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Hydrogenetic, Diagenetic and Hydrothermal Processes Forming Ferromanganese Crusts in the Canary Island Seamounts and Their Influence in the Metal Recovery Rate with Hydrometallurgical Methods

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Abstract: Four pure hydrogenetic, mixed hydrogenetic-diagenetic and hydrogenetic-hydrothermal Fe-Mn Crusts from the Canary Islands Seamount Province have been studied by Micro X-Ray Diffraction, Raman and Fourier-transform infrared spectroscopy together with high resolution Electron Probe Micro Analyzer and Laser Ablation Inductively Coupled Plasma Mass Spectrometry in order to find the correlation of mineralogy and geochemistry with the three genetic processes and their influence in the metal recovery rate using an hydrometallurgical method. The main mineralogy and geochemistry affect the contents of the different critical metals, diagenetic influenced crusts show high Ni and Cu (up to 6 and 2 wt. %, respectively) (and less Co and REY) enriched in very bright laminae. Hydrogenetic crusts on the contrary show High Co and REY (up to 1 and 0.5 wt. %) with also high contents of Ni, Mo and V (average 2500, 600 and 1300 μg/g). Finally, the hydrothermal microlayers from crust 107-11H show their enrichment in Fe (up to 50 wt. %) and depletion in almost all the critical elements. One hydrometallurgical method has been used in Canary Islands Seamount Province crusts in order to quantify the recovery rate of valuable elements in all the studied crusts except the 107-11H, whose hydrothermal critical metals' poor lamina were too thin to separate from the whole crust. Digestion treatment with hydrochloric acid and ethanol show a high recovery rate for Mn (between 75% and 81%) with respect to Fe (49% to 58%). The total recovery rate on valuable elements (Co, Ni, Cu, V, Mo and rare earth elements plus yttrium (REY)) for the studied crusts range between 67 and 92% with the best results for Co, Ni and V (up to 80%). The genetic process and the associated mineralogy seem to influence the recovery rate. Mixed diagenetic/hydrogenetic crust show the lower recovery rate for Mn (75%) and Ni (52.5%) both enriched in diagenetic minerals (respectively up to 40 wt. % and up to 6 wt. %). On the other hand, the presence of high contents of undigested Fe minerals (i.e., Mn-feroxyhyte) in hydrogenetic crusts give back low recovery rate for Co (63%) and Mo (42%). Finally, REY as by-product elements, are enriched in the hydrometallurgical solution with a recovery rate of 70–90% for all the studied crusts.