore and a cross-section A–A' shown in Figure 7

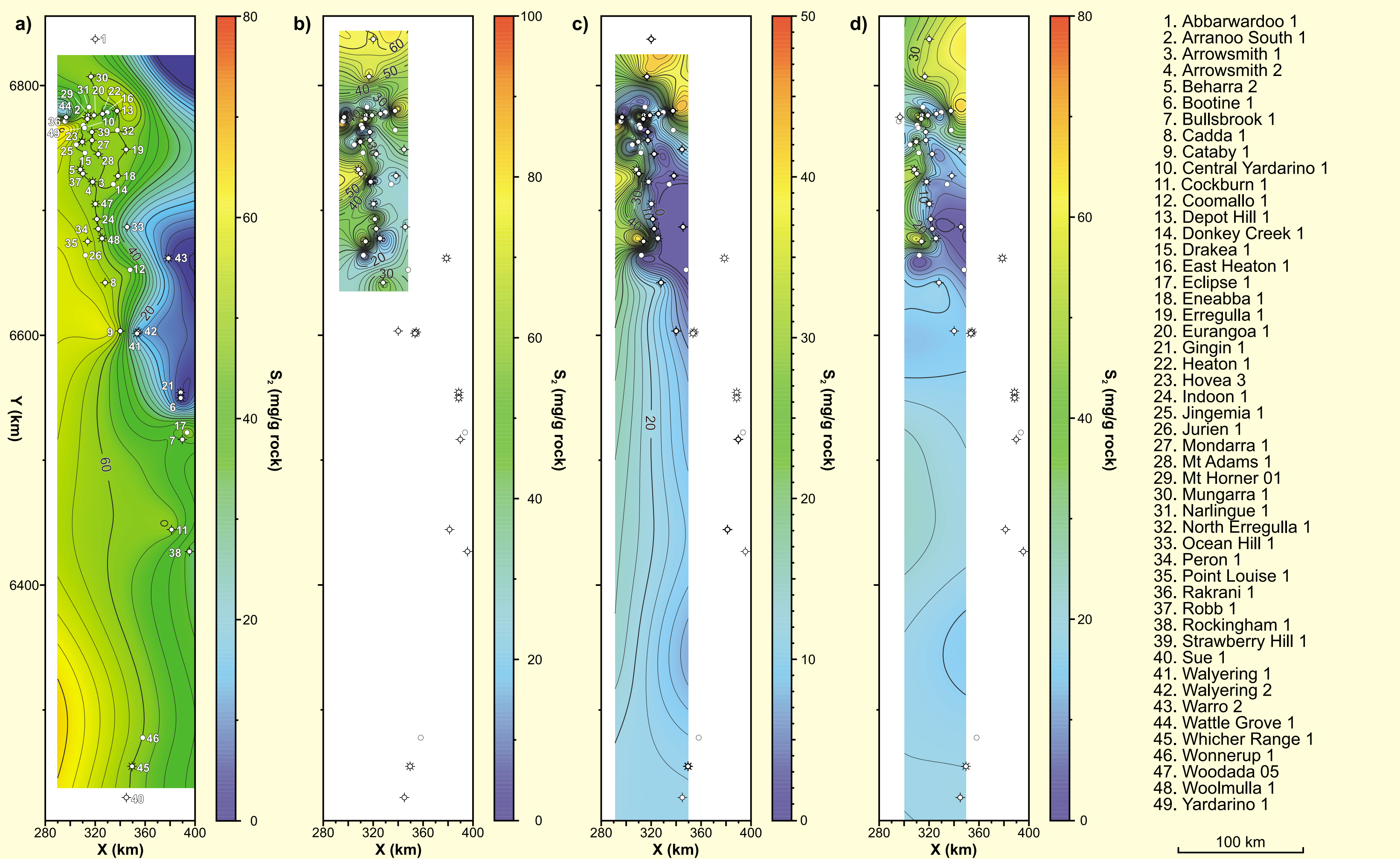


Figure 6. Perth Basin maps showing generating potential (S₂/mg) distribution within the: a) Jurassic Cattamarra Coal Measures; b) Triassic Kockatea Shale; c) Permian Carynginia Formation; d) Permian Irwin River Coal Measures

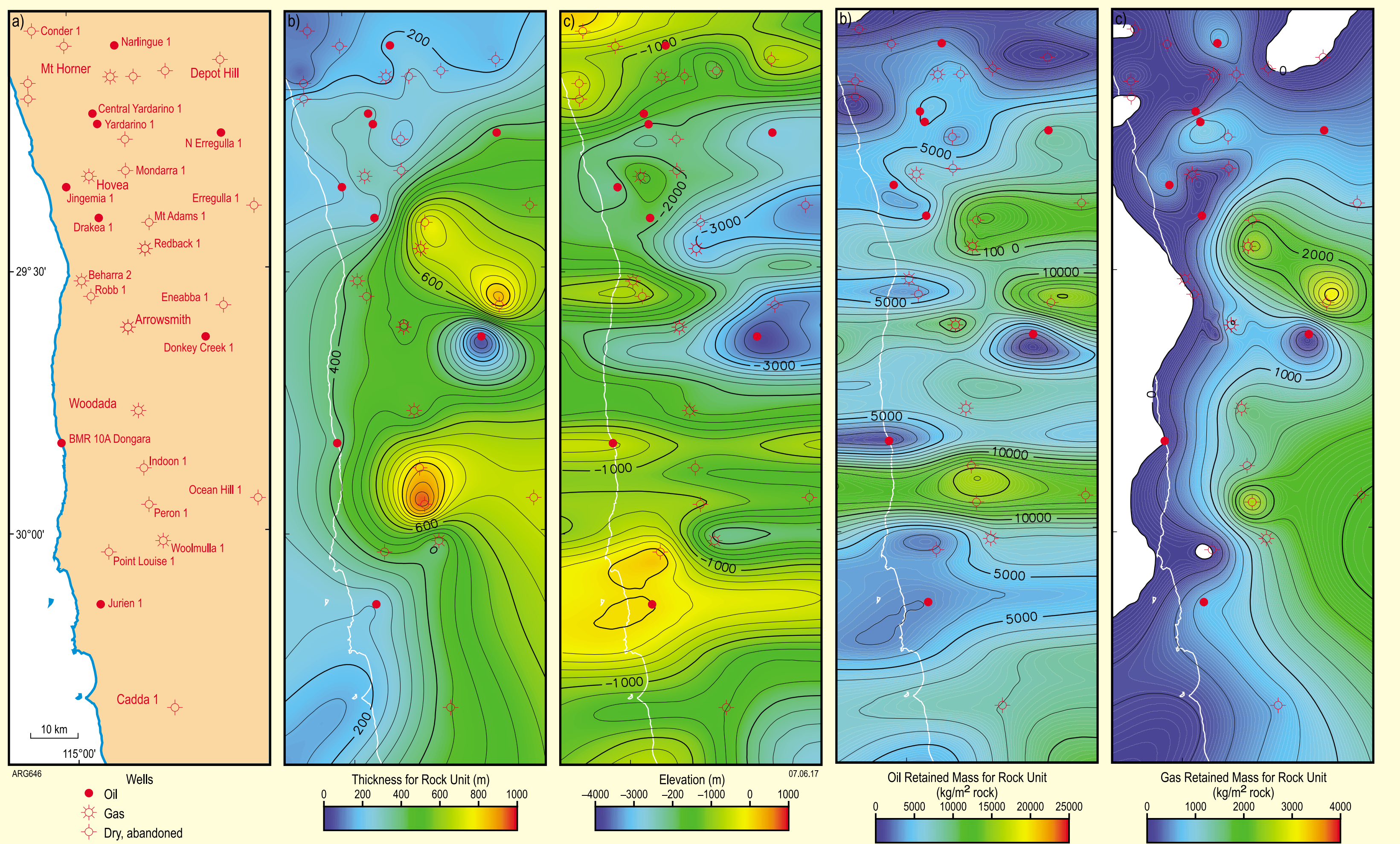


Figure 10. Perth Basin maps summarize the Kockatea Shale: a) wells used in the study; b) contoured thickness using study wells; c) present day depth; d) oil retained (not expelled); e) gas retained (not expelled).

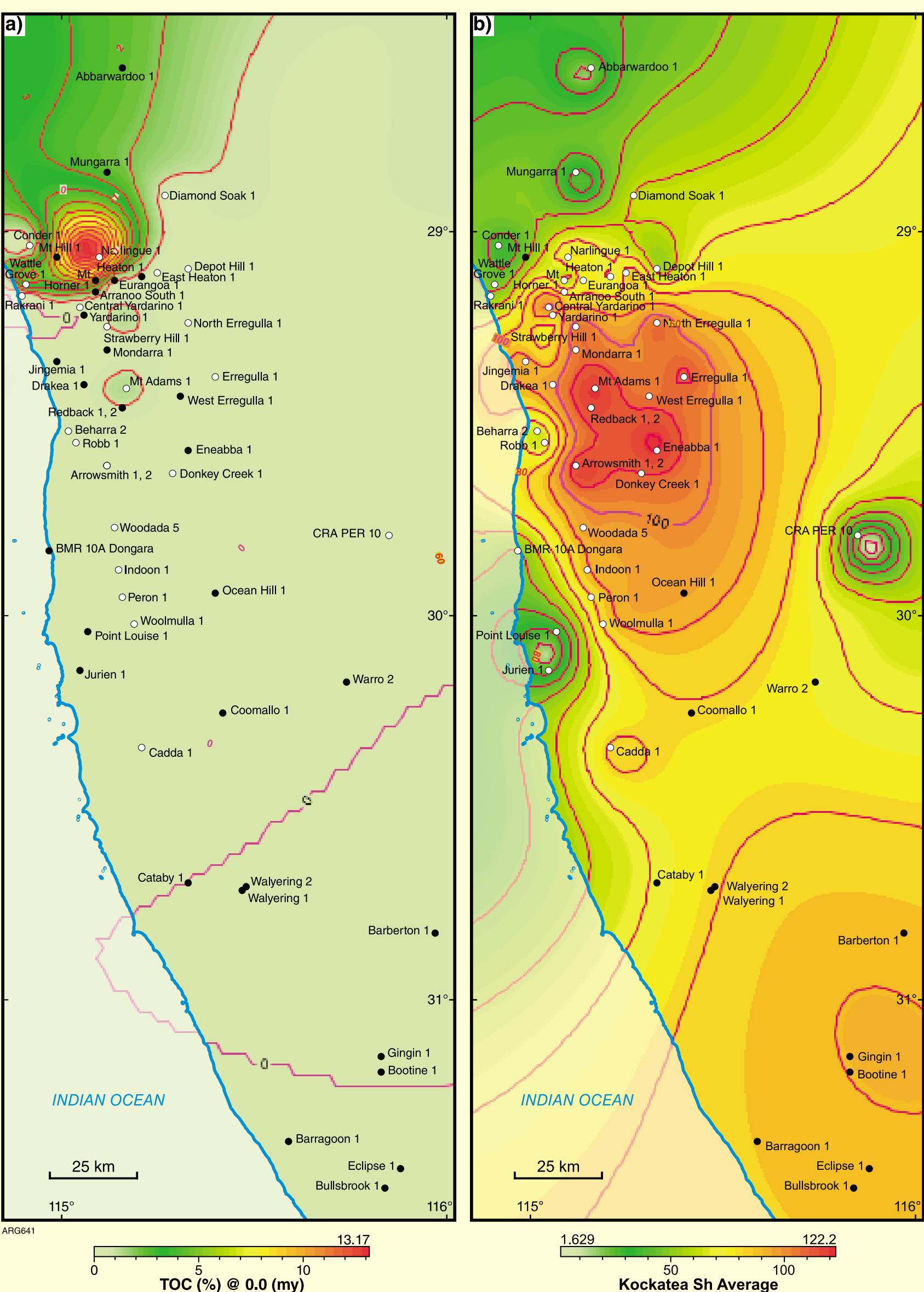


Figure 9. Northern onshore Perth Basin maps summarize: a) distribution of organic richness (TOC %) of the Kockatea Shale; b) distribution of temperature within the Kockatea Shale. Data wells are white highlighted. Pink are major contour (100°C) and red are minor contour at an interval of 20°C.

CONCLUSIONS

- The onshore northern Perth Basin is the prime petroleum province of the Perth Basin, which is rich in conventional and tight gas-condensate resources
- The new conventional Lower Permian gas play discovery at the Waitsia Gasfield and the oil recovery from Triassic shale play at Arrowsmith 2 has revived exploration of the Perth Basin
- The conventional petroleum production is depleting rapidly; the tight petroleum resources have the potential to compensate but are presently at initial stages of exploration and are many years away from commercial production
- An understanding of shale plays is at an early stage thus more exploration and research is required on new geological techniques and drilling and production technology that might be applicable to the Perth Basin
- Emerging tight-petroleum resources of the Perth Basin might be viable petroleum plays of significant quantity with favourable geology and well-developed infrastructure which will facilitate exploration and development

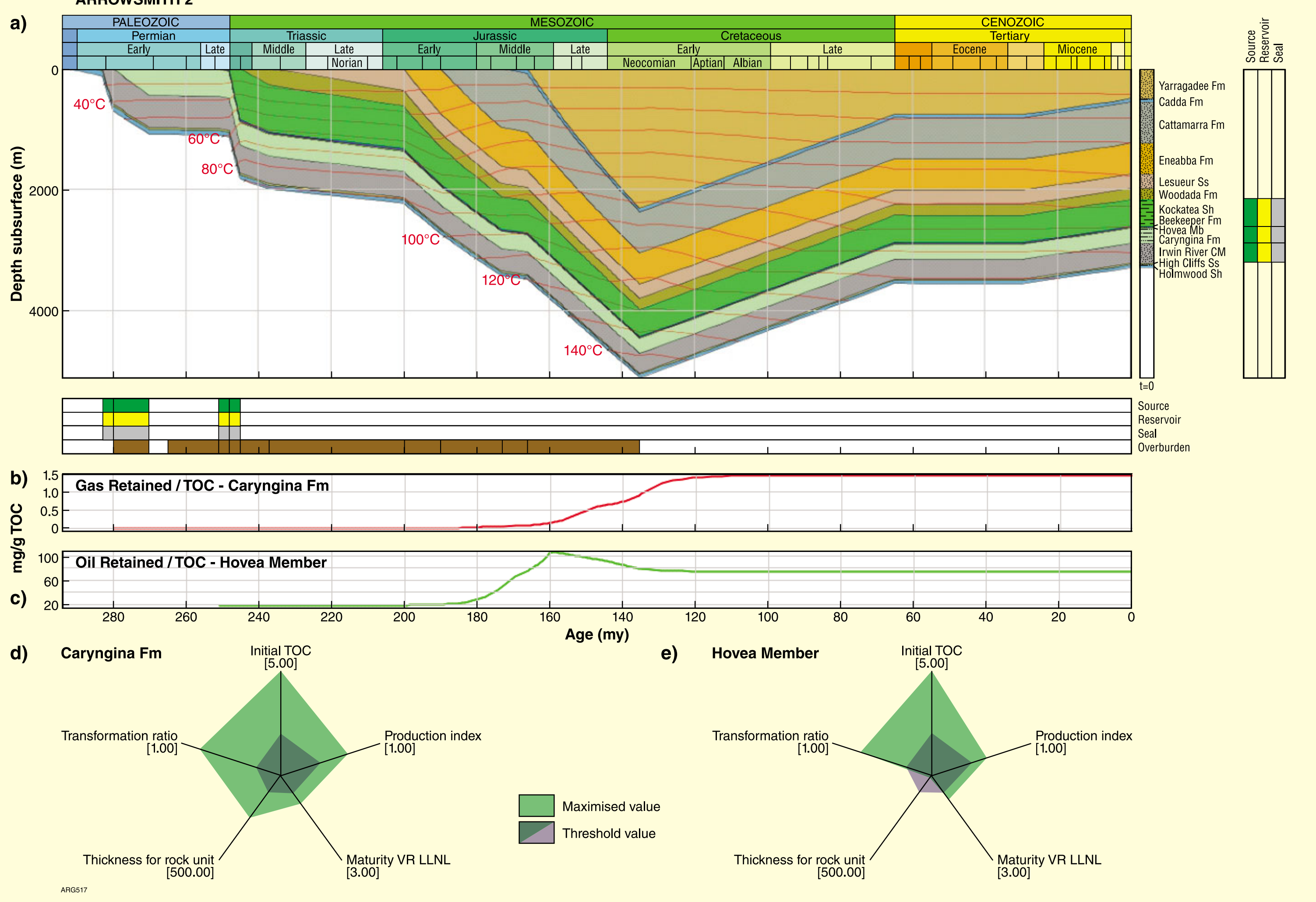


Figure 13. Summary of the shale petroleum systems of Arrowsmith 2; a) burial history and petroleum system elements; b) gas retained in the Permian Carynginia Formation shale reservoirs; c) oil retained in the Triassic Hovea Member Shale reservoirs; d) Carynginia Formation source richness, maturity and thickness; e) Hovea Member source richness, maturity and thickness.