Immobilisation of contaminants within uranium mine tailings *via* the production of mycogenic phosphate minerals

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Phosphate minerals are promising materials for the remediation of contaminants associated with uranium mining due to their ability to lock up relavant metals (e.g. U, Th, Pb, Ra) within insoluble phases. Analoguous naturally-occuring minerals (apatites, monazite, xenotime) are stable over geological timescales [1].

Microbial biomineralization of phosphates have gained attention due to improved contaminant incorporation properties, potential cost savings, and unique engineering possibilities [2]. Microbially induced phosphate biomineralization involves the use of phosphatase enzymes to degrade organic phosphate compounds. This process releases inorganic phosphate to solution which may in turn form precipitates with metals present (e.g. Ca or U) [2].

Phytate ($C_6H_{18}O_{24}P_6$) is a strong candidate as a phosphate donor due to its high content within many plant waste products, but its enzymatic degradation is challenging and has yet to be robustly investigated under conditions relevant to a remediation strategy. To investigate some of these factors, this work has tested phytate degradation and subsequent mineral precipitation by two organisms (*Aspergillus niger* and *Blastobotrys adeninivorans*) utilising different carbon sources (starch, glucose, or galactose) and at temperatures ranging from 4 to 30 °C.

Further work is ongoing to develop an engineered strategy for phosphate biomineral production within uranium mine tailings utilising the ability of multicellular fungi to grow through solid subtrates. Tests will be performed using simulated and real tailings and attention given to critical factors such as O_2 availability, pH, E_h, and presence of competing species such as sulfate. Challenges related to the monitoring of processes occurring within a solid material will be addressed using a range of techniques, including bio- and physicochemical analyses, X-ray diffraction, and imaging procedures such as X-ray CT scanning and optical and electron microscopy.

[1] Rakovan & Pasteris (2015) *Elements*, **11**, 195–200. [2] Macaskie et al. (2004) in *Phosphorus in Environmental Technologies: Principles and Applications*, 549–581.