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Environmental assessment of copper–gold–mercury mining in the Andacollo and Punitaqui districts, northern Chile

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Abstract

The Coquimbo region has been one of the richest producers of Cu, Au and Hg in Chile, and some of the deposits have been mined almost continuously since the 16th century. To assess the potential environmental contamination in this region, the authors measured the concentration of Cu, As, Cd, Zn and Hg in samples of stream and mine waters, stream sediments, soils, flotation tailings, and mine wastes in the Andacollo (Cu, Au, Hg) and Punitaqui (Cu–Au, Hg) districts. The concentration of Hg in the atmosphere in these districts were also measured. Although contamination is strongly controlled by the ore in each district, metal dispersion is modified by the degree of metallurgical processing efficiency as shown by the outdated Cu flotation system at Andacollo (stream sediments Cu 75–2200 μg/g). Conversely, more efficient procedures at Punitaqui resulted in less stream contamination, where stream sediments contained Cu ranging from 110–260 μg/g. However, efficient concentration by flotation of a given metal (e.g. Cu) may lead to the loss of another (e.g. Hg up to 190 μg/g in the tailings at Punitaqui), and therefore, to contamination via erosion of the tailings (downstream sediments Hg concentrations up to 5.3 μg/g). Continued use of Hg for Au amalgamation at Andacollo has led to significant contamination in stream sediments (0.2–3.8 μg/g Hg) and soils (2.4–47 μg/g Hg). Communities in this region are underdeveloped, and decades of inefficient treatment of flotation tailings and waste-rock stock piles has resulted in significant contamination of the surrounding landscape.

1. Introduction

The Coquimbo region is located in the northern part of Chile and is one of the richest in terms of mineral deposits and mining activity (Fig. 1). The mineral deposits are not only important in number or size, but also in terms of historical significance. Some of them have been almost continuously exploited for Cu, Au and Hg since the Spanish Colonial time (16th to 18th century), for example, Andacollo and Punitaqui (Fig. 1; Table 1). The Coquimbo region has a long record of mining-related environmental disturbances primarily as a result of runoff and downstream dispersion. Since the second

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