Geophysical Study of a Potential Source of Secondary Raw Materials – the Aijala Mine Tailings Area Southern Finland

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SMART GROUND PROJECT
The SMART GROUND project funded by the EU’s Horizon 2020 program improves the availability of information of the secondary raw material in the EU. The consortium will create a single EU database that integrates all the data from existing sources and new information retrieved with time progress. SMART GROUND database will enable the exchange of contacts and information among the relevant stakeholders, which are interested in providing or obtaining secondary raw materials. The project produces detailed information of secondary raw materials pilot landfills of partner countries. The tailings of Aijala closed mine is one of the Finnish pilots. In the SMART GROUND project, the integrated use of geophysics and geochemistry was tested to estimate the volumes of mineral resources of the tailings pond.

AIJALA TAILINGS POND
The Aijala tailings pond consists of material from Metsämonttu and Aijala mines and the layers of the them can be distinguished from the geochemical data. The composition of Aijala tailings has been studied already in 1982. It contains around 2 million tons of waste which average metal content is as follows: 0.12 % copper, 0.5 % lead, 0.11 % silver and 0.69 ppm gold. Thickness of the tailings layer is on average 8.7 m and at the deepest part 12 m. (Sipila, 1994, Kokkola, 1982).

SOIL DRILLING AND GEOCHEMISTRY
In summer 2016 Geological Survey of Finland made additional drill holes and the samples were analysed in 1 m intervals. 48 samples in total and a vast geochemical analysis was carried out. The geochemical assays of the samples revealed the interface of the tailings material from Metsämonttu and Aijala mines. The top part which contained tailings from Metsämonttu mine was rich in lead and the bottom part containing tailings from Aijala, was rich in copper (Figure 1).

GEOPHYSICAL STUDIES
Geophysics was used to study the inner structure and dimensions of the tailings pond. Magnetic and electromagnetic GEM-2 surveys were carried out over the whole tailings area. Gravity, Electrical Resistivity Tomography (ERT) and Induced Polarization Tomography (IPT) profiles were measured in selected places nearby the new drilling points.

Results of the gravity survey were used to interpret the thickness of the tailings pond and depth of bedrock surface (Figure 2). The bottom of the tailings pond could be defined fairly reliably by using in situ densities and drill hole data as reference. The bedrock outcrops at the ends of the measured profiles were used as reference in interpreting the bedrock topography (Vali & Mattsson, 1998).

MINERAL RESOURCES ESTIMATION
The mineral resources were estimated by interpolating the metal contents in the old and new drill cores into a 1 m resolution block model separately to the Metsämonttu and the Aijala mine tailings layers (Valjus & all, 2016). The blocks were determined by the layers generated according to the gravity interpretations of the tailings bottom and bedrock surface. Inverse Distance method was used to interpolate the metals contents. As the changes in metal contents are more likely to be in vertical direction, the used search ellipsoid was horizontal and it was 200 m in length and in width and 2 m in depth. Figure 6 shows as an example the interpolated copper content in the Metsämonttu mine tailings layers. The total volume of the layer is 852,399 m³ and it contains approximately 678 tons of copper.

CONCLUSIONS
The tailings pond of the closed Aijala mine was studied as an example of a source of secondary raw materials in EU. The use of detailed geophysical interpretations integrated to the geochemical sampling proved to be a profitable way in defining the inner structures of the mine tailings and they also gave more information of the variation of the tailings ponds bottom and bedrock surface. The results were utilised in 3D model of the structure and volumes of mineral resources of the tailings pond. The information concerning the tailings pond can be found later in the standardised EU landfills database, and it will be possible to utilise the possible re-use of the raw material to make feasibility study and planning the operations.

References
•Vali, T., Markkanen-Koivisto, M. and Tarvainen, T., 2016: Aijala mine tailings area as an example of a source of secondary raw materials. Lithosphere 2016 Symposium, November 9-11, 2016, Espos, Finland
•Karppinen, E., 2016: Aijala mine tailings area as an example of a source of secondary raw materials. Lithosphere 2016 Symposium, November 9-11, 2016, Espoo, Finland.