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# Constraining stress magnitudes using petroleum exploration data in the Cooper–Eromanga Basins, Australia

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**Abstract**

The magnitude of the in situ stresses in the Cooper–Eromanga Basins have been determined using an extensive petroleum exploration database from over 40 years of drilling. The magnitude of the vertical stress ($S_v$) was calculated based on density and velocity checkshot data in 24 wells. Upper and lower bound values of the vertical stress magnitude are approximated by $S_v = (14.39 \times Z)^{1.12}$ and $S_v = (11.67 \times Z)^{1.15}$ functions respectively (where $Z$ is depth in km and $S_v$ is in MPa). Leak-off test data from the two basins constrain the lower bound estimate for the minimum horizontal stress ($S_{hmin}$) magnitude to 15.5 MPa/km. Closure pressures from a large number of minifrac tests indicate considerable scatter in the minimum horizontal stress magnitude, with values approaching the magnitude of the vertical stress in some areas. The magnitude of the maximum horizontal stress ($S_{Hmax}$) was constrained by the frictional limits to stress beyond which faulting occurs and by the presence of drilling-induced tensile fractures in some wells. The maximum horizontal stress magnitude can only be loosely constrained regionally using frictional limits, due to the variability of both the minimum horizontal stress and vertical stress estimates. However, the maximum horizontal stress and thus the full stress tensor can be better constrained at individual well locations, as demonstrated in Bulyeroo-1 and Dullingari North-8, where the necessary data (i.e. image logs, minifrac tests and density logs) are available. The stress magnitudes determined indicate a predominantly strike-slip fault stress regime ($S_{Hmax} > S_v > S_{hmin}$) at a depth of between 1 and 3 km in the Cooper–Eromanga Basins. However, some areas of the basin are transitional between strike-slip and reverse fault stress regimes ($S_{Hmax} > S_v \approx S_{hmin}$). Large differential stresses in the Cooper–Eromanga Basins indicate a high upper crustal strength for the region, consistent with other intraplate regions. We propose that the in situ stress field in the Cooper–Eromanga Basins is a direct result of the complex interaction of tectonic stresses from the convergent plate boundaries surrounding the Indo-Australian plate that are transmitted into the center of the plate through a high-strength upper crust.


*Keywords:* Cooper–Eromanga Basins; Stress magnitudes; Tectonic regime; Crustal strength

## 1. Introduction

The Cooper–Eromanga Basins are located in central Australia and provide an ideal location to study the in situ stress field in an intraplate setting due to the extensive amount of available petroleum exploration data (Fig. 1). The Cooper Basin is a late Carboniferous

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