Formation and Destruction of IOCG-Type Mineralization in the Olympic Dam District

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The Olympic Dam district is a belt of Cu-enriched basement of the Gawler Craton, South Australia. Mesoproterozoic and older crystalline basement of the district is covered by thick succession of Neoproterozoic, Cambrian, and younger sedimentary basin rocks, known as the Stuart Shelf. The district is host to a giant Olympic Dam IOCG deposit and a few smaller economic to subeconomic IOCG deposits and prospects. One of them is the Emmie Bluff Fe-oxide deposit, in which the Fe-oxide unit is ca. 150 m thick and is located at a depth of approximately 800 m. Emmie Bluff is different from other prospects in that the mineralization is hosted in metasedimentary rocks. The main focus of previously published research within the Olympic Dam district has been the Olympic Dam deposit itself, and some other IOCG prospects such as Prominent Hill, Oak Dam, Wirrda Well, and Acropolis.

At Emmie Bluff, subeconomic Cu-Au mineralzation is associated with the hematite-chlorite-sericite alteration with chalcopyrite commonly replacing preexisting pyrite. With the use of cutting-edge Synchrotron X-ray Fluorescence Microscopy and Field Emission Gun Scanning Electron Microscopy, it was shown for the first time that subeconomic IOCG mineralization in the Olympic Dam district was affected by a late fluid event, which resulted in partial dissolution of Cu mineralisation and transport of Cu in the form of chloride complexes. The porous chlorite-sericite matrix associated with the late alteration of chalcopyrite hosts a Cu-Cl-OH phase previously undescribed in IOCG rocks, which was identified to be atacamite, $Cu_2Cl(OH)_3$. Thermodynamic modelling shows that atacamite is produced during dissolution of chalcopyrite by an oxidized Cl-bearing fluid. An acidic environemnt is produced within millimeters of the chalcopyrite grains during oxidation. This process drives chlorite recrystallization that is recorded by compositional variation of chlorite proximal to chalcopyrite. This suggests Cu removal from the system and has implications for a mineralization preservation vs. destruction and remobilization.