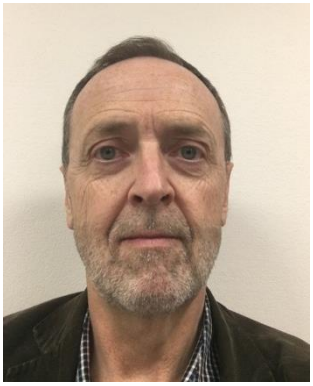
16th SGA BIENNIAL MEETING
KEYNOTE SPEAKER



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Geological evolution of the Lihir gold deposit, Papua New Guinea

The Lihir gold deposit, Papua New Guinea, is the world's largest alkalic low-sulfidation epithermal gold deposit in terms of contained gold (50 Moz). This Pleistocene gold deposit evolved from porphyry to epithermal-style hydrothermal activity over the past million years, with geothermal activity persisting today.

Lihir's early hydrothermal activity produced widespread porphyry-style biotite – anhydrite – pyrite ± K-feldspar ± magnetite alteration, weak gold ± copper mineralization and abundant anhydrite ± carbonate veins and anhydrite ± biotite-cemented breccias. Several hundred thousand years ago, one or more catastrophic mass-wasting events unroofed the Lihir porphyry system after porphyry-stage hydrothermal activity ceased, causing the top of the Luise volcanic edifice to be removed instantaneously. Epithermal mineralization occurred after sector collapse, resulting in phreatic and hydraulic brecciation and veining, widespread adularia – pyrite ± carbonate alteration, and formation of multiple mineralized ore zones that were mostly localized by a network of NE- to ENE-striking faults. Pyrite-rich veins and pyrite-cemented breccias mostly contains refractory gold in pyrite, with minor free gold and precious-metal tellurides hosted in late-stage quartz veins.

A period of diatreme volcanism disrupted the Luise amphitheatre during the latter stages of epithermal mineralization. The diatreme breccia complex has seven identified feeders that were controlled by the same fault array that localized gold mineralization. The diatreme complex truncated several of the epithermal ore zones and was crosscut locally by late-stage epithermal veins.

Recent geothermal activity overprinted a steam-heated clay alteration blanket that overprinted the near-surface refractory sulphide-rich epithermal ores. High-temperature leaching caused gold to be remobilized downward from the steam heated zone into the sulphide zone during argillic and advanced argillic alteration, producing thin gold-rich rims around pyrite grains. This recent steam-heated process produced a high-grade tabular enrichment zone immediately beneath the base of the clay blanket, producing Lihir's erroneously named 'boiling zone'.

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David Cooke is the Director of CODES, the Centre for Ore Deposit and Earth Sciences at the University of Tasmania. He has also been an Associate Editor of Economic Geology since 2001. In collaboration with his students, postdoctoral research fellows and research colleagues, David has been researching hydrothermal and magmatic processes that lead to porphyry copper and epithermal gold ore formation since the mid-1980s. David's team have also been studying geochemical halos to porphyry and epithermal deposits for almost two decades, developing new geochemical exploration tools for the minerals industry, which was recognised with the inaugural AMIRA International Award for Geoscience Research Excellence in 2012. David received the Society of Economic Geologists' Thayer Lindsley lecturer award in 2005, the SEG Silver Medal in 2013, the Australian Academy of Science's Haddon Forrester King Medal in 2018, and was the SEG Distinguished Lecturer in 2021.