Tellurium biogeochemistry in the world's richest tellurium hotspot

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Tellurium (Te) biogeochemistry research remains in its infancy, with most studies focusing on laboratory-based research rather than field-based studies. As a chalcogen with multiple oxidation states and varying solubilities, we expect to see complex and metal-resistant microbiomes in regions of Te-enrichment. This phenomena has been observed with other rare metals (Au and Pt) and metalloids (Se) that, when solubilised, are cytotoxic. Tellurium is an emerging critical material with growing industrial applications such as use in solar cells. As such, mining of Te-bearing base- or precious-metal deposits has become more extensive and has resulted in increased levels of anthropogenic Te in the environment. My research focuses on *in-situ* Te-enrichment surrounding Te-rich outcrops, i.e., natural Te contamination. At the Moctezuma (Northern Mexico) Te-Au Tertiary epithermal deposit, elemental Te is the main ore mineral. Surrounding the deposit, Te concentrations in soils exceed 0.1 wt%, indicating extreme levels of Te-enrichment. Our study is the first to perform a holistic field-study of the mineralogy and (bio)geochemistry at Moctezuma, and compare this with other historic Au/Te-rich mines in North America that also display only Te-enrichment in surrounding soils. Additionally, Te-bearing minerals from Moctezuma show preliminary evidence of alteration, which could be attributed to microbial activity. Specifically, the structure and chemistry of nanometre-scale textures suggest that tellurium biogeochemical cycling, i.e., Te dissolution and subseqent re-precipitation, is occuring within localised microenvironments. Our field site is an ideal location to better understand Te behaviour in near-surface environments relative to better-studied tailings piles. This research forms a step towards a better understanding of the full Te biogeochemical cycle, which remains decidedly limited.

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