ORGANIC GEOCHEMISTRY AND ORGANIC PETROGRAPHY OF THE BIRKHEAD AND MURTA FORMATIONS, EROMANGA BASIN, CENTRAL AUSTRALIA

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The Jurassic to Cretaceous Eromanga Basin, in conjunction with the underlying Late Carboniferous to Middle Triassic Cooper Basin (Figure 1a), comprise Australia's most significant onshore petroleum province since the 1950's. Most generating source rocks (shale and coal layers) have been identified in the Permian formations of the underlying Cooper Basin, while the source rock potential of organic-rich layers of the younger Eromanga sequence (including the Middle Jurassic Birkhead and the Early Cretaceous Murta formations) and associated hydrocarbon mixing came into focus of scientific investigations relatively late (Michaelsen & McKirdy 2001, Michaelsen 2002, Deighton et al. 2003). Burial depth and thermal maturity levels of these formations throughout the study area were mainly considered too low and most reservoirs (Figure 1b) are associated with Permian source rocks. However, sweet spots with locally elevated thermal maturity and increased organic matter content may have been overlooked but could have contributed to oil accumulations in the Eromanga Basin.

Previously built multi-1D models didn't account for the diachronous deposition of the Late Cretaceous Winton Formation, failed to predict oil expulsion from the Birkhead and Murta formations, and overlooked possible migration pathways for the generated hydrocarbons. In this initial study, we are examining the source rock potential of the Birkhead and Murta formations and their possible contribution to oil accumulations within the Eromanga Basin.

A set of 55 rock cores covering the above two formations from eight petroleum exploration wells (Bookabourdie-5, Jackson-2, Limestone Creek-7, Limestone Creek-8, Moorari-4, Poonarunna-1, Thungo-1, and Winna-1; see Figure 1c) were sampled in August 2018 from the core repositories of South Australia and Queensland state governments. This sample set is currently subject to geochemical and petrographical analysis to evaluate the respective source rock properties such as organic richness (total organic carbon (TOC)), hydrocarbon potential (Rock-Eval S1 and S2), sulfur content, maceral content, thermal maturity (Tmax, vitrinite reflectance (Ro_{random} %)), and saturated and aromatic biomarker composition (gas chromatography-mass spectrometry).

Measurements of the TOC content resulted in low to excellent values between 0.50 and 16.83 % (average = 2.74 %) for the investigated non-marine siltstones and carbonaceous shales. Results of the sulfur content measurements delivered comparably low values between 0.05 and 0.33 % (average = 0.12 %). The maximum TOC and sulfur values originate from Bookabourdie-5. Based on our findings (combined with public domain datasets) TOC, HI, maturity and maceral maps of the Birkhead and Murta formations will be generated. These observed results will serve as inputs to an integrated 3D basin modelling study. From the combined results of geochemical, petrographical and burial history analyses during this study we expect new insights into the tectono-thermal evolution, petroleum generation history (kerogen maturation, hydrocarbon generation), and prediction of migration and accumulation locally within the Eromanga Basin, calibrated against present-day Eromanga oil accumulations.

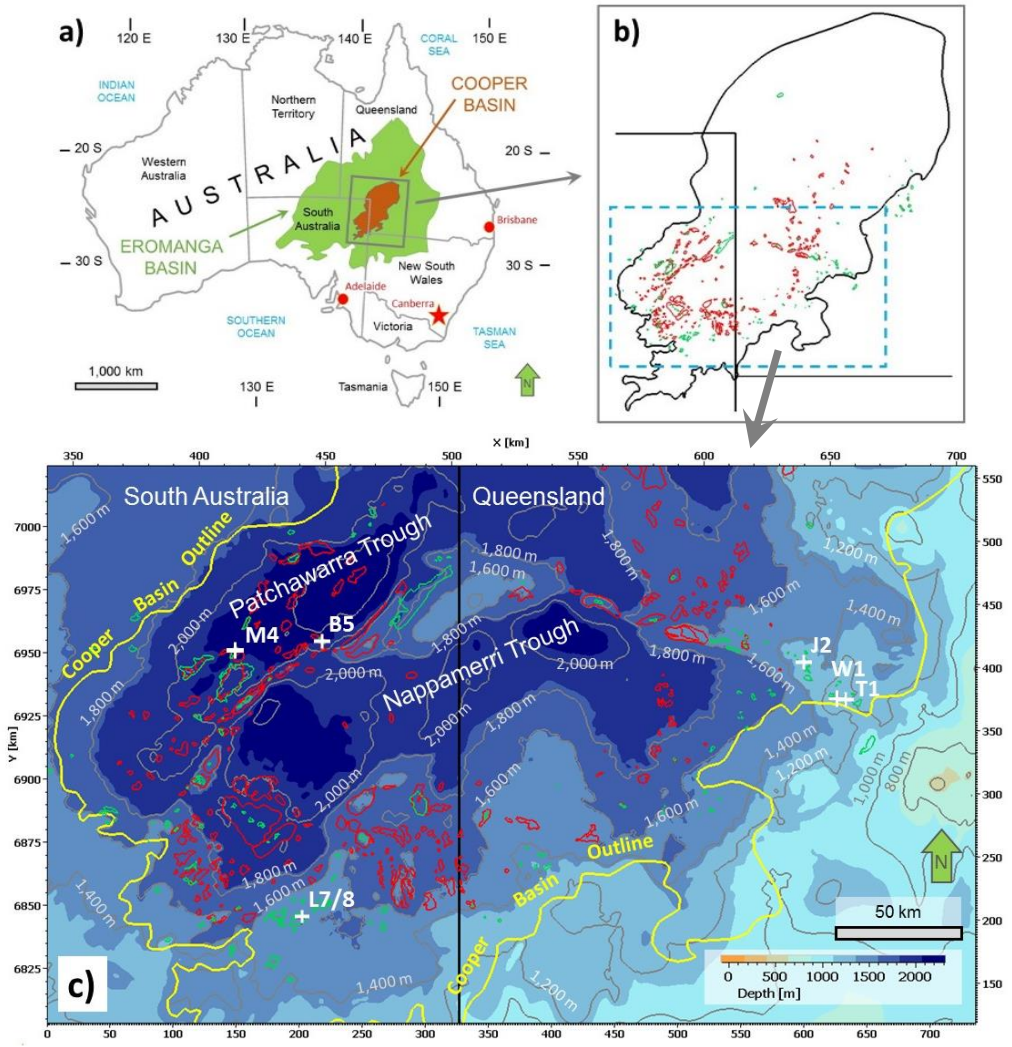

Figure 1 *a) The location of the study area in Central Australia where the Jurassic-Cretaceous Eromanga Basin overlies the Permo-Triassic Cooper Basin. b) Outline of the Cooper Basin and overview of hydrocarbon accumulations. c) Overview map of the main depocenters (Patchawarra and Nappamerri troughs) including sampling locations: B5 = Bookabourdie-5, J2 = Jackson-2, L7/8 = Limestone Creek-7/8, M4 = Moorari-4, T1 = Thungo-1, W1 = Winna-1; Poonarunna-1 is located outside this map. Depth overlay with isolines represents the top of the Birkhead formation.*

References

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