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Synbasin Transform Faults and Their Influence on Late-Stage Orogenic Gold Mineralization: Examples from the Mosquito Creek Basin, Pilbara Craton, Western Australia

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The Mosquito Creek Basin (MCB) is located within the southeastern part of the Archean Pilbara Craton of Western Australia and is dominated by siliciclastic sequences that were deposited ca. 2926 Ma and subsequently buried, metamorphosed, and intensely shortened at ca. 2905 Ma. Overprinting relationships indicate that orogenic gold deposits of the MCB are hosted by late-stage structures that are spatially associated with two steeply dipping, broadly east-west shear systems: the Middle Creek and Blue Spec shear zones (Fig. 1).

Although a late-stage mineralization paradigm for the MCB is geologically sound, this study has found that many so-called late-stage faults could be synbasin transform faults that have remained active through the evolution of the basin. The synbasin faults are primarily identified by their variable stratigraphic offsets, ranging from over 2 km within lower stratigraphic sequences to less than 100 m in higher stratigraphic sequences. Although rotational offsets along transform faults could still be active, the variable offsets can most readily be explained if they remained active throughout the whole history of the basin. In the northern part of the MCB, abundant slump structures and sedimentary folds are also observed, also showing that synsedimentary deformation was active during basin development. During basin inversion, the synbasin transform faults have remained at a high angle to the dominant MCB trend, possibly enhancing fluid-focusing mechanisms and structural contrasts assisting epigenetic mineralization. Given these outcomes a sequential D_1 to D_n deformation regime, commonly used to help understand mineralization events, cannot fully explain the genesis of gold mineralization.

By using examples from the MCB and other locations within Western Australia, this paper aims to show that although challenging, identifying preexisting structures can lead to new and effective ways to target for gold mineralization from the province to deposit scale.

Fig. 1. Geology map of part of the Mosquito Creek Basin, Pilbara Craton, showing the main gold deposit locations and the long-lived, synbasin transform faults interpreted from this study.

