Evaluation of the presence and spatial distribution of critical raw materials in the Cauquenes porphyry copper tailing

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Cauquenes is a porphyry copper tailing impoundment operated from 1936 to 1975 and is located at 725 m of altitude in the central valley of Chile, with a surface of 640 ha, 12 km southeast of Rancagua.

Currently, the extraction of Cu and Mo from Cauquenes, by the company "Minera Valle Central" (MVC), is economically feasible. However, there is a significant gap of information about the presence of critical elements, the minerals hosting them, and their potential as subproducts. Detailed 3D mineralogical and chemical distribution models of the tailing impoundment are lacking. The present research was designed to: 1) elucidate the presence of critical elements/ minerals aside from Cu and Mo, 2) study the spatial distribution of elements and minerals in the impoundment and, 3) improve the current mining plan.

To achieve these goals, five boreholes with depths around 30 m each were drilled, distributed in different areas of the deposit. The samples were mineralogically characterized using XRD, SEM and QEMSCAN analyses. Also, a partial digestion of the samples with aqua regia modified to the ratio 1:1:1 HNO_3:HCl:H_2O was made to determine major and trace elements by ICP-MS and ICP-OES.

The geochemical and mineral characterization in the impoundment indicates that the concentrations of critical elements/ minerals that may represent potential subproducts are under the global economically exploitable values using standard technologies or as stand-alone products.. From a spatial distribution perspective the elements and minerals in the impoundment are quite homogeneous, yet some metallic elements (among these Cu) in heavy minerals tend to concentrate preferentially at certain depths, mainly below the oxidation zone and towards the deepest areas of the deposit. These trends are also related with the textural variations in the impoundment (intercalations of fine sand and clay loam horizons) and the climatic conditions of the study area. These results indicate that the relative spatial homogeneity of the elements and minerals in the impoundment simplifies metal recovery strategies with respect to stratified deposits. However, it is possible to further improve the efficiency of the current mining plan, delimiting the areas where Cu enrichment is present, and evaluating potential subproducts that may be recovered by means of development of new metallurgical technologies. This study was funded by project CORFO 16PTECME66524.