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# Archaean orogen-parallel extension: evidence from the northern Eastern Goldfields Province, Yilgarn Craton

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**Abstract**

Evidence for a previously undocumented stage of extensional deformation in the northern Eastern Goldfields Province (EGP) of the Yilgarn Craton is presented, based on detailed studies of gold deposits in the Laverton region. It is suggested that extension was contemporaneous with, and controlled by, east–west-directed shortening associated with a major orogenic event ($D_2$) that affected all of the EGP. Thermal weakening associated with a major phase of granite emplacement destroyed isostatic equilibrium established during $D_2$ crustal thickening. Extension occurred during late $D_2$, with $\sigma_1$ being approximately vertical. Tectonic transport was constrained to an approximately NNW–SSE orientation due to the farfield effects of the waning stages of $D_2$. Gold mineralisation in a number of deposits, including the world-class Sunrise and Wallaby gold deposits, shows intimate temporal and spatial relationships with low-dipping structures produced during gravitational collapse. This suggests that the regionally developed, orogenically late stage of gold mineralisation represented across the goldfields was coincident with a complex interplay of both horizontally and vertically-directed contractional deformation.


*Keywords:* Deformation; Extension; Mineralisation; Gravitational collapse; Structure; Yilgarn

## 1. Introduction

The Yilgarn Craton is a complex tract of Archaean intrusive, volcanic, and sedimentary rocks that occupies much of the southern portion of Western Australia. Abundant gold mineralization has been attributed to the craton-wide alteration/mineralization event that took place in the complex protracted structural evolution of the craton (e.g. Witt and Vanderhor, 1998; Qiu and Groves, 1999; Kent et al., 1996). The significance of this event is indicated by the number of deposits in the craton with more than 1 million ounces (Moz) contained gold.

Although detailed studies of orogenic gold deposits and structural relationships have been conducted throughout the Yilgarn, the majority have focused on the Eastern Goldfields Province (EGP; Fig. 1). The EGP has been subdivided into a series of terranes that are interpreted as separated by a macroscale network of anastomosing brittle-ductile fault zones (Fig. 1; Myers, 1993, 1995; Swager, 1995, 1997). The largest of these fault zones is the trans-province Keith–Kilkenny Tectonic Zone (also called the Keith–Kilkenny Fault or Kilkenny Shear Zone; Fig. 1), which represents a major NNW–SSE trending dislocation.

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