16th SGA BIENNIAL MEETING
KEYNOTE SPEAKER

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Submarine hydrothermal systems as the shallow parts of porphyry Cu systems: the case for Brothers volcano

The geological record has several examples where sizeable volcanogenic massive sulfide deposits appear to have formed within submarine arc caldera volcanoes, including some that appear to be the shallow expression of porphyry Cu deposits. In 2018, a series of boreholes were drilled by the International Ocean Discovery Program into two active, but distinct hydrothermal systems at Brothers volcano of the Kermadec arc. One is magmatically-influenced and includes the Upper and Lower Cone vent sites that sit atop volcanic cones. The other is seawater-dominated and includes the Upper Caldera, NW Caldera and West Caldera vent sites, each perched on the inner caldera walls. The NW Caldera site strikes for ~600 m in a SW-NE direction where numerous active and inactive chimneys occur over a ~145 m depth interval, between ~1,690 and 1,545 mbsl. Faulting has exposed an anastomosing network of metal-rich stockwork veins that occur beneath the chimneys. These veins contain up to 10.1 wt.% Cu, 5320 ppm Zn, 3580 ppm As, 740 ppm Co, 467 ppm Mo, 296 ppm Pb, >90 ppm Se, >40 ppm Te, 40 ppm Bi, 37 ppm Sb, 16 ppm Ag, 12 ppm In, >11 ppm Tl and 1.9 ppm Au. Drilling shows hydrothermal alteration of the host dacitic volcaniclastics and lavas reflects primary lithological porosity and contrasting spatial and temporal contributions of magmatic fluid, hydrothermal fluid, and seawater. Initial hydrothermal activity, prior to caldera formation, is dominated by magmatic gases and hypersaline brines. The former mix with seawater as they ascend towards the seafloor, and the latter remain sequestered in the subsurface. Following caldera collapse, seawater infiltrates the volcano through fault-controlled permeability, interacting with wall rock and the segregated brines, transporting associated metals towards the seafloor and forming present-day Cu-Zn-Au-rich chimneys. Such a two-step process exposes metals that may be associated with a deeper porphyry Cu system.

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Cornel de Ronde is a principal scientist at GNS Science (Lower Hutt). Since 1997, Cornel has led a sustained GNS Science research programme to discover and understand submarine volcanism and hydrothermal venting along the Kermadec section of the Pacific Ring of Fire, northeast of New Zealand. This frontier research includes exploring active submarine volcanoes and their seafloor hot springs using surface ships, remotely operated vehicles, autonomous underwater vehicles, manned submersibles and drilling by IODP. More recently, he has also been interested in various shallow water surveys of geothermal systems in lakes of the Taupo Volcanic Zone. He is internationally recognised for this work and is in high demand as a speaker at a wide variety of forums from scientific conferences to special interest groups and schools. His awards include: ‘best paper’ for Economic Geology (2005 and 2014) and Mineralium Deposita (2011-12); Society of Economic Geologists’ Distinguished Lecturer Award (2008); Prime Minister’s Science Media Communication Prize (2010); AusIMM Distinguished Lecturer (2014); SEG Honorary Lecturer (since 2014); Joubin James Award, University of Toronto (2017); and Excellence Professorship Award, Werner Petersen Foundation, Germany (2019).