Understanding of, and exploration for, porphyry and epithermal deposits: Processes, transitions, and variations

25-26 February 2016
James Cook University, Townsville, Queensland, Australia

Course Leader:
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Course Topics
1) Volcanic-related hydrothermal systems, processes, and porphyry Cu-Au deposits
2) Lithocaps, enargite-Au deposits, and transition to the porphyry environment
3) Geothermal processes and epithermal Au-Ag deposits
4) Epithermal Ag-Au-base metal deposits, and variations

Course Fees

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Registration opens December 2015
To register for this course - https://alumni.jcu.edu.au/EGRU
Contact: egru@jcu.edu.au
Understanding of, and exploration for, porphyry and epithermal deposits: Processes, transitions, and variations

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Course Details
This course reviews the nature of active hydrothermal fluids from intrusion-centered volcanic-hydrothermal and geothermal systems, as well as the processes that occur in these systems and the exploration insight that comes from their understanding. The features of deposits formed in different epithermal environments as well as the transition to the tops of porphyry deposits will be examined, with numerous case studies from around the world. Variations among epithermal deposits, and differences from the end-member (model) characteristics will be discussed, and exploration guidelines highlighted. It is essential to treat every exploration prospect on its own merits, rather than generalizing and missing the mineralized portion of a deposit that does not neatly fit a current, in-vogue model.

Background
Epithermal Au-Ag-Cu and porphyry Cu-Au deposits form largely in volcanic arcs from magmatic-driven hydrothermal systems; they are typically intrusion centered. During the early, potassic stage of formation of porphyry deposits, vapors separate from the dense brine. The vapors may either discharge as volcanic fumaroles or condense near the surface to form acidic (pH ~1) liquid that leaches the rock to form residual quartz and a halo of advanced argillic alteration; if there is a permeable lithology, a lithocap of this alteration may form but it will be barren (<100 ppb Au). During the subsequent phyllic stage of the porphyry, this lower salinity, less dense liquid may ascend to the level of the epithermal lithocap. Cooling of the phyllic-stage liquid, which has an intermediate-sulfidation state, in the lithocap results in an evolution to high-sulfidation state, with sulfosalts such as enargite deposited, accompanied by gold; the white mica that overprints the porphyry grades upward to pyrophyllite ± dickite alteration. Depending on the structural permeability and hydrology of the system, the phyllic-stage liquid may not reach the lithocap but rather ascend along structures in propylitic-altered rock, forming epithermal veins of quartz ± anhydrite ± rhodochrosite at paleodepths to ~1 km, with deposition of silver and gold in variable ratios and intermediate sulfidation-state sulfides with base metals. In some cases, both epithermal settings as well as the deeper porphyry deposit may constitute ore bodies (e.g., Lepanto-Victoria-Far Southeast, Luzon). Gold-rich and sulfide-poor quartz-adularia veins tend to form in the shallow epithermal environment, <300-400 m depth, in back-arc extensional settings. These deposits contain low sulfidation-state sulfides and are distinct from their arc-hosted cousins in vein mineralogy, alteration halos, and geochemical association as well as tectonic setting and volcanic affiliation; although they are also magmatic driven, the magmas are deeper and evidence is less obvious than where magmas intrude to 2-3 km depth to form porphyry deposits in volcanic arc.

About the Presenter
Jeffrey Hedenquist was educated in the USA followed by the University of Auckland, New Zealand, where he received a Ph.D. in 1983. He conducted research with national institutes in the USA, New Zealand, and Japan for 24 years on lunar studies, geothermal energy development, the composition of volcanic discharges, and epithermal and porphyry deposits of the circum-Pacific region, topics on which he has published widely. Since 1999 he has been based in Ottawa, working as an independent consultant to the World Bank Group Mining Department, several government agencies, and the mineral resources industry worldwide, preparing over 300 reports for 85 clients in 28 countries, and providing over 100 training courses for organizations in 24 countries, plus presentation of numerous invited lectures. He is also adjunct professor at the University of Ottawa and James Cook University, and in 2010 was President of the Society of Economic Geologists, a scientific society with over 7000 members in 105 countries.