

Size fractionation in mercury-bearing airborne particles (HgPM₁₀) at Almadén, Spain: Implications for inhalation hazards around old mines

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Abstract

Almadén has a >2000y mining history and an unprecedented legacy of mercury contamination. Resuspended airborne particles were extracted from mine waste (Las Cuevas), retort site soil (Almadenejos), and urban car park dust (Almadén), separated into fine (PM₁₀) and coarse (PM_{>10µm}) fractions, analysed for mercury using ICP-MS, and individual HgPM characterised using SEM. Cold extractable mercury concentrations in PM₁₀ range from 100 to 150 µg g⁻¹ (car parks), to nearly 6000 µg g⁻¹ (mine waste), reaching a world record of 95,000 µg g⁻¹ above the abandoned retort at Almadenejos where ultrafine HgPM have pervaded the brickwork and soil and entered the food chain: edible wild asparagus stem material from here contains 35–65 µg g⁻¹ Hg, and pig hair from animals living, inhaling and ingesting HgPM₁₀ at the site yielded 8–10 µg g⁻¹. The PM₁₀ fraction (dusts easily wind transported and deeply inhaled) contains much more mercury than the coarser fraction. The contribution of HgPM₁₀ to ecosystem contamination and potential human health effects around old mercury mines has been underestimated.

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1. Introduction

The Almadén area, 285 km south of Madrid in south-central Spain (Fig. 1), has supplied more than one-third of all mercury ever mined and refined by humans (Saupé, 1990; Ferrara et al., 1998; Higuera et al., 2003). This is the largest point source of mercury in the world,

as illustrated by the fact that 90% of all dental amalgam used in the European community was mined here (Wilman, 2004). Primary ore has been extracted from both underground and open-cast mines, and processed locally to produce a huge quantity of the liquid metal: an estimated 8 million flasks (250,000 tonnes). Mining at Almadén has now ceased, but the unprecedentedly long history of mining and processing has left a spectacular legacy of contamination that poses a health threat to the current population and to the local ecosystem (Higuera et al., 2005). Studies have recently been published on

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