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Strong Metal Anomalies in Stream Sediments from Semiarid Watersheds in Northern Chile: When Geological and Structural Analyses Contribute to Understanding Environmental Disturbances

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Abstract

We present data from a reconnaissance geochemical environmental survey (stream sediments) in the Limarí watershed (northern Chile), and include information from the neighboring Elqui Basin for a combined analysis. Given that the region has a long historical record of mining activities, important environmental disturbances were expected. However, one of the rivers in the Limarí watershed that was chosen to serve as a baseline, as no mining activities had ever taken place along the valley, showed one of the largest geochemical anomalies. The sampled stream sediments of the Hurtado River are highly enriched in Cu (50–1,880 μg g^{-1}), Zn (65–6,580 μg g^{-1}), and Cd (130–31,350 ng g^{-1}). The river system is sourced in the high-altitude domain of the Andes, and drains important Miocene hydrothermal alteration zones. The Coipita zone (El Indio gold belt) appears to be the most likely candidate to have originated the metal anomaly. The study of Landsat images suggests that the belt of alteration zones is located within a large (400+ km long, ~150 km wide) NW-SE dextral fault zone. This highly fractured domain may have conditioned the rapid unroofing of epithermal ore deposits in Miocene time, contributed to important circulation of meteoric waters, and eventually, to subsequent strong oxidation, leaching, and dispersion of metals, thus contributing to major metal dispersion in the Elqui and Limarí fluvial systems.

Introduction

THE LATE 1980S–1990S marked a major change in the emphasis and aims of geochemical surveys. While previously (1960s–1970s) the surveys were aimed at the detection of ore deposits, at present the characterization of metal environmental disturbances is becoming the centerpiece of many of these studies. However, the study of metal anomalies is much more than sampling, analyzing sediments or waters, and treating the data with sophisticated statistical tools. Metal dispersion is, above all, a geological process, and as such, it requires a careful analysis of the many factors (e.g., the geological, structural, and metallogenic settings, mineralogy, landscape, climate) controlling metal mobility. On top of this, we must add (if present) the type of mining (open pit, underground) and metallurgical (smelter, heap leaching, mineral dumps, tailings) operations taking place in the area under study.

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