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Anthropogenic tufa at legacy industrial sites: Potential for metal capture

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Uncontrolled leaching from legacy industrial waste may release toxic elements, which poses long-term risks of water and soil contamination. In some situations, secondary mineralisation from the leachates may occur downstream from waste sites, thus potentially limiting contaminant migration. An example is tufa, a surface freshwater $CaCO_3$ (calcite) deposit which forms as a result of atmospheric CO_2 absorption into Ca-rich hyperalkaline leachates. The tufa develops a range of morphologies and varies in hardness across the deposit. Moreover, it may also incorporate other elements into its mineral structure during precipitation. Understanding the processes of secondary mineralisation which are able to capture toxic metals would provide beneficial insights into controlling hazardous leaching.

This work characterises tufa occurring within anthropogenic contexts. Several tufas were found forming on or adjacent to anthropogenic sites (colliery spoil and steel slag heaps) in central Scotland, UK and studied for their geochemistry. A combination of direct field measurements of water physico-chemistry is complemented by alkalinity and elemental analyses of leachate source, water and tufa by ion chromatography (IC) and ICP-OES. The results from these analyses will help understand the processes involved in tufa formation and can be applied to the re-creation of tufa with the purpose of metal capture under controlled laboratory conditions. Early experiments have focused on $CaCO_3$ precipitation onto different media by bubbling CO_2 into $CaCl_2$ solutions. The aim of these experiments is to create an engineered metal-capturing tufa system which can be applied across different post-industrial settings as a low-cost technique which beneficially captures CO_2.