COMMINUTION EFFECTS ON MINERAL GRADE DISTRIBUTION:
THE CASE OF AN MVT LEAD-ZINC ORE DEPOSIT

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INTRODUCTION

Every mining operation is followed by a beneficiation process aimed to deliver quality material to the metallurgical industry. Most of mineral processing is focused on a concentration and grinding of extracted ore that is crucial for the following separation stages in order to divide gangue from valuable minerals. Concentration is the most energy consuming phase and the quality of the results is strictly related to the characteristics of the material under treatment.

In order to understand the crushing behavior of a mixed sulfo-arsenic ore, a preliminary study has been performed. The analyzed material was sampled in a Mississippi Valley Type (MVT) deposit in Northern Italy and contains mainly galena and sphalerite. This study concerns the distribution of concentrate minerals among the different sized products of the crushing process. Once samples have been measured and characterized through thin section observation and SEM analyses for the determination of the grain liberated sizes, while XRD quantitative analyses have been performed for the identification of the concentrates. The selected crushing circuit comprises lab-scale impact cruscher, jaw cruscher, disk mill and rod mill. The collected products are below the free grain size threshold and granulometric analyses have been performed. All these evaluations have shown a closer overlap on size different minerals react to the same comminution pathway.

The importance to have a clear comprehension on the redistribution of target minerals in real processing plants could lead to an efficient separation. Benefits that could be achieved can enhance a reduction in process waste, as well as control on water use, reagents and machinery utilization during beneficiation stage.

1. THIN SECTIONS CHARACTERIZATION

OPTICAL MICROSCOPY

OM observations underlined the abundant presence of sphalerite (light grey) concentrated by a calcite-matrix. Sphalerite shows a yellow-terracotta or blackish coloration in Parallel Light (PL) (Fig. 1a) and may set in matrix, while they are opaque in Cross Polarized Light (XPL) (Fig. 1b). Future thin section analyses are needed with the target of the mineral problematics. Sphalerite identification in SEM was carried out by EDX analysis and measured as fine and roughly meaning around 50µm.

SELECTED POLARIZED TRANSMISSION IMAGES

OM observations have been carried out in order to understand the elemental composition of minerals under OM through EDAX analysis. OM observation (Fig. 1c) under a special power of sphalerite (Sph) and high magnification of the areas under observation, as well as in analyses of diamonds and diamonds with calcite matrix. Presence of organic matter (Org) has been detected in microfractures filling. Zn alteration compounds, such as cerussite (Cer) and smithsonite (Sm). Presence of organic matter (Org) has been detected in microfractures filling.

3. COMMINUTION FINE PRODUCTS CHARACTERIZATION

The output product of each comminution step has been characterized in terms of grain size distribution (Fig. 4), aiming to understand the effectiveness of comminution flowsheet and the quality of the obtained material.

XRD quantitative analyses have been realized using the Whole Powder Pattern Fitting (WPPF) based on the ICCD PDF database. Quantitative analyses important information have been obtained for the evaluation of the most suitable dimension cuts to be delivered to flotation separation, showed a variable mineral grade distribution varying with the products. This phenomenon has been studied in bibliography as selective comminution, but in this case further investigations may be needed to better define parameters relating to the specific behavior of mineral, thanks to quantitative analyses important informations have been obtained for the evaluation of the most suitable dimension cuts to be delivered to flotation separation stages. This important trend should be considered for further studies relative to the mineral recovery achievable by each flotation.

REFERENCES