Linking the Nature and Timing of Diagenesis of Source Rocks with Hydrocarbon Migration and Copper Mineralisation Events in the Neuquén Super Basin, Argentina

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The Mesozoic Neuquén Super Basin in Argentina, with up to 6km thickness of clastic sediments, contains more than 800 million m^3 of hydrocarbon reserves as well as sediment-hosted copper occurrences in altered sandstones. Known metal deposits each contain between 10^3 and 10^6 tonnes of metal at grades ~0.3% Cu with V credits. Previous work has established that early diagenesis of synorogenic sedimentary rocks (Cenomanian Santonian age) is followed by a protracted hydrocarbon migration event (upper Cretaceous to Middle Tertiary) that is closely followed and partially overlaps with mineralization events (Middle-Late Tertiary) resulting in deposition of sulfides dominated by chalcocite and minor bornite and chalcopyrite.

In this new study, novel U-Pb dating methods have been applied to three calcite generations from synorogenic red beds that indicate early diagenesis between 100-94 Ma, hydrocarbon migration 76-55 Ma, and mineralization at around 28 Ma. This supports the previous model of hydrocarbon migration promoting redbed bleaching and secondary porosity formation followed by a second event bringing copper-rich brines into sandstones impregnated with bitumen. To integrate basin development, metallogenic, and hydrocarbon histories, a range of potential metal source rocks were collected across the basin and studied using a range of analytical techniques, complimented by preliminary laboratory leaching experiments applied to bulk samples. A programme of Pb isotope analysis is now underway on a range of sediments, leachates, and sulfides to confirm the likely source rocks for the metals in the deposits. Preliminary mass balance work measuring the volumes of potential source rocks versus the known basin occurrences will be presented in an assessment of the potential for further undiscovered deposits.

We will discuss the likely origins of the copper, probable pathways, and depositional history for the copper mineralization with reference to the primary metal sources for the coatings and matrix cements from the sedimentary source regions.