Sulfur gases emission from sulfidic mine tailings in winter: geochemical and geophysical evidence

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Sulfide-bearing mine tailings is a heterogeneous system transformed greatly due to seasonal and daily fluctuations in air temperature. The pore fluid freezes and thaws, which leads to cracking of soils and activation of oxidation with the formation of acid mine drainage and sulfur gases emission. The dynamics of the Specific Electrical Resistivity (SER) reflects the changes in the tailings dump depending on the environmental conditions. The abandoned sulfide-bearing mine tailings of the gold processing plant (Ursk, Kemerovo region, Russia) were investigated in February 2018 by the Electrical Resistivity Tomography (ERT) using SKALA-48 equipment (Novosibirsk, Russia) at an air temperature of -15 0C. The local areas with different conductivity were sampled, the atmospheric air above the tailings surface was examined on the concentrations of sulfur gases (SO2, CS2, C2H6S) using the portable gas analyzer GANK-4 (Moscow, Russia). The temperature and SER of the tailings and the concentration of the dimethylsulphide (DMS) in the near-surface layer of the atmosphere have a close relationship. There is a local anomaly of the lowered SER with a positive temperature (+ 40C) under the cover of snow with a thickness of 50 cm. The concentration of the DMS is equal to 0.4 mg/m3 above the anomalous area which is 5 times higher than the maximum allowable concentration and increased in comparison with other “cold” and less conductive sites. The appearance of the DMS we associate with methylation of the sulfide-bearing compounds by microorganisms. Previously, we found bacteria Pseudomonas sp. and Bacillus sp. in the Ursk tailings, having the ability to methylate compounds of metals and metalloids (Hg, Se, Bi, Te, Sb, and As), increasing their mobility. The data obtained indicate active metabolic processes in the heap even in winter. The monitoring of the seasonal changes in dump carried out using ERT in complex with geochemical methods.