

## **Contaminant-bearing minerals and related elements of the Northern Atacama Region, Chile**

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The Northern Atacama Region has historically been affected by mining activities since the beginning of the 20th century. In this area there are 4 hydrologic systems, 3 of which are in the Andes (Pedernales, Maricunga, Laguna Verde) and 1 of which is on the coast (El Salado). In particular, El Salado River has been impacted by mine tailing contamination for over 40 years [1]. With the purpose of determining the main contaminants and contaminant-bearing minerals, a three year long survey and subsequent analysis has been carried out.

Element quantification was performed in previously dried and sieved (<63 µm) sediments digested in aqua regia. Quantification was performed by ICP-MS in the Helmholtz Centre for Environmental Research (Germany). Modal mineralogy was determined through X-ray diffraction (XRD) and QEMSCAN. Contaminant-bearing minerals were identified by QEMSCAN and SEM. Mineral sources were determined by a magnifying glass and thin sections of the coarse fragments (> 2mm).

Lithologies found in the Andes Mountains correspond to intrusive and volcanic rocks. El Salado Alto is constituted by variable lithologies and El Salado Bajo is mainly characterized by sedimentary rocks. Mineralogies found in the Andes correspond to quartz, calcite, and feldspar. In El Salado Alto, quartz, feldspar, calcite, and mica are found while in El Salado Bajo, quartz, feldspar, and calcite are present. Sediments are contaminated with Cu, Sb, and Mo and are naturally enriched in As, Cd, and Li. For As and Cu, contaminant-bearing minerals were clearly determined in contrast to other contaminant elements.

In the Andes Mountains, As is hosted by undetermined and highly soluble silicates (Pedernales) [2]. In the inlet of the El Salado River, contaminant minerals correspond to As-bearing silicates and As>Cu-bearing silicates. In areas with intense mining activities, Cu and As are hosted by iron oxides (Cu>As), As sulfides (tennantite), and Cu-As silicates. Through magnetic separation it was determined at these sites that As is also associated with magnetite and is adsorbed to mineraloids that are located on the surface of magnetites. In the El Salado Bajo basin, As hosted by silicates (and likely allanite) is present at the outlet of the El Salado River.

[1]Castilla, 1996. Environmental Monitoring and Assessment 40:171-184. [2] Tapia et al. 2016. Arsenic Research and Global Sustainability, 207-208