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Environmental Geochemistry of Near-Neutral Waters and Mineralogy of Zinc and Lead at the Angouran Non-Sulphide Zinc Mine, NW Iran

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Abstract

This study aims to investigate the geochemistry of major ions, trace and rare earth elements (REE) near the Angouran Zn-Pb mine. Thermodynamic modelling and saturation indices were computed using PHREEQC. Process and tailings water samples of the Calcimin processing plant were near neutral (pH=5.8-7.9) and had high concentrations of SO_4 (1179-15000 mg/L), Zn up to 18529 mg/L, Pb up to 1780 µg/L, As up to 465 µg/L and Cd up to 230 µg/L. Water of the Angouran pit was neutral-alkaline (pH=7.6-8.25) with low concentrations of SO_4 (21-87 mg/L), elevated concentration of Zn up to 27 mg/L, Pb up to 586.3 µg/L and Cd up to 33 µg/L. Water flowing out of the Angouran mine adit was neutral-alkaline (pH=7.5-8.05) with variable SO_4 content (30-2294 mg/L), Zn content up to 8 mg/L, Pb up to 123 µg/L and As up to 35.4 µg/L. Elements As, Pb, Cd, Ni and Zn concentrations in the plant waters were higher than USEPA effluents limits. Generally, the types of water in the plant and the mine ranged from Zn-SO_4,