Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29440

Mineralogical phase transformations in thermally treated fine grain mining wastes

MANUEL RUIZ-RODRIGUEZ, **MANUEL ANTONIO CARABALLO**, ANTONIO JESÚS DIOSDADO-ARAGON AND MARIA JOSÉ MARTIN-ALFONSO

University of Huelva

Mine tailings (MTs) are by far the main fine grain mining wastes worldwide. However, some other fine grain wastes can have a significant presence, like filtration sludges from acid mine drainage (AMD) treatment plants, ashes from pyrometallurgy furnaces or sludges from electrowinning plants, to mention a few. This type of residues have in common: a very small grain size, (typically from 1 mm to 10 mm), a high surface area and a high chemical reactivity. They exhibit a wide variety of mineral signatures that are mainly controlled by the initial mineralogy of the ore deposit, and by the processing technology used. Cementation of these wastes using Ordinary Portland Cement (OPC) or other alkaline binders, is a common practice in mine galleries backfilling, where pastes are made by mixing MTs, OPC and water. Many studies have shown that a thermal pre-treatment can improve the pozzolanic activity of these wastes and, as a result, enhance their cementation ability (allowing a reduction on OPC used). However, the knowledge about the specific mineralogical transformations induced after the thermal pretreatment is poor.

Two mine tailings (from IOCG and massive sulfide stockwork) and one AMD filtration sludge were initially characterized by XRD, total digestion + ICP-OES and thermogravimetry (100 to 1000 ºC), followed by a muffle thermal treatment at different temperatures (defined by the initial thermogravimetry) and times (5-10-15-30-60-90-120 minutes) and XRD characterization of the end products.

AMD treatment sludge confirmed the presence of gypsum and its thermal transformation to basanite $CaSO_4$. $1/2H_2O$ at 150-200ºC and to anhydrite ($CaSO_4$) at 800-950ºC.

Massive sulfide stockwork MTs were initially comprised by quartz (51wt%), chlorite (41wt%) and gypsum (8wt%). At 650ºC chlorite transform into montmorillonite to finally disappear at 800ºC.

IOCG MTs had clinochlore (41wt%), quartz (18wt%), calcite (14wt%), microcline (10wt%), albite (5wt%), gypsum (5wt%) and magnetite (2.5wt%). At 650ºC clinochlore transforms to montmorillonite (to disappear at 800ºC) and gypsum to anhydrite while calcite transforms to portlandite at 800ºC.

Pozzolanic activities of the thermally treated wastes are not available at the time of writing this abstract but will be presented at the Conference.