

## **The Avebury Nickel Deposit, Tasmania, Australia: Further Insights into the Genesis of a Significant Unconventional Nickel Sulfide Deposit**

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The Avebury Ni deposit comprises a significant Ni resource ( $22 \times 10^6$  tonnes at 0.97 % Ni) that occurs at the contact of an obducted ultramafic sill and the overlying volcanogenic sediments of the Crimson Creek Formation. The Avebury ultramafic is cogenetic with the 510 Ma Heazlewood River Complex, which was formed as a subvolcanic sill by boninitic magmas in an island arc tectonic setting.

The Avebury ultramafic lies within the contact aureole of the ~370 Ma Heemskirk Granite. Much of the mineralization, which is dominated by pentlandite with lesser amounts of pyrrhotite but significant amounts of magnetite, occurs in skarns that replaced the ultramafics or, to a lesser extent, in skarns developed in the volcanogenic sediments. Although the PGE contents of both the host rocks and the mineralization are low, they are similar to sulfide-poor, olivine-rich rocks elsewhere. With the exception of Pd, there are strong to good correlations between Ru, Rh, Ir, and Pt with Cr. The absence of any form of correlation between Ru, Rh, Ir, and Pt with Ni, as well as the low PGE contents of the Avebury Ni sulfides, rules out the possibility that Avebury is a strongly metasomatized magmatic Ni sulfide deposit.

Evidence that fluids from the granite played a major role in the development of the skarns and the mineralization process is provided by highly elevated Bi, As, Sb, Mo, and W in both mineralized and sulfide-poor ultramafic host rocks, as well as strong correlations between some of these elements and Ni. Strong evidence that the granite was also the source of the S is provided by S isotopes, which average  $17.3 \pm 1.1\text{‰}$  for the Avebury mineralization; mineralized samples in the Heemskirk granite average  $9.8 \pm 3.7\text{‰}$ , with the highest value being 15.1‰. Evidence that the Ni mineralization is hydrothermal is provided by strong correlations between Au and Ni as well as between Sb and Ni. The localization of the mineralization adjacent to the contact between the ultramafics and the volcanogenic sediments suggests that the contact was a reaction front.

The absence of any significant Ni depletion in the unmineralized ultramafics suggests that these cannot have been the source of the Ni in the Avebury deposit. On the other hand, the strong correlation between Pd and Ni suggests that both were sourced from (magmatic?) sulfides at depth below Avebury. It is therefore suggested that magmatic Ni-Cu-PGE sulfides lie somewhere at depth within the plumbing system of the Avebury Ni sulfide mineralization.