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Article

Integration of Stress–Strain Maps in Mineral Systems Targeting for IOCG Mineralisation within the Mt. Woods Inlier, Gawler Craton, South Australia

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Abstract: The application of finite element analysis is used to simulate the relative distribution and magnitude of stress–strain conditions during a geologically brief, NNW-SSE-oriented, extensional event (1595 Ma to 1590 Ma), co-incident with IOCG-hydrothermal fluid flow and mineralisation across the Mt Woods Inlier, Gawler Craton, South Australia. Differential stress and shear strain maps across the modelled terrane highlight regions that were predisposed to strain localization, extensional failure and fluid throughput during the simulated mineralisation event. These maps are integrated with other datasets and interpretation layers, one of which is a proposed structural–geometrical relationship apparent in many world-class IOCG deposits, including Prominent Hill, Olympic Dam, Sossego, Salobo, Cristalino and Candelaria. These deposits occur at steeply plunging, pipe-like intersections of conjugate extensional systems of faults, shears and/or contacts, wherein the obtuse angle may have been bisected by the maximum principal extensional axis (viz., σ_3) during mineralisation. Several other layers are also used for the generation of targets, such as distance from major shear zones, favourable host lithologies, and proximity to tectonostratigraphic contacts of markedly contrasting competency. The result is an integrated target index or heat map for IOCG prospectively across the Mt. Woods Inlier.

Keywords: structural control; fluid flow; IOCG mineralisation; finite element analysis; numerical modelling; exploration; target generation; Mt. Woods Inlier; Gawler Craton

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1. Introduction

The discovery of near-surface, world-class deposits is becoming sporadic, with an increasing focus on deeper-seated orebodies situated in more structurally complex terranes [1,2]. The development of improved critical detection technologies and integrated conceptual targeting methodologies, e.g., [2] are two ways to address this. Both require a robust understanding of the structural controls of mineralisation, including the characteristics of the deposit, emplacement style, age, origin [3] and the mechanisms of, for instance, breccia and vein formation in the context of regional tectonism and deformation events [4].

It is widely accepted that the formation of hydrothermal mineral deposits is governed by the interaction of structural–geometrical, hydrological, thermal and chemical controls, e.g., [5–12]. Understanding the structural–geometrical controls is critical in establishing pathways or conduits to reservoirs at both the deposit scale and the regional scale, e.g., [6]. The manner in which structural–geometrical elements influence and control the development and geometry of orebodies and ore-shoots has been demonstrated for a wide range of deposit types and tectonic settings, e.g., [13–21]. On a deposit scale, controlling structural elements include tectonostratigraphic contacts, fault networks, shear zones and folds that are