Nanoscale approach in mineralogy and its implications in ore deposits.

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Although nanoscale studies in minerals science have increased in the last decade, the number of publications in this field continue being scarce. By contrast, FIB/SEM/TEM techniques are now well established [1], especially for analysis of silicate minerals (e.g. [2]). Regard to ore minerals, recent studies have taken relevance, especially to explain the behavior of minor and trace elements in different geochemical systems [3, 4]. The submicron structural study of the natural occurring ore minerals can be used to resolve several questions about their origin by understanding their forming conditions, growth and structure.

In the present work, FIB/SEM/TEM coupled with EDS and PED showed its great potential for studying the structure of heterogeneous mineral that are otherwise difficult to study by conventional methods because of their small crystal size, low purity, and high structural complexity. We also want to remark that the followed approach to identify and characterize the crystal structure on otherwise ‘‘too-small-to-study” minerals or aggregates can be directly applied to any type of naturally occurring as polycrystalline aggregates that are of interest in earth sciences, environmental sciences and related disciplines.

By combining the chemical composition (obtained from the EDS mapping) and the crystalline structure identification (obtained from PED-based crystal phase maps) at sub-micron scale, for the first time we can study the crystallographic structure of small gold nuggets in lateritic soils (Figure, 1). This is an example of an emerging field of research in earth related sciences and shows how advanced electron microscopy, if focused on sites of metallogenetic interest, can provide new insights into ore deposit formation.

Figure 1: Gold crystal orientation maps obtained by means of PED (a) zone axis identification distribution yellow (4 1 9) blue (8 7 9) and pink (-3 -2 -9), (b) the goodness of fit map in grayscale showing the darkest areas that correspond to the grain boundaries with unassigned zone axis, (c) composite image with zone axis identification and goodness of fit and (d) zone axis and the corresponding color scale.

References

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