

Structural History and Timing of Gold Mineralization in the Northern East Strelley Belt, Pilbara Craton, Western Australia

D. E. L. BAKER,[†] P. K. SECCOMBE, AND W. J. COLLINS

School of Geosciences, University of Newcastle, Callaghan, New South Wales 2308, Australia

Abstract

The McPhees and Iron Stirrup deposits, recent gold producers in the Pilbara Craton, Western Australia, are located within a succession of Early to Middle Archean metavolcanic rocks of the northern part of the East Strelley belt. Deformation occurred during five stages (D_1 – D_5), with mineralization late in the tectonic cycle (D_4). D_1 structures only affected rocks below a regional, Early Archean unconformity. D_2 deformation produced a ubiquitous, variably developed S_2 foliation, defined by peak metamorphic minerals. Mineralization is hosted within, but postdates a 100- to 400 m-wide, D_2 high-strain zone of talc-chlorite-carbonate schist (ultramafic protolith) that contains competent boudins of actinolite-chlorite schist (mafic protolith). D_3 deformation produced localized open folds, outlined by lithological layering and S_2 foliation. Regional, open folding, and sinistral shearing of reactivated D_2 structures occurred during D_4 deformation, which controlled synkinematic intrusion of granitic pegmatite at ca. 2880 Ma. At the McPhees deposit, narrow, sinistral, north-northeast-trending D_4 shear zones were conduits for mineralizing fluids, which reacted with, and preferentially mineralized, mafic rocks. Gold occurs in altered schistose wall rock and within veins composed of actinolite, quartz, and pyrrhotite, and minor tourmaline, albite, talc, and magnesite; vein selvages consist of albite and tourmaline. Mineralization at Iron Stirrup was also controlled by north-trending D_4 structures that reactivated D_2 fabrics, and was concentrated at a sheared contact between serpentinite and talc-chlorite \pm carbonate schist. Similar north-trending D_4 shear zones overprint earlier structures and control ca. 2890 Ma gold mineralization nearby in the Mount York gold district, suggesting a single mineralizing event for the entire belt, which is the same age (within analytical error) as granitic pegmatite intrusions. Gold was deposited under amphibolite metamorphic conditions at Mount York and greenschist conditions at Iron Stirrup and McPhees, indicating a decrease in metamorphic conditions away from the western granite-greenstone contact, where granitic pegmatite dikes are abundant. Therefore, mobilization and transport of gold occurred in response to thermal perturbations related to granitic pegmatite dike emplacement during D_4 deformation.