SEG 2017 Conference

Formation of a giant Pleistocene porphyry and skarn Cu-Au deposit in 200, 000 years: Re-Os and U-Pb evidence from OK Tedi, Papua New Guinea

Peter J. Pollard*, Holly Stein, Mark Fanning, Robert Smillie, Oscar Rarua

*Pollard Geological Services Pty. Ltd., The Gap, Australia, Queensland, Email: peter@peterpollard.com

The Pleistocene Ok Tedi Cu-Au deposit is situated in the western part of the Ok Tedi intrusive complex in the Star Mountains of Papua New Guinea. Ok Tedi is the world's youngest giant Cu-Au deposit, with combined historical production and current resources of 9.4 Mt Cu and 868 t Au. Geological mapping and drill core logging have revealed six main intrusive phases in the mine area: Sydney Monzodiorite, Kalgoorlie Monzodiorite, medium-grained monzodiorite, Ningi Quartz Monzonite Porphyry, Bonn Monzonite and Fubilan Quartz Monzonite Porphyry. SHRIMP U-Pb zircon dating indicates the intrusions were emplaced over a period of ca.155, 000 years between the preferred U-Th disequilibrium corrected ages of 1.368 ± 0.045 Ma (Sydney Monzodiorite) and 1.213 ± 0.049 Ma (Fubilan Quartz Monzonite Porphyry).

Four major episodes of Cu-Au mineralization are recognized at Ok Tedi, including the Gold Coast skarn, Siltstone Ridge porphyry system, Fubilan porphyry system, and Taranaki skarn. High-precision Re-Os ages of molybdenite for the first three episodes of mineralization range from 1.3206 ± 0.0020 Ma for the Gold Coast skarn to 1.1297 ± 0.0026 Ma for molybdenite-only veins which are a late component of the Fubilan porphyry system. Each stage of mineralization closely followed an intrusive episode and spanned 10, 000-40, 000 years as recorded by molybdenite ages. The Taranaki skarn appears to be later than the Fubilan porphyry system with a source in the Sulphide Creek area northeast of the mine.

Ok Tedi is one of several porphyry deposits in New Guinea that are localized at the intersection of crustal transfer structures perpendicular to strike and strike-parallel extensional faults that were inverted during Late Miocene-Pliocene orogenesis. These intersections likely provided local extensional sites for magma emplacement during subsequent transpressive deformation. Compared to the 1-5 Ma duration that is common for the magmatic and hydrothermal histories of many major porphyry deposits (e.g. El Salvador, El Teniente, Cadia), the emplacement of multiple intrusions, porphyry systems and skarns at Ok Tedi was very rapid. The nearby Grasberg-Ertsberg district (55.5 Mt Cu and 5055 t Au) also formed over a short time period (~800, 000 years) in the late Pliocene. These shorter time periods of intrusion and mineralization compared to many other systems indicate that size and grade of deposit clusters does not correlate with the time period of their formation.