

Critical metals in polymetallic nodules from the eastern equatorial pacific

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Polymetallic nodules are Mn, Fe-rich concretions found on the ocean floor. These deposits are enriched (relative to the Earth's crust) in important economic metals such as Mn, Ni, Cu, Mo and have also gained a renewed attention as a source for the so-called critical metals such as Co and the Rare Earth Elements plus Yttrium (REY). These metals are increasingly becoming important in the green and high tech industry and polymetallic nodules are seen as a potential source for these metals in the future. Our project involves the geochemical investigation of nodules from the UK claim area located in the eastern equatorial pacific between the Clarion and Clipperton fracture zones. Bulk geochemical analysis shows that the nodules formed from both hydrogenetic (precipitation from bottom oxic seawater) and diagenetic (precipitation from oxic/suboxic sediment porewaters) processes. Bulk analysis revealed high contents of Mn (29%), Ni (1.3%), Cu (1.0%), Co (0.17%) and REY (700 – 800 ppm). Analysis of (micro-drilled) individual layers in three nodule samples using ICP-MS shows that REYs are more enriched in the hydrogenetic layers (up to 1200 ppm) compared to the diagenetic layers (up to 600 ppm). Similarly, Co is also concentrated in the hydrogenetic layers, while Ni and Cu are distributed in the diagenetic layers. Mineralogical analysis using XRD shows the 10Å and 7Å phyllosulfates as the dominant mineral phases in the nodules. Simple leaching experiments using weak inorganic and organic acids revealed that ~60% of REYs are hosted in the phyllosulfate phase while less than 7% are hosted in the amorphous FeOOH phase.