# Rapid Screening Tool for Mining

Rapid growth in the automotive, electronics and construction industries has led to an increase in the worldwide demand for steels, alloys and rare metals. At the same time the extraction of the necessary raw materials from natural resources is becoming ever more challenging due to decreasing ore grades in viable minerals deposits. As a consequence, the extraction of minerals at competitive prices demands accurate characterisation of the mineral feedstock, the concentrate (valuable minerals) and the mine tailings (waste). Here we introduce a rapid screening method to carry out this characterisation using the JSM-7100F (Field emission scanning electron microscope by JEOL) and INCAMineral (EDS system and mineral liberation software by Oxford Instruments).
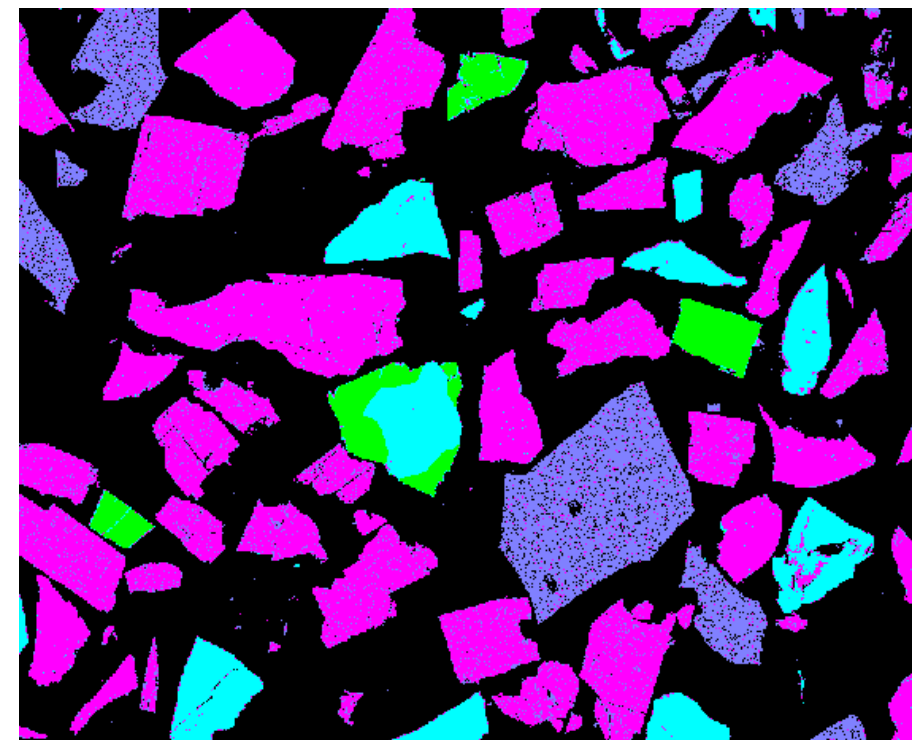
STEP-1 ·· Electron image
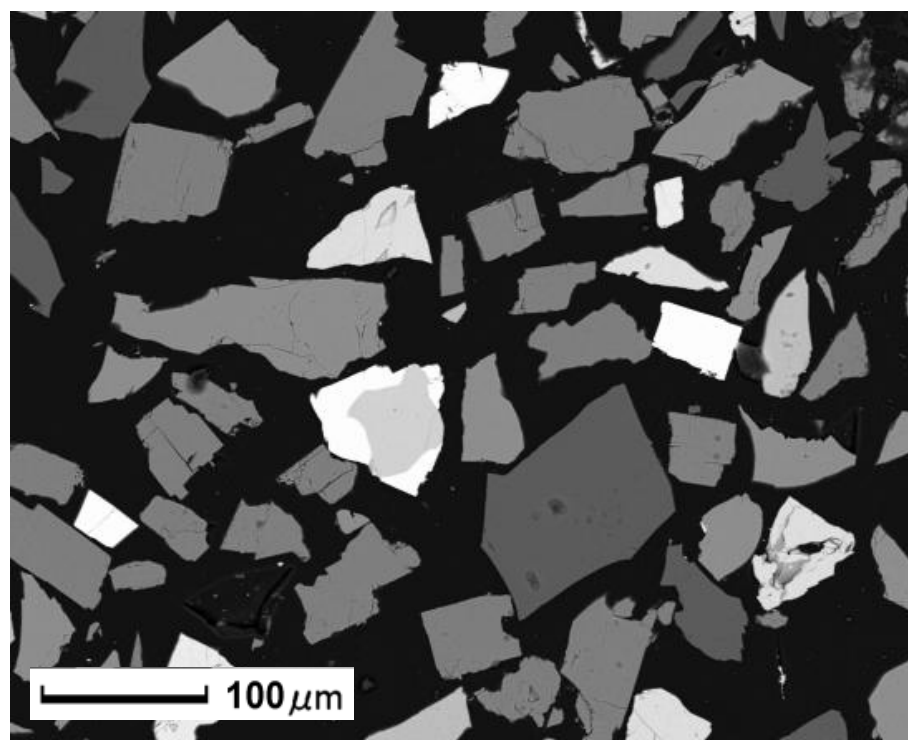
Samples taken from the minerals processing plant contain particle powders embedded in resin. In the back scattered electron (BSE) image (left), the contrast in the image corresponds to the composition of the minerals in the particles as captured in the scanning electron microscope (SEM).

STEP-2 ·· Segmentation

Grains and grain morphology are identified using the contrast in the BSE image. Morphological data like area, perimeter length, ECD and location of each grain is stored in a database for further processing. A grain can be classified from the BSE image or using the composition determined from an EDS measurement (Step 3).

STEP-3 ······················· Automated particle analysis and classification
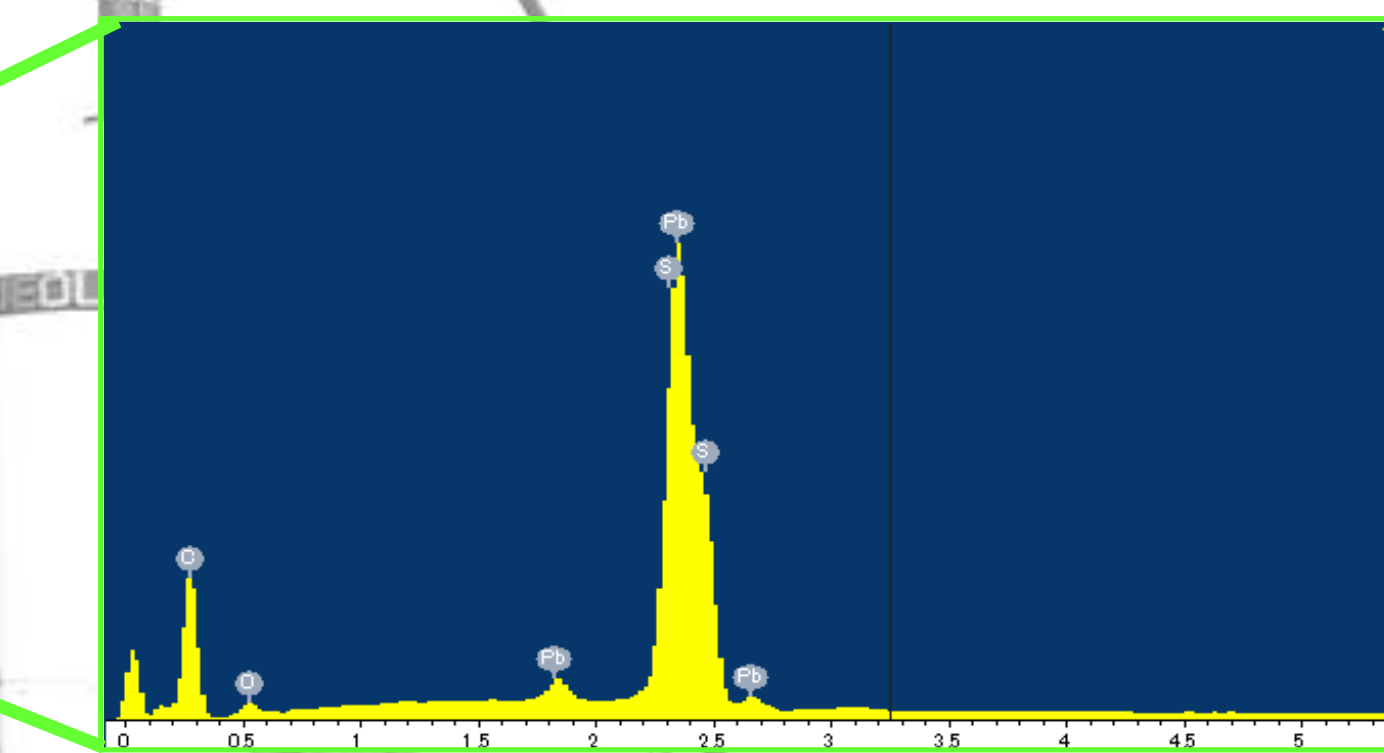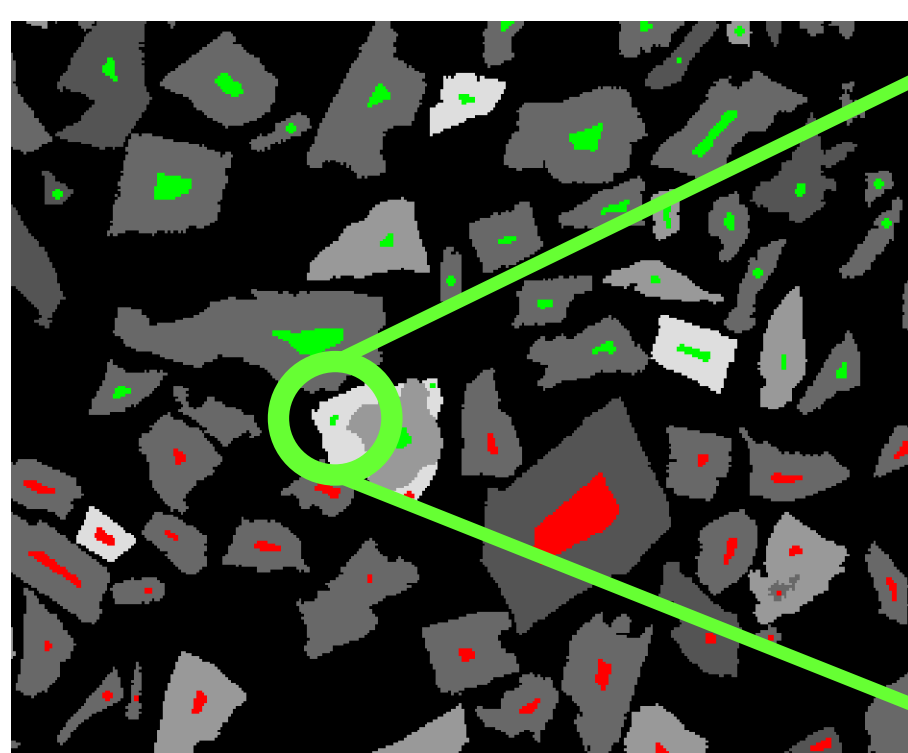
The composition of a grain is automatically analyzed using characteristic X-rays and a mineral phase is assigned using a pre-defined classification scheme. Here, green indicates a particle already analyzed, while red ones waiting to be processed. An X-ray spectrum of a Galena grain is shown. The grain composition and phase information is stored in the database together with the morphological data from the segmentation (Step 2).

STEP-4 ······················· Data analysis and report generation

Mineral fractions
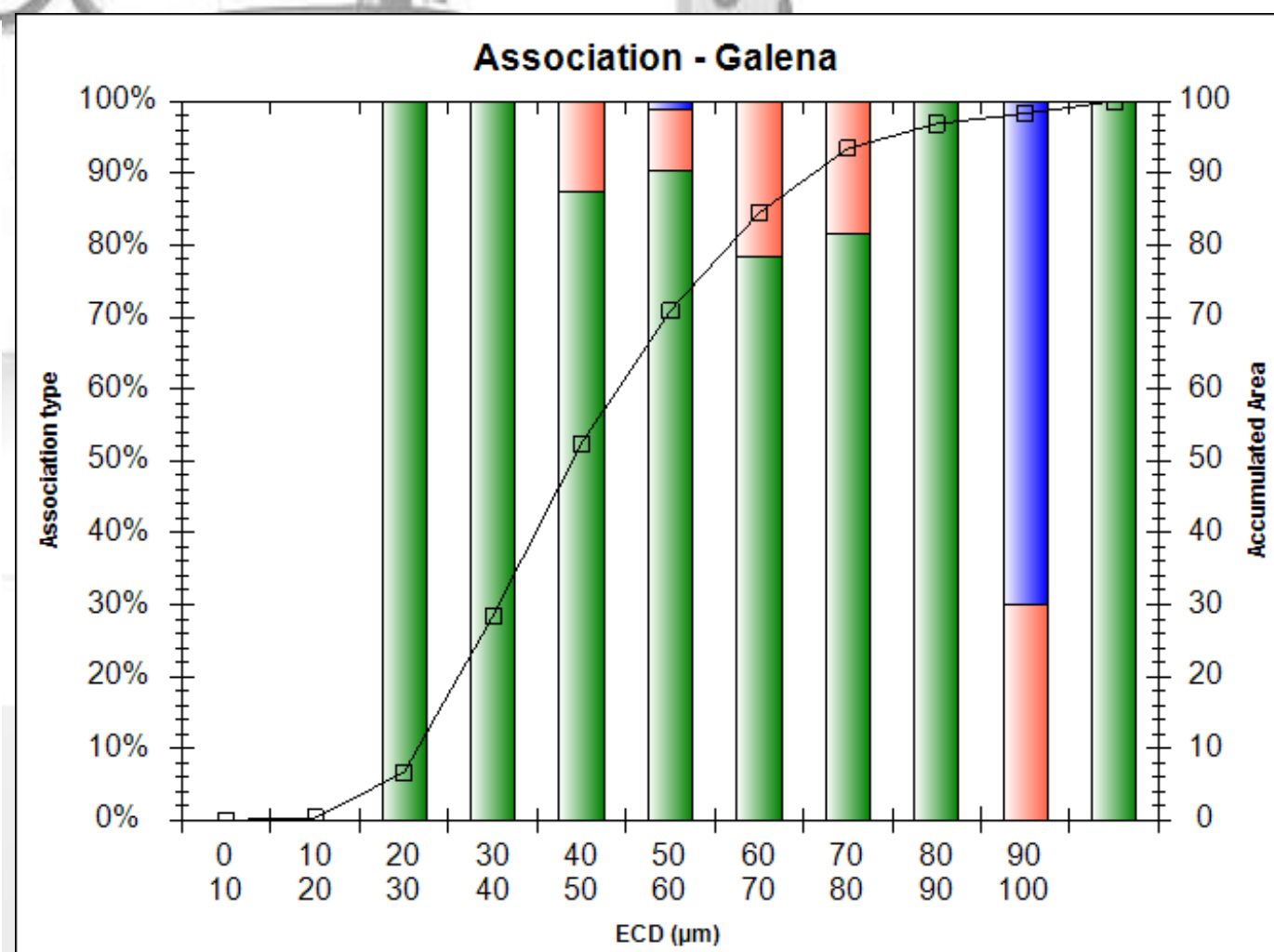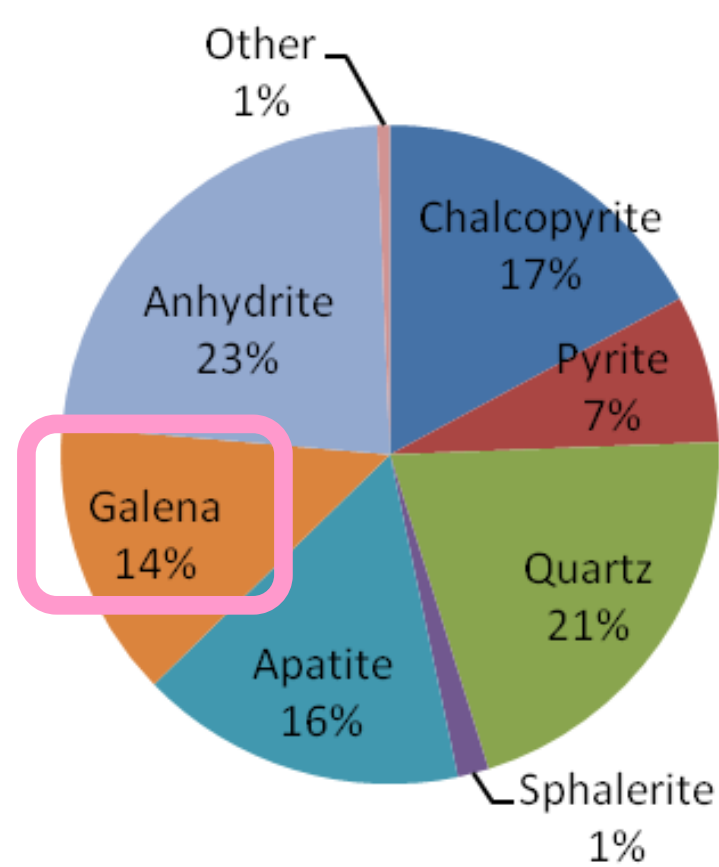
Morphological and phase information are used by the software to calculate the overall mineral fractions (modal composition), minerals association and cumulative liberation data. Detailed graphs and reports can be generated directly into MS-Excel spreadsheets.

- 🟩 **Solo Assoc**
- 🟥 **Binary Assoc**
- 🟦 **Ternary Assoc**

Pie chart:
- Other 1%
- Chalcopyrite 17%
- Anhydrite 23%
- Pyrite 7%
- Galena 14%
- Quartz 21%
- Apatite 16%
- Sphalerite 1%

Chart: Association - Galena (Association type % vs ECD (µm), Accumulated Area)

The sample studied for this application note contains 14 % Galena. Around 50% of the Galena is associated with other minerals and contained in particles larger than 40 µm. More detailed reports can be generated on associated minerals.

Features of INCAMineral

Automated mineral liberation analysis (MLA) for multipurpose SEMs

Calculations of liberation, locking and mineral composition

Microsoft Access database with morphological, compositional and phase data for each grain

INCAMineral Application

Mineral Liberation Analysis

JEOL Technical Information