Economic Geology
Vol 94, 1999, pp. 1305-1328

The Structural Setting and Contact Metamorphism of the Wonga Gold Deposit, Victoria, Australia

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Abstract

Gold quartz vein deposits in the Wonga mine area are fault-related structures, occur in a low-grade, regionally metamorphosed, Cambrian quartz-rich turbidite sequence (Wonga schist) interlayered with mafic volcanics, and postdate a suite of quartz-feldspar porphyry dikes. The nonplanar geometry of these vein deposits can be explained by their location within a shear system as en echelon dilations, in combination with refraction across rheological interfaces within the sediment package. The gold mineralization and related deformation occurred under low- to midgreenschist facies conditions. The intrusion of the Early Devonian Stawell granite, at approximately 400 Ma, has contact metamorphosed the Wonga schist, a preexisting suite of porphyry dikes and the first stage of mineralization. Typically, mineralization and alteration occur in discrete dilational openings as a package of mineralized structures related to a D_4 deformation event and fluid injection. The first stage of gold mineralization and accompanying alteration was deposited in 350°-trending 25° to 50° east-dipping fracture sets within a 320°-trending shear system (Eastern and Western shears), and a 240°-trending 40° to 70° southeast-dipping extensional fracture set (link structures).

Both the Eastern and Western shears are anastomosed high-strain zones, up to 50 m in width, and are connected at a high angle by linking mineralized structures that begin to dominate as the main mineralized lodes persist with depth, where the mineralized link has an east-west trend. The lodes located within the Eastern and Western shear zones are oblique shear veins, whereas the link structures are large-scale tensile fractures in the block between the zones of shear zone-hosted mineralization. These D_4 features initiated in a regional northeast-southwest crustal shortening episode. Subsequent deformation was then accommodated by sinistral oblique slip during a north-south compressional event. The mineralized lodes are locally influenced by a set of northwest-trending, shallow northeast-dipping faults and refracted across the preexisting porphyry dikes.

Postdating the Stawell granite is a second stage of hydrothermal fluid introduction along some northwest-trending, northeast-dipping faults (D_5 event). This fluid flow is focused along the reverse faults and gave rise to local retrogression of peak contact metamorphic assemblages producing local carbonate-sericite alteration and further gold mineralization. Subsequent fluid activity has produced carbonate alteration and/or minor sulfide mineralization that can be related to either the Stawell granite, late fractures, or a suite of lamprophyre dikes.