A mineral equilibria study of the hydrothermal alteration at Magdala gold deposit, Stawell, Victoria, Australia.

F.L. ELMER[1] A. L. DUGDALE[1] AND C.J.L. WILSON[1]

[1] School of Earth Sciences, The University of Melbourne, Vic 3010, Australia. Fiona.Elmer@csiro.au

Gold mineralization in the Magdala deposit at Stawell, Victoria, is hosted within an iron-bearing unit (Stawell Facies) adjacent to quartz-rich turbidites (Albion Formation) that envelop tholeiitic basalt lavas (Magdala Basalt). The gold mineralization is surrounded by alteration haloes that extend across all rock types, and alteration assemblages suggest a complex mineral evolution. The Stawell Facies includes the chlorite, muscovite and stilpnomelane alteration zones; the Albion Formation includes the chlorite and muscovite zones; and the Magdala Basalt comprises the ankerite-muscovite and distal zones. The first fluid infiltration event occurred during D_2 deformation, involving a CO_2-bearing fluid to produce carbonate spots thoughout the chlorite zone. The second fluid infiltration event, involving a CO_2, S-bearing fluid, produced the muscovite zone, in which muscovite defines the S_3 clevage, that overprinted the chlorite zone due to dilation within the Central lode during the D_3 deformation event. Textural relationships within the Stawell Facies indicate late growth of albite and compositional zonation of carbonate spots from ankerite in the core, to siderite around the rims, during D_3-$D_{4a\text{-}b}$. The third infiltration event is associated with the main gold mineralisation during D_{4c}. This CO_2-S-Au bearing fluid produced the stilpnomelane zone of the Stawell Facies and the proximal and distal alteration zone within the Magdala Basalt.

Mineral equilibira, calculated using Thermocalc, combined with detailed petrological study of the alteration zones constrain the temperature of formation of the Magdala deposit to T = 345-390°C at 3 kbar. Further, the composition of the mineralizing fluid is constrained to $x(CO_2) <0.08$ at 3 kbar. Calculated internal buffering paths show the impact of a thermal event on the mineral assemblage during D_3-$D_{4a\text{-}b}$,; such a process is consistent with the growth of siderite at this time. Calculations involving minor infiltration of a fluid that is more H_2O-rich than the equilibrium fluid composition of the rock may account for $D_{4a\text{-}b}$ growth of albite within the Stawell Facies. These results impact on the genetic models for orogenic lode gold deposits, as Palaeozoic deposits appear to be associated with fluids that are more H_2O-rich than their Archaean counterparts.