Lithogeochemistry and fluid flow in the epithermal Veta Rublo base metal-silver deposit, Chonta Mine (Huancavelica, Perú)[1]

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Keywords: *epithermal, lithogeochemistry, metal ratios, fluid flow.*

The Chonta Mine (75º00'30" W & 13º04'30"S, 4495 to 5000 m absl), owned by Compañía Minera Caudalosa, operates a polymetallic Zn-Pb-Cu-Ag vein system of the low sulphidation epithermal type, hosted by cenozoic volcanics of dacitic to andesitic composition (Domos de Lava Formation). Veta Rublo, one of the main veins of the system, is worked underground to nearly 300 m. It strikes 60-80º NE and dips 60-70º SE; its width varies between 0.30 and 2.20m, and it crops out along ~1 km, but is continued along strike by other veins, as Veta Caudalosa, for some 5 km. Typical metal contents are 7% Zn, 5% Pb, 0.4% Cu and 3 oz/t Ag, with quartz, sericite, sphalerite, galena, pyrite, chalcopyrite, fahlore as main minerals, and minor carbonate and sulphosalts.

The Rublo vein has been the subject of a lithogeochemical study. Its metal contents have been systematically analysed (4 840 samples), compared, and related to their spatial distribution along the structure, to depict the evolution. Metal ratios (as ln) have been used to show fluid chemistry variations of the evolving hydrothermal system. These variations can be related to the directions of fluid flow, under the assumptions that (i) metal precipitation will not begin until the metal reaches saturation in the hydrothermal solution; (ii) saturation and therefore precipitation will be enhanced by cooling, and this is favored by flow of the fluids to shallower levels or by lateral flow away from the source; pressure drops or other changes related to this process may act in the same way; (iii) the temperature, and therefore the time, of precipitation of a particular metal depends not only on its solubility, but also on its concentration: the precipitation of an undersaturated metal will be delayed, as compared with the saturated metal.

Under these assumptions, the resulting picture (e.g. Fig. 1 for lnZn/lnCu –other metal ratios' pictures are similar) suggests a consistent upward flow of the hydrothermal fluids, progressing from the center and from both sides of the structure –arrows- and selectively precipitating Zn and Pb at lower levels, with a relative Cu enrichment at higher levels. This distribution could be explained by the relatively poor Cu concentration of the original solutions (Zn/Cu>15, Pb/Cu>10), which would prevent the precipitation of this metal until its saturation threshold is reached, at shallower levels.

Some requirements, which have been tested, must be fulfilled for these assumptions to be applied. The picture might be chaotic and the method unreliable, should different hydrothermal events be superimposed in the same structure and be unconsciously bulk sampled together. To prevent this, a preliminary underground reconnaissance and vein mapping have been carried out. Factor analysis of all the data is consistent with a single main event related to about 90% of the overall metal content (Factor 1, Fig. 2), and fits with the space distribution of metal ratios –compare Figs. 1 & 2-, while there seems to be a second, unimportant, event represented by Factor 2 (supergene silver enrichment?). Additional processes, as boiling, can also enhance precipitation; a fluid inclusion study is being carried out as well, to check the (palaeo)thermal history of the vein, and its consistency with the lithogeochemical picture discussed above.

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[1] Projects AL05_PID_0021 (Universidad Politécnica de Madrid) and ALFA II 0459FA (European Union). The support of Compañía Minera Caudalosa and its staff is gratefully acknowledged.

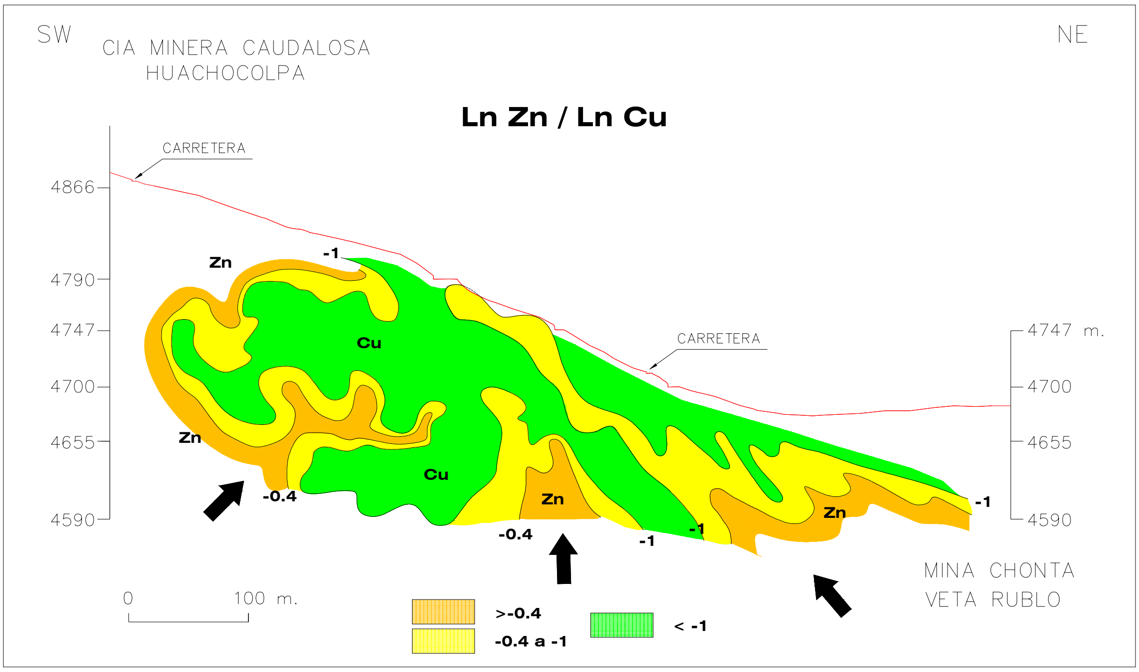

Figure 1. Metal ratios lnZn/lnCu

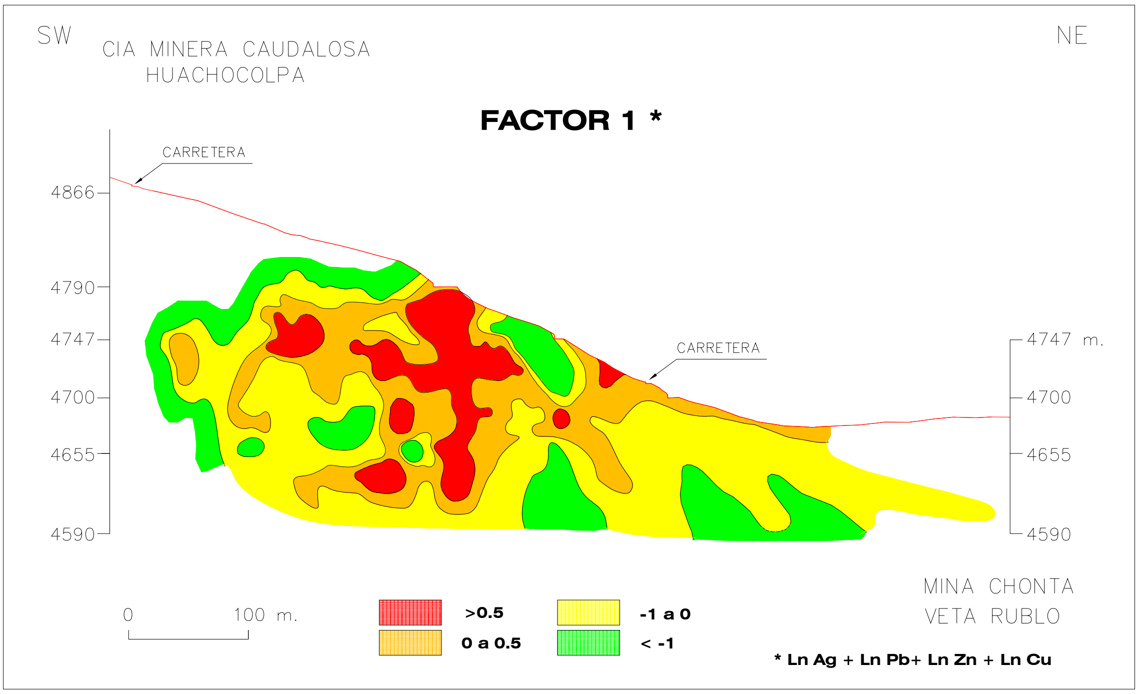

Figure 2. Spatial distribution of Factor 1 (isolines)