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Geochemical and biological characterisation of supergene efflorescences in pollymetallic mining wastes from Portman Bay (SE, Spain)

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In freshly deposited sulphidic mine tailings, the pH is neutral or slightly alkaline. Due to pyrite oxidation, the pH decreases to values lower than 3 at which acidophilic iron- and sulphur-oxidizing prokaryotes prevail and accelerate the oxidation processes. Portman Bay is heavily polluted as a result of historical mining and processing activities, during which time great amounts of wastes were produced, characterised by a high potentially toxic elements (PTE) content, acidic pH and minerals resulting from supergene alteration. Three soil samples were collected from the most recent exploitation stage, stored in containers for a year and moistened simulating rainfall events. The percolates obtained were collected and naturally evaporated, obtaining three efflorescence samples. The existence of bacterial activity was evaluated by scanning electron microscopy (SEM).
C15 sample is characterised by copiapite small crystals generating an homogeneous, porous mass. Inside the mass of copiapite crystals, both pyrite and gypsum were also found. In this sample, a laminae of material fills the pore space. The high carbon content shown in the spectrum of this material permits to characterise it as a biofilm.
In the cross section sample of C15, a noticeable lamination of copiapite crystals has been observed, probably originated by dissolution processes. A clear limit between the lamination zone and the upper zone of the efflorescence was noticed, and here arborescent forms are developed. C17 and C18 also presented copiapite crystals, but, unlike C15, they do not present lamination and are characterized by an irregular shape and massive fabric. In C17, small crystals growing in the surface of this material were observed, generating small crusts. According to the spectrum analysis, these crusts are formed by alunogen. In C18, crystals of acicular morphology are present, and appear grouped at certain points.
Therefore, out of the three natural efflorescences, biotic activity was only found in C15. This efflorescence differs significantly in morphology and fabric from samples C17 and C18. Besides the morphology, the PTEs content is also different, suggesting that chemical properties of this soil favoured the organic activity. An important factor could be related to a high iron content, since, as demonstrated in similar materials, iron performs a fundamental factor for bioinducted nucleation.