Cu-Co-Au mineralisation in the Pilbara Craton during the Mesoarchean

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The majority of the world's cobalt (Co) is sourced from sediment-hosted copper (Cu) deposits that formed from the Proterozoic onward (<2500 Mya) through Earth history [1]. This is because the oxygenation state of the atmosphere imparts a critical control on the genesis of these deposits as the mobility of Cu and Co in these mineral systems is controlled by oxidative conditions. Consequently, much of the exploration for Co deposits is limited to Proterozoic or younger terranes. Here we present findings on the genesis of a newly-discovered Cu-Co-Au deposit in the Archean Pilbara Craton of Western Australia. This deposit, named *Carlow Castle* is a geologically complex and economically significant system of Cu-Co-Au mineralisation with an inferred resource estimate of 7.7 Mt @ 1.06g/t Au, 0.51% Cu, and 0.08% Co [2]. Our analysis suggests that *Carlow Castle* is most likely an orogenic Au deposit, however the unusual enrichment in Co and Cu gives it a uniquely sedimentary metal association. The occurrence of this unique Cu-Co-Au metal association within orogenic Au suggests the mineral system had a unique metal source relative to other orogenic Au systems; with a potentially remobilised sedimentary component. The discovery of this deposit also implies that there is potential for hitherto unknown Co mineralisation in Archean terranes, which formed prior to the widespread oxygenation of the atmosphere at ~2.4 billion years ago. These findings bear important implications for Co exploration, which is particularly pertinent due to the emerging status of Co as a critical battery metal. Furthermore, the hypothetical existence of Archean sedimentary Cu-Co deposits would add to the growing evidence for transient oxygen-rich environments in the Archean [3,4].

[1] Hitzman, Selley, and Bull (2010), *Economic Geology* 105, 627-639. [2] Artemis Resources Ltd. (2019), ASX: www.asx.com.au/asx/statistics/announcements.do?by=asxCode&asxCode=ARV&timeframe=Y&year=2019. [3] Wang, et al. (2018), *Geochimica et Cosmochimica Acta* 238, 438-452. [4] Plavansky, et al. (2014), *Nature Geoscience* 7, 283-286.