LEME OPEN FILE REPORT 194

HYDROGEOCHEMISTRY OF THE TUNKILLIA GOLD PROSPECT, SOUTH AUSTRALIA

David J Gray and Mark C Pirlo
August 2005

ABSTRACT

The hydrogeochemistry of the Tunkillia gold prospect in the Gawler Craton of South Australia has been examined as part of a broader regolith and airborne electromagnetic study. Ninety four groundwater samples were collected from exploration drill holes using a bailer system. Field measurements included pH, Eh, EC and temperature. Separate, field preserved sub-samples were collected for cation, anion and alkalinity analyses. A 1 L sub-sample sample, filtered to 0.1 µm, was also collected for determination of Au content. Gold determination was based on pre-concentration onto a 1 g sachet of activated carbon, followed by Neutron Activation Analysis.

The hydrogeochemistry at Tunkillia is generally found to be comparable to that in the Kalgoorlie and Eastern regions of the Yilgarn Craton, with groundwaters dominantly saline and neutral to moderately acid. Groundwater salinity tends to be close to, or slightly below, that of seawater. However, in contrast to Yilgarn groundwaters, Tunkillia groundwaters exhibit a fairly homogeneous salinity. Another characteristic of Tunkillia groundwaters is their relatively high dissolved concentrations of base metals (Mn, Cu, Zn), REE and Y when compared with groundwaters from the Yilgarn.

A Ca enrichment and correlating K depletion is observed in Tunkillia groundwaters, and this may reflect the hydrolysis of Ca feldspars. The dominant lithologies in the area are thought to be felsic, an interpretation supported by minor element compositions (Li, Al, Si, U) when pH effects have been taken into account.

The main mineralised zone (Area 223), exhibits lower groundwater Au concentrations than observed in a secondary mineralised zone (Area 191 North). This might suggest that kinetic barriers are affecting Au dissolution in some parts of the study area. Low groundwater flow rates (ponding) could explain the low variation in groundwater salinity. Furthermore, the mineralisation at various zones in the study area may include different assemblages of sulphide and/or accessory minerals, resulting in differing availability for groundwater dissolution. For example, the Area 191 North mineralisation zone exhibits a clear enrichment in the SO_4/Cl ratio, interpreted as representing SO_4 release via sulphide oxidation. Dissolved Te, V and the saturation indices of Fe oxide minerals all show correlations with mineralised zones.

Interpretation and use of hydrogeochemical data for exploration programs must consider the role that groundwater flow rates are playing on groundwater residence time and in turn the contact time with fresh or weathered rocks.