PROCESS MINERALOGY

Prof Eric PIRARD

Work load: 25h Theory (lectures), 25h Practice (lab), 15h Project work.
Number of credits: 5 ECTS
Course code: GEOL0312-2
Source: http://www.emerald.ulg.ac.be/?q=process-mineralogy

► *Course contents:*

1. Introduction : from analytical chemistry to analytical mineralogy
2. Sampling of particulate materials
3. Particle Size and Shape Analysis
    - Sieving, Coulter, Sedimentation, Laser Diffraction, Image Analysis,…
    - Representation of particle size distributions (PSD)
    - Statistics for PSD
4. Reflected Light Optical Microscopy
    - Theory of optics and mineral surfaces
    - Mineralogical Imaging
    - Image processing and analysis principles
    - Quantitative mineralogy (modal analysis, liberation analysis,…)
5. Electron beam microscopy
    - The electron microscope
    - Imaging modes (SE, BSE, …)
    - Electron beam microanalysis and mapping
    - Automated mineralogy
6. Infrared and Raman spectroscopy for minerals
7. X Ray diffraction
8. Xray MicroCT Tomography

► *Intended Learning Outcomes:*

- Understand qualitative and quantitative analytical mineralogy techniques essential for monitoring mineral processing operations.
- Be able to use them appropriately and to make a sound data interpretation
- Be able to cross-correlate the results of the different techniques for validation
- Make use of the obtained mineralogical data to balance unit operations and identify issues related to elemental deportment in the process
- Be able to build recovery curves and develop a geometallurgical approach in processing complex and low grade ores

► *Prerequisites and co-requisites:*

General geology;
Introduction to mineralogy;

► *Planned learning activities and teaching methods:*

Lectures are delivered in a classroom allowing for spontaneous interaction between professor and students. The lessons use PPT with images of microscopic ore textures.

Every (2h) lecture is complemented by a (2h) practical session on the instruments presented during the course. The students are given real ore samples on which they have to perform a series of analyses and report in written form about their findings. Ideally the samples are those on which they work in the mineral processing course so that the analytical information gathered during these practical sessions serves for the interpretation of recoveries obtained in the mineral processing lab.

Whenever possible scholars (expert researchers) are invited to present insights into the most advanced and innovative technologies (ex. X-Ray tomography; automated mineralogy;…).

► *Mode of delivery (face-to-face; distance-learning):*

- Frontal instruction (2h) to explain the principles, capabilities and limitations of the techniques
- Hands-on learning (2h) on real ore samples using a variety of techniques
- Written report and face-to-face discussion with young researchers about results

► *Recommended or required readings:*

<u>Required :</u>
Power Point presentations available through the student portal (MyULg)

<u>Recommended:</u>
Process Mineralogy, M.Becker et al. (editors), JKMRC Monograph Series (to be publ. in 2016)

► *Assessment methods and criteria:*

Written examination (80%) consists in a series of questions relating to both a sound understanding of the underlying principles <u>and</u> to the proper interpretation of data collected from real case studies. The practical works handed over by students during the year contribute to the final mark of the course:

- Report on particle size distribution analysis (5 %)
- Report on image analysis (5%)
- Report on XRD (and ICP) result analysis in the Mineral Processing Project (5%)
- Mineralogical Analysis of the results of the Mineral Processing Project (5%)

The scientific rigor, clear structure and illustration as well as care taken in the presentation are essential criteria in the evaluation

► *Contribution to EIT's Overarching Learning Outcomes:*

(EIT OLO 4 and OLO5) : This course is an introduction to both routine and very advanced analytical techniques. In this way, students are invited to understand the current limitations and possible niches of innovation. They should be able to imagine and design possible improvements to existing instruments. Several of these techniques (particle sizing, automated mineralogy,…) have been developed in start up companies created by engineers with similar background.