

RESEARCH ARTICLE

Bacterial and fungal diversity in the lorandite (TlAsS₂) mine 'Allchar' in the Republic of North Macedonia

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One sentence summary: This study identifies newly described As- and Tl-tolerant bacteria and fungi with potential for use in bioremediation strategies.

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ABSTRACT

The Allchar mineral mine is one of the oldest arsenic-antimony mines in the Republic of North Macedonia. The mine is a well-known reservoir of the worldwide purest source of the thallium-bearing mineral, lorandite (TlAsS₂). The current study evaluated the bacterial and fungal diversity of three As- and Tl-contaminated sites in Allchar mineral mine. We used a combination of high-throughput sequencing and bioinformatic analyses. Trace metal content was detected using inductively coupled plasma optical emission spectrometry. Our analysis showed the presence of 25 elements and confirmed a high concentration of As and Tl. Alpha diversity indices suggested a high diversity and evenness of bacterial and fungal communities. Bacterial phyla that dominated the environment were Bacteroidetes, Acidobacteria, Planctomycetes, Actinobacteria and Verrucomicrobia. Looking at the genus level, we found the following groups of bacteria: *Chryseolinea*, *Opitutus*, *Flavobacterium*, *Pseudomonas*, *Terrimonas*, *Sphingomonas* and *Reyranella*. For the fungi genera, we report *Tetracladium* sp., *Coprinellus micaceus*, *Coprinus* sp. from Ascomycota and Basidiomycota phyla in all sites. We also observed a high abundance of the fungal species *Pilidium* sp., *Dendroclathra lignicola*, *Rosellinia desmazieri*, *Hypomyces rosellus* and *Coprinellus disseminatus*. This study is the first to identify specific As- and Tl-tolerant fungal (*Pilidium* sp., *Cladophialophora* sp., *Neobulgaria* sp. and *Mycena acicula*) and bacterial (*Trichococcus*, *Devosia*, *Litorilinea* and *Gimesia*) genera from Allchar mine, suggesting bioremediation and industrial potential.

Keywords: Allchar mine; microbiome; arsenic; thallium; geomicrobiology