ABSTRACT

The Fiddlers Flat section is a steep gorge cut into basement rocks and Tertiary sediment cover by the Manuherikia River downstream of Falls Dam in Central Otago, New Zealand. The river section exposes little-metamorphosed Torlesse Terrane sediments and their metamorphic equivalent, the Otago Schist with textural grades I, IIA, IIB and III. Sediments overlying the Miocene unconformity that cut into the basement schist host a famous vertebrate fossil locality.

The project uses field observations, petrography and geochemistry to produce a detailed structural section through the Otago schist margin exposed along the Fiddlers Flat section. This provides a structural setting for the aforementioned Miocene fossil locality and tests the hypothesis that argillite serves as a precursor to gold-bearing schist such as that which hosts the Macraes mine.

The study area is ideal for this, because it contains all the typical structural characteristics of the metamorphosed Torlesse Terrane and provides a section showing a gradual increase in textural zone towards higher metamorphic grade Otago Schist in the SW.

The geochemical composition of pelitic rocks from all textural zones at Fiddlers Flat, compared to unmineralised schist from Macraes and Oturehua, suggests that the unmineralised schist is Torlesse-derived. The geochemical comparison of Fiddlers Flat mineralised pelitic rocks with mineralised schist from Macraes identified some correlation but clearly indicated that Macraes rocks underwent an additional alteration process and/or mineralisation. Furthermore, Fiddlers Flat meta-pelites display two features characteristic of nearby gold-deposits: (1) post-metamorphic ankeritic alteration associated with argillitic material is similar to hydrothermal alteration occurring at Oturehua and (2) the high graphite content is similar to that found in Macraes intrashear schist. However, Macraes graphite is post-metamorphic while graphite at Fiddlers Flat was added pre- or syn-metamorphic and has distinctly higher values (up to 11.91 wt. %).

Observations of changes in the textures and the amount of pyrite and graphite with increasing strain are used to make inferences about possible protolith-hydrothermal fluid interactions.

The results of this study highlight that structural and chemical properties of rocks are important for post-diagenetic Au-mineralisation. These properties include (1) high permeability and (2) graphite enrichment. Two lithologies at Fiddlers Flat have these properties: a sheared TZ IIA meta-pelite and a pyrite-rich TZ IIB meta-pelite. Both lithologies localise graphitisation, sulphidation, ankeritic alteration and tectonic deformation.

The occurrence of graphitised TZ IIA rock and ungraphitised TZ IIA rock within a single complex tectonosome is the first genetic link between lithologies altered by graphite. Argillaceous rocks at Fiddlers Flat are structurally weak and chemically highly reactive and therefore more favourable for hydrothermal alteration than any other lithology observed.

Data presented in this dissertation suggest that the protolith of Macraes mineralised micaceous schist may be genetically related to argillites of the Torlesse Terrane and that a complex interplay of protolith-fluid interaction is necessary in order to precipitate minerals.