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ARTICLE

Ore-shoot formation in the Main Reef Complex of the Fairview Mine—multiphase gold mineralization during regional folding, Barberton Greenstone Belt, South Africa

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Abstract

Gold production in Fairview Mine in the Barberton Greenstone Belt, South Africa, is focused on high-grade, steeply plunging ore shoots contained within a gently undulating system of spaced, low-displacement, broadly bedding-parallel faults, and shear zones, collectively referred to as the Main Reef Complex. This shear zone system is developed in metaturbiditic sedimentary rocks of the Mesoarchean Fig Tree Group on the steep western limb of the regional (D_3), refolded, and distinctly arcuate Ulundi Syncline. Shear zones are preferentially localized along lithological contacts with pronounced rheological contrasts, particularly pronounced along the limbs of tightly infolded ultramafic schist against Fig Tree Group metasedimentary rocks. The main ore shoot of the MRC at Fairview shows a steep southeasterly plunge that can be traced for > 2000 m down-plunge, parallel to the fold hinge (F_{3b}) that refolds the Ulundi Syncline. Fabrics and structures in the ore shoot record combined top-to-the NW thrust sense and dextral strike-slip kinematics and strongly constrictional strains interpreted to indicate dextral transpression and associated steep extrusion of the rocks during progressive NW-SE (D_3) shortening. A combination of structural and lithological controls govern ore-shoot formation and gold mineralization. The main ore shoot corresponds to dilational jog geometry that developed during dextral transpression, bedding-parallel shearing consistent with the flexural-slip refolding (F_{3b}) of the Ulundi Syncline. High-grade pockets correlate with sheared, commonly dismembered, graphite-rich and sulfide-mineralized shale units, testifying to the preferential fluid focusing and strain localization into incompetent shale units during deformation. Cross-cutting relationships with other auriferous reefs from the Fairview Mine complex indicate a late timing of the MRC-type mineralization, underlining the complex fluid focusing and utilization of differently orientated structures with different kinematics during progressive deformation and either episodic or protracted fluid flow events.

Keywords Orogenic gold · Barberton Greenstone Belt · Sheba fault · Multiphase timing

Introduction

In over 130 years, gold mining in the Barberton Greenstone Belt (BGB) in South Africa has produced some 350 tons of gold, mainly from the northwestern margin of the supracrustal belt and centered around the Fairview and Sheba mines (Anhaeusser 1976a, b, 1986a; Fig. 1a). This region is underlain by mainly clastic metasedimentary rocks of the Mesoarchean Fig Tree and Moodies groups that are preserved in the two regional-scale Eureka and Ulundi synclines separated by the central Sheba Fault (Ramsay 1963; Anhaeusser 1969; De Ronde and de Wit 1994; Lowe and Byerly 2007; Fig. 1a). Gold mineralization is almost invariably associated with quartz-carbonate-sulfide veins and vein networks and the long mining and exploration history has identified a plethora of gold-mineralized structures, locally referred to as "fractures" or "reefs." Gold-mineralized fractures represent planar or curviplanar, commonly bedding-discordant brittle faults or vein stockworks of mostly limited

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