CHARACTERIZATION OF SULPHATE INTERACTIONS WITH HEMATITE MINERALS USING XANES

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Sulphur bearing hematite is a product of some novel hydrometallurgical sphalerite treatments. Leaching tests aimed at investigating the stability of the hematitic leach residue have shown that only a fraction of the sulphur present is removed. In this study sulphur bearing hematites were leached in a variety of media and examined using XANES Sulphur K-edge and L-edge spectroscopy at the Canadian Synchrotron Radiation Facility, SRC-Madison, WI, to address questions regarding the chemical environment, oxidation state and physical distribution (surficial versus intercrystalline) of the sulphur within the hematite minerals. XANES S K-edge FY and TEY and L-edge TEY spectra indicate that the sulphur predominantly occurs as sulphate having a formal oxidation state of $S^{6+}$ and is largely distributed within the hematite matrix at concentrations between approximately 0.04 and 4.7 %. The XANES S K- and L-edge absorption spectra have also been used to assess the effectiveness of leach treatments employing HNO$_3$ and NH$_4$OH solutions for the removal of sulphate from the hematite minerals. Here, the spectra indicate that a 0.05M HNO$_3$ solution was largely ineffective at removal of surficial and intercrystalline sulphate whereas 1 to 4M NH$_4$OH leach solutions appear to have variably removed sulphate from the uppermost regions (5 to 30 nm depth) of the hematite minerals. Overall integration of the XANES S K-edge and L-edge TEY and FY spectra provides both unique information regarding the distribution of sulphate within the hematite matrix and a means to evaluate the effectiveness of leach processes used to remove sulphate from hematite minerals.