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# A Thrust Ramp Model for Gold Mineralization at the Archean Trondhjemite-Hosted Tarmoola Deposit: The Importance of Heterogeneous Stress Distributions around Granitoid Contacts

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## Abstract

The trondhjemite-hosted Tarmoola gold deposit is situated in the Leonora district in the Eastern Goldfields province and is the largest granitoid-hosted gold deposit in the Yilgarn craton of Western Australia (>100 t Au). The massive trondhjemite pluton intrudes a northwest-striking, shallowly northeast-dipping, supracrustal sequence that comprises greenschist facies metamorphosed basalt, komatiite, chloritic siltstones, and a volcaniclastic unit. Several east-northeast–striking, quartz diorite dikes cut the trondhjemite and supracrustal sequence. Major ore zones (>1 g/t Au) occur (1) within the trondhjemite as discontinuous west-northwest–striking zones, (2) along the steeply dipping, eastern trondhjemite contact in the supracrustal and trondhjemite rocks, and (3) subparallel to the shallowly dipping, western trondhjemite margin in supracrustal rocks. Ore zones in the trondhjemite are controlled by west-northwest–striking, steeply southwest- and northeast-dipping, conjugate, quartz-carbonate veins that contain minor pyrite, chalcopyrite, sphalerite, galena, gold, and rare scheelite. Gold-bearing veins in supracrustal rocks have a similar vein mineralogy and timing to that of the auriferous veins in trondhjemite.

Deformation at Tarmoola occurred during progressive, regional east-west-directed shortening. The first deformation event ($D_1$) caused early barren, isoclinally folded, quartz-carbonate veins and a pervasive foliation in supracrustal rock to be aligned subparallel to the steeply dipping eastern margin of the pluton. During the gold mineralization event ($D_2$), the trondhjemite pluton acted as a competent body within ductile supracrustal country rocks. Subhorizontal, northwest-southeast shortening caused auriferous conjugate veins in trondhjemite and the reactivation of the eastern contact and a preexisting subparallel foliation in the supracrustal rock. The reverse movement of supracrustal rock along the sheared western trondhjemite contact caused the formation of west-dipping, gold-bearing shear zones in the overlying supracrustal sequence. The reactivation of the eastern trondhjemite contact caused the development of low mean stress zones adjacent to the contact. Hydrothermal ore fluids were focused into these regions to form ore zones. The third deformation event ($D_3$) produced brittle-ductile shear zones, quartz-carbonate veins, and brittle faults that offset lithological contacts and gold-bearing veins.