GEOCHEMISTRY OF PATRICIA Zn-Pb-Ag DEPOSIT (PAGUANTA, NE CHILE)

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Abstract

The Patricia Zn-Pb-Ag ore deposit is located within the Paguanta mining project, situated at the northern end of the Andean Oligocene Porphyry Copper Belt of Chile. The sulfide mineralization occurs as W-E oriented veins hosted in volcanic rocks, mainly andesite (pyroclastic, ash and lavas), of Upper Cretaceous to Middle Tertiary age.

Samples examined in this study were collected from outcrops in the Patricia deposit. Several drill cores that cut the mineralized veins were also studied. Samples were studied by transmitted and reflected optical microscopy, as well as environmental scanning electron microscopy (ESEM) operated in backscattered electron mode. These microscopy analyses were followed by electron microprobe (EMP) studies. We carried out analyses of the whole rock of selected samples and drill cores by ICP/MS and XRF. Contents of major and trace elements were obtained. Least squares linear regression was applied to each pair of element showing linearity, normality and homoscedasticity.

The ore minerals in the veins comprise in order of abundance, pyrite, sphalerite (5.5 - 10.89 wt % Fe, 9.8-19 % mol FeS and 0.52 wt % Cd), galena, arsenopyrite, chalcopyrite and Ag-bearing sulfosalts. The veins show a zoned and banded internal structure with pyrite at the edges and sphalerite in the center. The Ag occurs mostly as Ag-Cu-Sb sulfosalts, in order of abundance: series freibergite - argentotennantite – polybasite and stephanite. Other minor Ag phases such as argentite, pyrargirite and diaphorite were also identified. These Ag phases are typically associated with the base-metal sulfides. Freibergite occurs filling voids within sphalerite, chalcopyrite and at the contact between sphalerite and galena. Polybasite, stephanite, pyrargirite and argentite are mostly in close association with freibergite. In the case of diaphorite, it commonly occurs filling voids between galena crystals or as inclusions within galena. Some minor Ag-bearing sulfosalts are also identified between pyrite crystals. The alteration minerals are dominated by chlorite, illite and kaolinite. The gangue minerals consist of quartz and carbonates identified by XRD as kutnahorite.

We obtained linear correlation statistically significant only for Ag, As Au, Cd, Cu, Pb, Sb and Zn and therefore we generated an enhanced scatter plot matrix of these elements (Figure). Bulk rock analyses of drill cores show that Ag is strongly and positively correlated with Pb and As, moderately with Cd, Sb, Au and Zn and weakly

with Cu, while Au is moderately and positively correlated with Ag, As, Cd, Sb and Zn and weakly with Cu and Pb. These results are consistent with bulk rock analyses of selected and mineralizated samples were similar correlations have been obtained.

Ag positive correlations indicate that the formation of Ag-bearing minerals is mainly associated with galena, arsenopyrite and sphalerite occurrence. Au positive correlations indicate that this element occurs in close relationship with Ag-bearing minerals, arsenopyrite and sphalerite. The weak correlation between Cu and Ag and Au indicate that the formation of chalcopyrite is not related with the main stages of Ag-Au mineralization.

The main conclusion of this study is that geochemical analyses along drill cores that cut mineralization confirm that the occurrence of Ag and Au in the Paguanta deposit is associated with the formation of galena, arsenopyrite and sphalerite. This study suggests that the Patricia deposit represents an example of epithermal mineralization of low or intermediate sulfidation state.

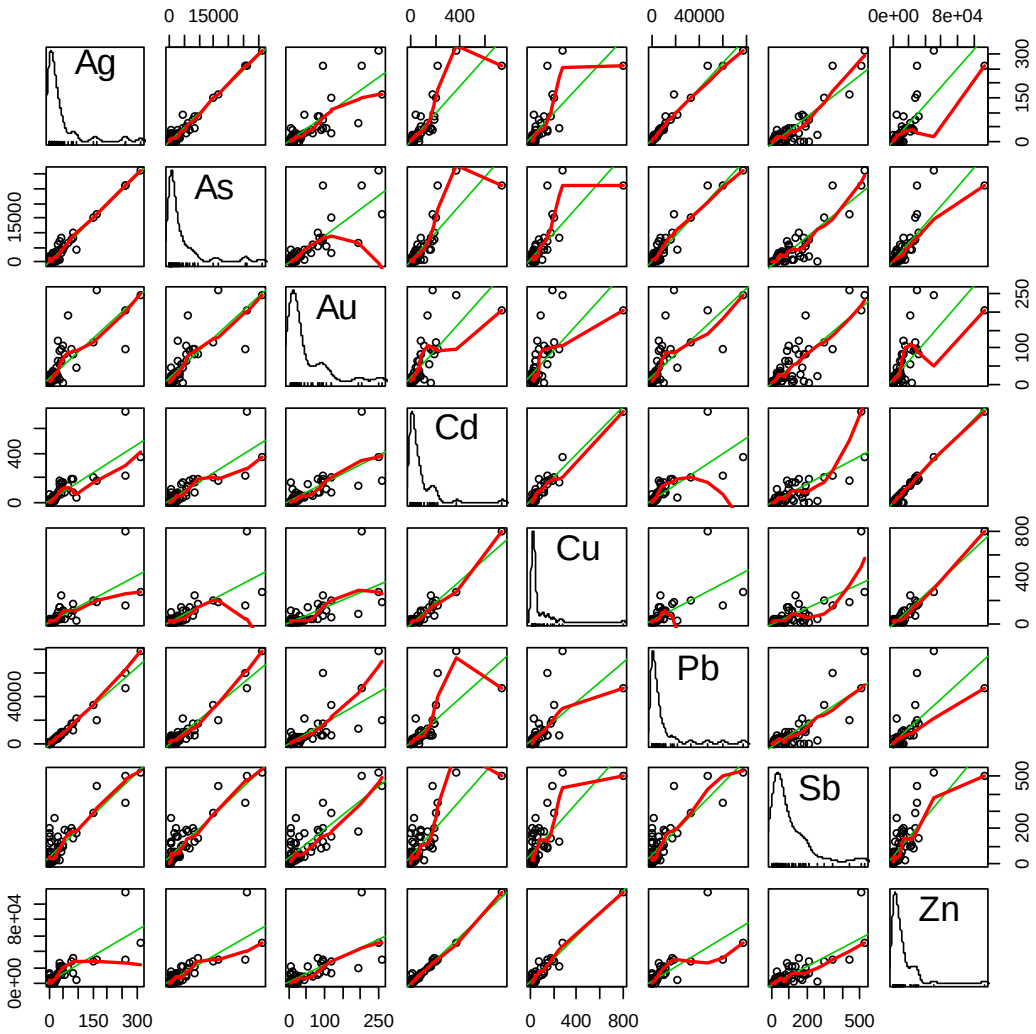

Figure. Matrix of scatter plot of Ag, As, Au, Cd, Cu, Pb, Sb and Zn. Least squares linear regression line (green) and nonparametric regression smooth line (red) is displayed in each scatter plot. Density plots of each element are also displayed down the diagonal. Units are ppm for all elements but ppb for Au.

Table. Pearson coefficients obtained for least squares linear regression of each pair of element.

R^2	Ag	As	Au	Cd	Cu	Pb	Sb	Zn
Ag		0.95	0.66	0.72	0.59	0.96	0.77	0.66
As	0.95		0.71	0.74	0.61	0.91	0.67	0.70
Au	0.66	0.71		0.61	0.45	0.49	0.62	0.66
Cd	0.72	0.74	0.61		0.90	0.64	0.51	0.97
Cu	0.59	0.61	0.45	0.90		0.49	0.47	0.86
Pb	0.88	0.91	0.67	0.84	0.81		0.57	0.57
Sb	0.77	0.67	0.62	0.51	0.47	0.57		0.53
Zn	0.66	0.70	0.66	0.97	0.86	0.57	0.53	