Boletin de la Sociedad Geologica del Perú

journal homepage: www.sgp.org.pe ISSN 0079-1091

Combining geology, geochemistry and geometallurgy to characterise Ore Deportment using la-ICPMS technology

Helen Thomas[1,2]*, Ross Large[2], Sebastien Meffre[2], Christina Wanhainen[1], Glenn Bark[1], Riia Chmielowski[1]

[1]Luleå University of Technology, Luleå, Sweden. *(Current address)

[2]CODES Centre of Excellence in Ore Deposits, University of Tasmania, Australia.

ABSTRACT

Improvements in analytical technology allow characterization of ore to a greater extent, with more detail and with increased automation. Using laser ablation mass spectrometry alongside traditional metallurgical characterizations, means in-situ ore relations can be studied, as well as trace element zonation in the ore and across the deposit. This information is critical for the planning of metal extraction as well as environmental concerns for mine waste. This paper presents an overview of how Laser Ablation-Inductively Coupled Mass Spectrometry (LA-ICPMS) technology can be used to investigate gold deportment from refractory gold held in pyrite structure, to nanoparticles to free gold inclusions.

KEYWORDS

Gold, LA-ICPMS, geometallurgy, geochemistry, trace elements

METHODOLOGY

Data presented here was acquired using a solid-state laser microprobe attached to a quadrupole ICPMS, with a laser spot size between 55µm and 12µm depending on the size of the pyrite grain (Thomas, 2011 and references therein). See figure 1 below for a typical LA-ICPMS spot analysis, where the gold inclusion present can be quantified and its approximate size calculated. Using iron (Fe) as an internal standard the concentration of

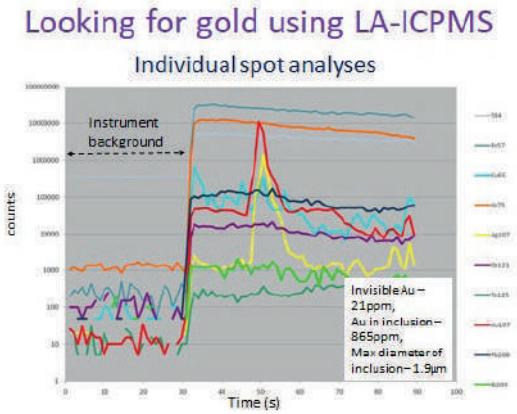

Figure 1.

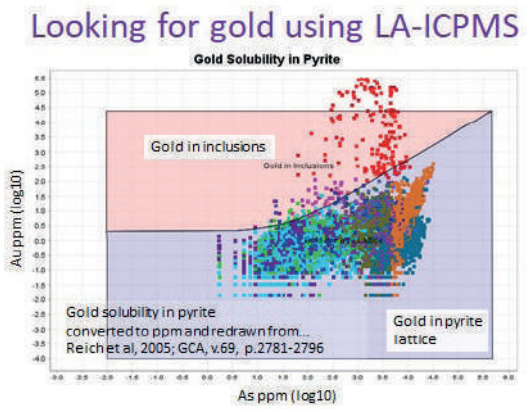

Figure 2.

trace elements selected can be quantified to ppm and imported to geochemical analysis software such as IoGAS. Figure 2 illustrates how the trace

elements selected can be quantified to ppm and imported to geochemical analysis software such as IoGAS. Figure 2 illustrates how the presence of free gold inclusions in quantified image data can be evaluated using Reich et al´s 2005 gold saturation diagram. Gold was studied as well as 20 other trace elements.

The size and location of gold inclusions has a strong affect on the ore response to extraction technique and the ability to characterize the amount and location of gold is imperative to be able toplan a metallurgical process that can extract all the gold. This technique allows the variation in gold deportment to be investigated across a deposit, including vectors to ore figure 3. With geochemical analysis of the trace elements aquired in addition to Au and As the deposit evolution can also be studied. Deleterious elements (eg. Cd, Tl, Sb) can also be characterized in this fashion, allowing the deposit to be mapped in terms of smelter credits and penalties, environmental concerns (e.g. acid mine drainage) and extraction technique (e.g. cyanide leach vs pressure oxidization).

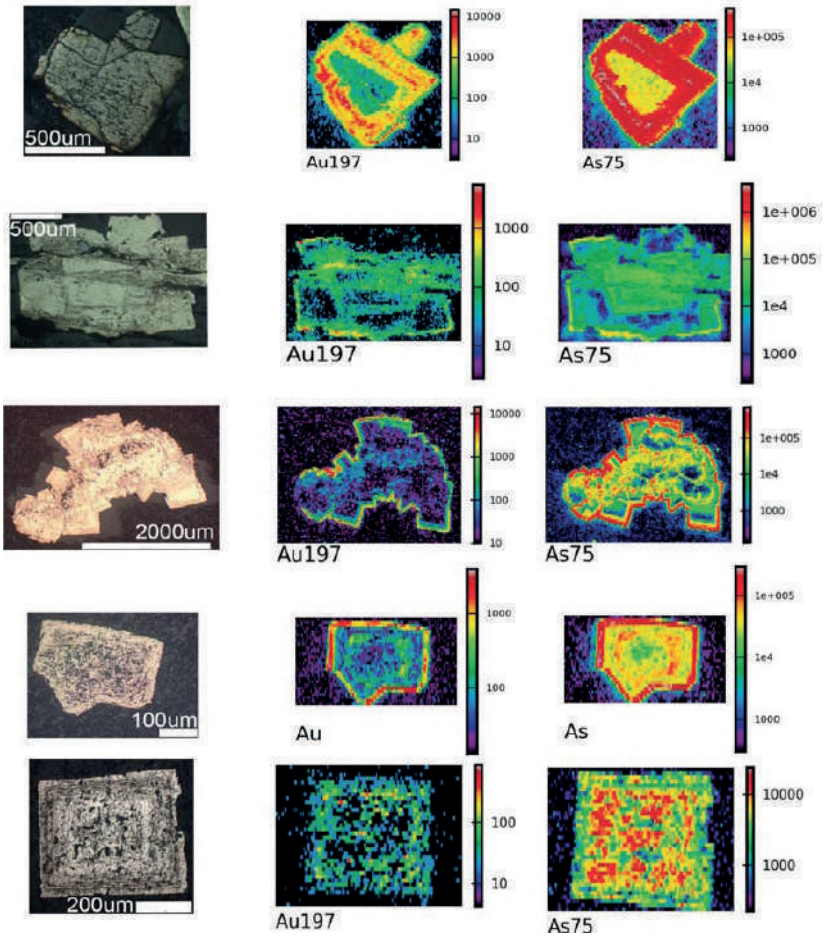

Figure 3. Variation of Au-As rims on various types of pyrite from an orogenic gold deposit in Bendigo, Australia. Rims are thicker proximal to gold-bearing reef structures.

CONCLUSIONS

LA-ICPMS is a powerful tool to unmask complexities in ore deportment and extraction. Using in-situ information from across the deposit it aids in a complete characterization from exploration, to extraction and remediation.

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