Multiple sources of metals in seafloor hydrothermal FeMn deposits: A case study at Utu'Uli, Pacific Ocean

E. PELLETER[1], O. ROUXEL[1], Y. FOUQUET[1], P. JOSSO[1], Y. GERMAIN[1], S. CHERON[1], J. ETOUBLEAU[1] AND SCIENTIFIC PARTIES

[1]Ifremer c/Brest, Laboratoire de Géochimie et Métallogénie, F-29280, Plouzané, France

The Utu'Uli Mn(-Ni) deposit, discovered in 2010, is a unique deposit showing large nickel enrichment surpassing those reported for hydrogenetic Fe-Mn crusts and polymetallic nodules. The Mn-Fe-Si mineralization covers a surface area of approximately 1.5 km^2 and is composed of (from surface to depth): (i) dense and layered hydrothermal Mn crusts, (ii) Mn oxhydroxides impregnations with variable amount of Fe oxhydroxides and yellow nontronite, (iii) Fe oxyhydroxides with yellow nontronite and (iv) green nontronite. Even though nickel is anomalous in nontronite (up to 382 ppm), the most enriched samples (up to 5.3 wt.% Ni) are those with the highest manganese concentrations. Investigation of rare earth elements (REE) composition of hydrothermal precipitates points to (i) a seawater REE source between 0-45cm below seafloor (bsf) and (ii) a pore water REE source i.e. modified seawater below 45 cm bsf.

We performed coupled nickel, copper and zinc isotopic analyses at Ifremer on a Neptune MC-ICP-MS using previously reported methods. Samples analyzed encompass a wide range of mineralogical and geochemical types from pure Mn oxide to nearly pure Fe-Si precipitates. Results show that (1) Ni isotopes, and to a lesser extent Zn and Cu isotopes are fractionated during their incorporation into Mn minerals (essentially birnessite) and (2) seawater provides a significant source of Zn, Ni and Cu to the Mn-rich deposits exposed at the seafloor, consistent with REE composition. We therefore propose that the exceptional enrichment of nickel in hydrothermal Mn-Fe-Si deposits results from the continuous scavenging of nickel onto crystalline hydrothermal Mn-oxides and is derived from both low-temperature hydrothermal fluid (i.e. lacking H_2S) leaching the substrate rocks and from seawater circulating through the porous structure of the deposit.