

# **A LOW-COST AND WIDELY APPLICABLE METHODOLOGY OF DIGITAL IMAGE ANALYSIS OF ORES TO ASSESS PROBLEMS OF MINERAL AND ENVIRONMENTAL ENGINEERING**

**Edgar Berrezueta**

**Ricardo Castroviejo**

Technological and environmental problems related to ore processing are a serious limitation for sustainable development of mineral resources, particularly for countries / companies rich in ores, but with little access to sophisticated technology, e.g. in Latin America. Digital image analysis (**DIA**) can provide a simple, unexpensive and broadly applicable methodology to assess these problems, but this methodology has to be carefully defined, to produce reproducible and relevant information.

The procedure presented uses a 3-CCD colour video camera mounted on a reflected light microscope and connected through a frame grabber to the CPU containing the DIA software. Polarization of light, currently used for routine ore identification, has to be discarded, to avoid errors due to the unpredictable orientation. The use of color allows to identify common ores by comparison and mathematical treatment of the measured grey-level values of each of the RGB bands, if the choice is limited by additional constraints: only the common or industrially important ores (around 30) are routinely considered; furthermore the search is constrained by type of deposit and the corresponding mineral association, among other data; uncommon ores require specific treatment. The IMA /COM reflectance data are used for validation of the method. Physical and instrumental conditions (quality of polishing, feed power and lamp temperature, drifts, white balance, etc.) are strictly controlled to achieve reproducible measures.

Once the minerals are properly identified (reliable segmentation succeeded), the mathematical algorithms needed to process the measures and to address industrial problems (e.g. ore processing) can be applied. Routines for the fully automation of the process are possible, should a last generation microscope with automated stage and auto-focus be available, but a previous qualitative ore microscopic study would still be needed to ensure proper definition of the problem and control of the process.

The system can be applied as well to the beneficiation of ores as to prevent pollution or to remediate environmental threats (e.g. sulphides in coal or in industrial tailings), and has been tested in several real problems. It allows processing a big volume of information and in different ways to answer different questions relevant to the engineer. This would not be possible with traditional point counting (non automated) methods, but it is fast with DIA, once the relevant image information has been properly acquired, since the digital format allows any mathematical treatment at any time.