The occurrence of newly formed minerals in acidic environment and dry-arid climate, case study: low-grade dump of Miduk copper mine

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Abstract: Newly minerals could be formed as a result of oxidation, hydrolysis, precipitation and dehydration processes in acid mine drainage (AMD) environment. The occurrence of secondary minerals within the dump No. 7 from Miduk copper mine was studied using mineralogical approaches including X-ray diffraction (XRD), Scanning Electron Microscope (SEM-EDS) and Raman Spectroscopy (RS). Geochemical invetigations, including saturation index and speciation, were conducted on pore water of the dump which simulated from paste pH test. Acidic pH value (ranges from 1.47 to 4.23), a high concentration of $\text{SO}_4^{2-}$ (ranges from 3.95 to 286 g/L) and a high level of Fe (varies from 120.9 to 70860 mg/L) of the waste leached indicate that sulphide oxidation especially pyrite occurs within the dump. Complex $\text{FeSO}_4^{2+}$ was dominant species of ferric iron in the leached solution phase. According to mineralogical and geochemical studies, newly formed minerals including coquimbite, ferricopiapite, plumbojarosite, rozenite, alunogen and brochantite were identified within the dump. Retention of As, Pb and Cu by iron sulphate, especially coquimbite, were confirmed in the dump. The results of the present study could be employed to develop a comprehensive environmental management program at the mining sites.

Keywords: newly formed minerals; pyrite oxidation; iron sulphate; Raman Spectroscopy; copper low-grade dump.