The Karangahake Epithermal Au-Ag Deposit Hauraki Goldfield, New Zealand: A Telescoped Vein System?

Mark P. Simpson[1*] and Anthony B. Christie[2]

[1]GNS Science-Wairakei Research Centre, 114 Karetoto Road, Taupo 3377, New Zealand
[2]GNS Science, 1 Fairway Drive, Avalon, Lower Hutt 5040, New Zealand

*E-mail, m.simpson@gns.cri.nz

The Karangahake deposit is the third largest Au producer in the Hauraki goldfield with historic production (1882–1944) of 0.95 Moz Au and 3.13 Moz Ag. Additionally, minor Hg was extracted from nearby sinter at Ascot. Both areas are enclosed within a single irregular demagnetized zone, delineated by aeromagnetics, that is 4.2 × 2.7 km in extent (~6 km^2), corresponding to the area of strong hydrothermal alteration and thus the deposit and sinter are likely parts of the same hydrothermal system. The main veins at Karangahake are the N-NE striking Maria and Welcome/Crown, hosted by andesite, with over 90% of Au and Ag mined from the Maria vein that has an exceptional vertical extent exceeding 650 m. A stockwork of thin quartz veins occurs at the summit of Mt Karanghake, within a 200-m-thick cap of rhyolite. Minor sediments with andesite occur to the north at Ascot and Rahu.

Microthermometric measurements have been taken on fluid inclusions trapped in quartz spanning a 600-m vertical interval (544 to -65 m asl) of the Maria vein, and also on quartz and calcite veins in drill core from Ascot and Rahu, revealing a complex thermal history. Outcropping sinter at Ascot is exposed at 135 m asl, approximately 400 m lower than the present summit of Mt Karangahake (544 m asl), and formed from discharging chloride waters (<100°C) at the paleosurface. Within the sinter are cavities lined by quartz crystals that have trapped fluid inclusions with homogenization temperatures (T_h) of 224° to 237°C and salinities of <0.7 wt % NaCl equiv. Assuming entrapment under boiling conditions, these formed below a paleowater at 430 m asl, which suggests subsequent burial by ~300 m of rock (under hydrostatic conditions) or a lake. Fluid inclusions at the adjacent Rahu (T_h 152°–264C°) appear to have formed below a paleowater table of near equivalent elevation (440 m asl). Fluid inclusions in quartz from the Karangahake deposit have a T_h range of 168° to 287°C and they generally increase in temperature with depth and have trapped fluids with salinities typically <1.7 wt % NaCl equiv. Formation depths estimated by best fitting boiling point for depth curves suggest quartz stockwork veins at the summit formed beneath a paleowater table at 900 m asl. However, ~80 % of the fluid inclusion data for the Maria and Welcome veins can be accounted for by a shallower paleowater table at ~600 m asl.

In reconstruction of the hydrologic history, it is possible that many of the veins at Karangahake and the sinter at Ascot formed contemporaneously, but that at a later stage these areas were subsequently buried by ~300 m of rocks or water with additional veins formed at Karangahake (including the stockwork), Rahu, and Ascot. This telescoping event could potentially explain the exceptional >650 m of vertical mineralization at the Karangahake deposit. Further study is required to test this hypothesis and to unravel the thermal, burial, and tectonic settings of these areas, as well as the timing of events.