Distribution of tailing minerals deduced from remote sensing data in Bor mining area, east Serbia

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City of Bor is located in east part of Republic of Serbia. The exploitation of copper ore has been operated since 1903. Main types of the copper ore in Bor ore deposits are massive sulfide copper deposits, vein and stockwork-disseminated type of mineralization, porphyry mineralization, and reworked ore-clasts of copper sulfides. Underground mining and open pit mining carry out exploitations of ore. In the five-year-period, between 2010 and 2014, Mining and Smelting Combine Bor produced 155 thousand tons of copper, 24 tons of silver, and 4.5 tons of gold. Mining activities have produced large amount of waste materials. Until now, it has been disposed 450 million tons of overburden, 207 million tons of flotation tailings and 23 million tons of slag. Pyrite from the tailings is exposed to water and oxygen, which leads oxidation of this mineral and production of acid mine drainage. Releasing untreated acid mine drainage and wastewater from smelter into a river is a reason of serious environmental pollution. Fine-grained flotation tailings transported by winds and river water become air and soil pollutions and river sediment. In order to make comprehensive environmental evaluation and propose reclamation system, collaboration between Japan and Serbia has been started in 2015. This project is supported by SATREPS from JICA and JST. The project will be continued until 2020. This project has two main research groups; environmental evaluation group, and detoxification and resources recovery group.
Environmental evaluation group studied about distribution of tailings and wastewater deduced from satellite image data analyses. In 2015, the group members researched about tailing distribution by using satellite images. First, tailing positions were extracted from ASTER and LANDSAT images. Because spectrum of the tailing had decay slopes in Band 3 images in both of ASTER and LANDSAT, the tailing areas were identified from ratio between Band 2 and Band 3 of these images. ASTER and LANDSAT images were not able to distinguish between soil and tailing because of their wide Band ranges. Therefore, the members distinguished tailings from seasonal changes of spectrum in these areas. The seasonal change was caused by vegetation. Next, 22 samples of surface materials were took and observed. Almost surface materials matched satellite analysis results, but a few areas were different from the satellite analysis results. These 22 samples were analyzed spectrum by a spectrometer and determined mineral by XRD. These spectrum data were compared with satellite images. In addition, high-resolution images (World View 2) were purchased and analyzed with other images and data. Especially, Vrazogrnac plane where was confluence of Bor and Timok Rivers. Timok River connects to Danube River.
Environmental evaluation group would reveal from material content with depth in future drilling works. Spectrum data was correlated with XRD data. XRD result showed that tailing samples were including Jarosite, Kaorinite, Illite, and Gypsum. Vrazogrnac area was measured secular change and collected samples. There were also compared with spectrum data. High resolution images around there were also measured the areas in details.
These tailings would be transported to Danube River, the international river, then they could make around countries environmental influences. Our study would resolve the problems by continuing our observation about distribution of tailings. In order to research in details, we should prepare hyper spectrum images. Acquirement of images from Hyperspectral and/or LCTF-UAV would resolve these problems in the future.

Keywords: remote sensing, mining, tailings, pollution, Bor

