Chemical controls on mineral transport and precipitation in turbidite-hosted gold deposits.

T. P. MERNAGH[1] AND F.P. BIERLEIN[2]

[1] Geoscience Australia, GPO Box 378, Canberra, ACT, 2601, Australia; Terry.Mernagh@ga.gov.au

[2] Centre for Exploration Targeting, School of Earth and Geographical Sciences, The University of Western Australia, Crawley, WA, 6009; fbierlein@tsrc.uwa.edu.au

The HCh chemical modelling software [1] was used to perform mass transfer calculations on a series of models designed to investigate the major chemical controls on mineralisation in turbidite-hosted gold deposits in Phanerozoic metamorphic terranes. Each model simulates a fluid cooling from 350 – 200 ºC at saturated vapour pressure, as it rises through an open vein, and also investigates the predicted host rock alteration assemblage with decreasing fluid:rock ratio (simulating fluid flow from the vein into the host rock).

The first model uses a near neutral pH, CO_2-rich, aqueous fluid with 3 wt.% NaCl (i.e. a typical orogenic gold fluid) as the input fluid. Predicted vein and alteration assemblages are in good agreement to that observed in many Phanerozoic gold deposits. If, however, boiling is prevented by increasing the confining pressure, then the modelling predicts that gold only precipitates at 350 ºC and the vein mineralogy below 275 ºC does not correspond with that commonly observed.

Reducing the concentration of CO_2 in the initial fluid also prevents gold precipitating at temperatures above 240 ºC. Reducing the total concentration of S in the initial fluid also leads to a reduction in the amount of gold precipitated in the vein. As may be expected, no sulphide minerals are predicted to occur in the alteration assemblage from a low total S fluid.

In a model that investigated the effect of redox controls, the log fO_2 of the initial fluid was first increased from -33.5 to -28. The modelling predicts that no gold will be precipitated in the vein at such high fO_2. Lowering the initial log fO_2 to -35.3 also resulted in reduced amounts of gold being precipitated in the vein.

In another model, the initial pH of the fluid was first increased from 5.5 to 8.7. The modelling then predicts the precipitation of calcite and arsenopyite, but no gold, in the vein at high temperatures. Lowering the initial pH of the fluid to 3.5 predicts that gold will precipitate at all temperatures in the vein.

The results are in agreement with the widely accepted premise that gold is transported as bisulphide complexes and they also show that phase separation, pH, and fO_2 changes are important controls on gold precipitation.

References

[1] Shvarov Y. and Bastrakov E. (1999) *AGSO Record* **1999/25,** 60pp.