

## **Discovery of the Pebble Porphyry Cu-Au-Mo Deposit, Southwest Alaska: History and Exploration Methods**

Mark Rebagliati\* and James R. Lang

Hunter Dickinson Inc, Vancouver, British Columbia V6E 4H1, Canada

\*E-mail, MarkRebagliati@hdimining.com

The Pebble deposit, located in southwest Alaska, is one of the largest porphyry deposits ever discovered. Total resources comprise 10.9 billion tonnes that contain 36.88 million tonnes copper, 2.53 million tonnes molybdenum, 3,054 tonnes gold and 14,588 tonnes silver, along with abundant rhenium and, locally, palladium.

Discovery of the mineral endowment at Pebble was not a singular event but spanned more than 20 years. In the mid 1980s, Cominco Alaska targeted the Pebble area for epithermal and intrusion-hosted gold mineralization and, in 1987, Cominco geologists were taken to several color anomalies by a local bush pilot. Rock chip sampling discovered the Sill epithermal vein prospect and a second target of uncertain affinity that was called Pebble Beach. The Pebble target is almost completely concealed by glacial sediments, but soil geochemistry and IP geophysical surveys suggested a porphyry environment; the deposit was discovered in 1989 by drill hole #6, which intersected 80.2 m grading 0.65% Cu and 0.52 g/t Au. In 2000 Cominco estimated an inferred resource of 1 billion tonnes of mostly low grade mineralization.

In the 1990s, Hunter Dickinson and Northern Dynasty Minerals undertook a 5-year review of several hundred porphyry copper prospects in the Americas. The Pebble deposit placed near the top on most criteria and became a high-priority acquisition target. Notably, drill holes averaged only 150 m in depth, 60% and 30% of these ended in mineralization that exceeded 0.30% and 0.60% CuEq, respectively, the inferred resource was already at world-class thresholds for copper (>3 Mt) and gold (>200 t) deposits, and mineralization remained open to depth and in all directions except to the west. After several unsuccessful attempts to strike a deal with Cominco, a change in corporate priorities as Cominco merged with Teck led to an option agreement in 2001.

Northern Dynasty immediately began aggressive exploration led by seasoned geologists supported by a head office that raised funds for eight years of nearly continuous drilling. In 2002, expansion of IP coverage revealed a chargeability anomaly at least 89 km<sup>2</sup> in extent that included numerous highs, the drilling of which led to discovery of several zones of intrusion-related Au and Cu ± Au ± Mo mineralization. Drilling in the Pebble deposit through 2004 expanded the resource to >4 billion tonnes, including a large central zone of higher grades. In spite of low-grade mineralization on the east side of this resource which suggested closure, certain patterns of metals, alteration, veins, and rock types were used to postulate the presence of the high-grade East zone below younger, unmineralized rock types; the East zone was discovered in 2005 by drill hole #327, which intersected 798 m grading 0.87% Cu, 0.70 g/t Au, and 0.028% Mo. The current resource was mostly delineated by 2009.

The Pebble area retains excellent discovery potential. Very high grade mineralization intersected at depth east of the resource has not been pursued. Magnetic, electromagnetic, and IP surveys and novel geochemical techniques including copper isotopes, till studies, and high-resolution aqueous geochemistry have identified numerous exploration targets that remain to be drill tested.