Alteration in epithermal Au-Ag and geothermal systems in New Zealand: insights for mineral exploration.

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Epithermal Au-Ag veins of the Hauraki Goldfield (12.3 Moz Au, 54.9 Moz Ag) and geothermal systems of the Taupo Volcanic Zone (TVZ) in the North Island, New Zealand, are hosted by rocks that are extensively altered over large distances. Alteration halos surrounding epithermal veins of the Hauraki goldfield cover <10 to 50 km^2 from field mapping and aeromagnetics. Those for geothermal systems, based on resistivity, are of a similar size. Larger halos (>100 km^2) can envelope multiple mineralisation centres or several geothermal systems. For epithermal systems, there is no correlation between the amount of contained Au and extent of the alteration halo.

The rocks in epithermal and geothermal systems are similarly altered; typical hydrothermal minerals include, quartz, adularia, albite, chlorite, illite, mixed layered illite-smectite, smectite, pyrite, calcite, and kaolinite. Minor epidote and zeolites (mordenite, wairakite) occur in many of the geothermal systems, but are seldom identified in epithermal systems. In geothermal systems, the alteration minerals can be related to fluids of known temperature, pressure and composition. Both clays and hydrothermal feldspar are zoned with illite (~230°C) in main reservoir bordered by mixed-layered illite-smectite (230 to 130°C), and marginal smectite (<130°C). Adularia is dominant in the central upflow of the reservoir from 100 to >1,000 m depth and can coexist with albite (~>600 m). Adularia, and coexisting adularia with albite coincide with areas of high measured fluid flow (permeability); whereas, albite without adularia coincides with areas of low measured fluid flow. Identical clay and feldspar zonations are seen for epithermal systems with quartz veins typically contained in adularia and illite altered rocks, although some occur in illite-smectite altered rocks proximal the illite/illite-smectite boundary. Although very rarely found in geothermal systems, rocks at several epithermal deposits are replaced by ammonium (NH_4) minerals (buddingtonite and NH_4-illite) that occurs proximal veins (within 200 m).