Telescopied porphyry Cu-Mo-Au mineralisation, advanced argillic alteration and quartz-sulphide-gold-anhydrite veins in the Thames District, New Zealand

Abstract  Porphyry Cu-Mo-Au mineralisation with associated potassic and phyllic alteration, an advanced argillic alteration cap and epithermal quartz-sulphide-gold-anhydrite veins, are telescopable within a vertical interval of 400–800 m on the northeastern margin of the Thames district, New Zealand. The geological setting is Jurassic greywacke basement overlain by Late Miocene andesitic-dacitic rocks that are extensively altered to propylitic and argillic assemblages. The porphyry Cu-Mo-Au mineralisation is hosted in a dacite porphyry stock and surrounding intrusion breccia. Relicts of a core zone of potassic K-feldspar-magnetite±biotite alteration are overprinted by phyllic quartz-sericite-pyrite or intermediate argillic chlorite-sericite alteration assemblages. Some copper occurs in quartz-magnetite-chlorite-pyrite-chalcopyrite veinlets in the core zone, but the bulk of the copper and the molybdenum are associated with the phyllic alteration as disseminated chalcopyrite and as molybdenite-sericite-carbonate veinlets. The advanced argillic cap has a quartz-alunite-dickite core, which is enveloped by an extensive pyrophyllite-dioptase-dickite-kaolinite assemblage that overlaps with the upper part of the phyllic alteration zone. Later quartz-sphalerite-galena-pyrite-chalcopyrite-gold-anhydrite±carbonate veins occur within and around the margins of the porphyry intrusion, and are associated with widespread illite-carbonate (argillic) alteration. Multiphase fluid inclusions in quartz stockwork veins associated with the potassic alteration trapped a highly saline (50–84 wt% NaCl equiv.) magmatic fluid at high temperatures (450 to >600 °C). These hypersaline brines were probably trapped at a pressure of about 300 bar, corresponding to a depth of 1.2 km under lithostatic conditions. This shallow depth is consistent with textures of the host dacite porphyry and reconstruction of the volcanic stratigraphy. Liquid-rich fluid inclusions in the quartz stockwork veins and quartz phenocrysts trapped a lower salinity (3–20 wt% NaCl equiv.), moderate temperature (300–400 °C) fluid that may have caused the phyllic alteration. Fluid inclusions in the quartz-sphalerite-galena-pyrite-chalcopyrite-gold-anhydrite±carbonate veins trapped dilute (1–3 wt% NaCl equiv.) fluids at 250 to 320 °C, at a minimum depth of 1.0 km under hydrostatic conditions. Oxygen isotopic compositions of the fluids that deposited the quartz stockwork veins fall within the 6 to 10‰ range of magmatic waters, whereas the quartz-sulphide-gold-anhydrite veins have lower δ18Owater values (−0.6 to 0.5‰), reflecting a local meteoric water (−6‰) influence. A δ18O versus δD plot shows a trend from magmatic water in the quartz stockwork veins to a near meteoric water composition in kaolinite from the advanced argillic alteration. Data points for pyrophyllite and the quartz-sulphide-gold-anhydrite veins lie about midway between the magmatic and meteoric water end-member compositions. The spatial association between porphyry Cu-Mo-Au mineralisation, advanced argillic alteration and quartz-sulphide-gold-anhydrite veins suggests that they are all genetically part of the same hydrothermal system. This is consistent with K-Ar dates of 11.6–10.7 Ma for the intrusive porphyry, for alunite in the advanced argillic alteration, and for sericite selvages from quartz-gold veins in the Thames district.

Introduction

A porphyry Cu-Mo-Au prospect was discovered at Ohio Creek, 3 km northwest of the Thames gold bonanza zone (Fig. 1), by Amoco Minerals, and was drill-tested...
Fig. 1 Geological map of the Thames district, Hauraki Goldfield, showing the location of the Ohio Creek porphyry Cu-Mo-Au deposit, Lookout Rocks and the Thames gold bonanza zone. The locations of cross section lines in Fig. 2 are indicated by A-A’ and B-B’. Inset A shows the location of the Thames district and the Hauraki Goldfield on the North Island of New Zealand, and inset B shows the location of some of the epithermal Au-Ag and porphyry copper deposits in the Hauraki Goldfield in 1978 and 1981 by six vertical holes totaling 2,530 m. The holes outlined a zone of low grade Cu-Au (0.12–0.20% Cu, 0.23–0.4 g/t Au) mineralisation, with a vertical extent of greater than 600 m (Merchant 1986). Significant molybdenite was found only in drill hole OCl (grading 0.01% MoS₂ over 300 m) on the eastern margin of the Cu-Au zone (Merchant 1978b).