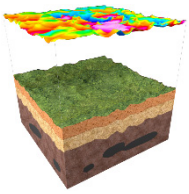

WORKSHOP - SOLOS EM PROSPEÇÃO MINEIRA
CASOS DE ESTUDO SOBRE PROSPEÇÃO GEOQUÍMICA DE SOLOS
Centro Ciência Viva do Lousal | 11 de Dezembro de 2015
INICIATIVA COMEMORATIVA DO ANO INTERNACIONAL DOS SOLOS

Geochemistry of soils and stream sediments in the NE border of the Iberian Pyrite Belt: Implications to Mineral Exploration

Filipa luz[1*], António Mateus[1], João Xavier Matos[2], Mário Gonçalves[1]

[1] Dep. Geologia e IDL, Faculdade de Ciências, Universidade de Lisboa, C6, Piso 4, Campo Grande, 1749-016 Lisboa, Portugal
[2] Laboratório Nacional de Energia e Geologia, U.I. Recursos Minerais e Geofísica, R. Frei Amador Arrais 39 r/c, Ap. 104, 7801-092 Beja, Portugal
*geo.filipa.luz@gmail.com

Key-words: Soils, Geochemistry, Mineral Exploration, Iberian Pyrite Belt

Introduction

Natural materials (*e.g.* rocks, soils, stream sediments) had a chemical composition that can be used to define geological domains. The ore-related geological processes have left geochemical imprints in their host rocks, which are usually related to alteration and/or mineralization processes. In these cases, the contents of some elements (often metals) may present high concentrations that substantially exceed their background threshold. The recognition of these values represents an important step in mineral exploration. The spatial distribution analysis of multi-element concentrations in rocks, stream sediments and/or soil samples makes geochemical surveys an important tool to mineral exploration. Several exploration campaigns were held in the NE border of the Iberian Pyrite Belt (IPB) including the southern region of the Pulo do Lobo Terrane (PLT) concerning soils and stream sediments sampling programs. The large volume of exploration geochemical data collected on this sector is stored in the Laboratório Nacional de Energia e Geologia databases. The aim of this work is making use of an extensive Cu-Zn-Pb soil campaign and additionally Co, Cr and Ni in a stream sediments campaign, as a case study, in this sector of the South Portuguese Zone.

Database and Methodology

The geochemical data (soil and stream sediments) used in this work results from an ensemble of geochemical surveys, performed during the 1990's for mineral exploration purposes. Soil the sampling grid it varies from 300 m X 300 m to 100 m X 100 m in tight profiles making a total of 17424 sampling sites. For stream sediments, which has an irregular grid, were studied 1034 sites from the Guadiana hydrographic basin. The soil were collected between 20-40 cm depth and the stream sediments up to third tributary; the subsequent processing and chemical analysis only used the soil fractions less than 80 *mesh* and were carried out in certificated laboratories using ICP-AES and colorimetric methods after biquinoline extraction.

The preliminary statistical analysis of the Cu, Zn, Pb, Co, Cr and Ni (last three elements evaluated only for stream sediments) allowed the population identification, their distribution and outliers. This was followed by the calculation of statistical parameters and boxplot charts that were used for comparison purposes. According to the method of moments (Halsey et al. 1986) corrected for edge effects (Gonçalves 2001) the data multifractal character was inspected, as well as, the respective multifractal spectrum. The background values, commonly called regional threshold, were calculated using the Concentration-Area model (Cheng et al. 1994). The spatial variability and the anisotropy of each distribution were first through variogram modelling, followed by interpolation (using ordinary kriging), thus producing the final geochemical maps. The anomalies maps were designed taking in account contour values on the regional threshold, which is calculated before.

Results

The final geochemical data results are able to show that the distribution patterns of Cu, Zn and Pb are primarily influenced by the bedrock. The geochemical background calculated to Pulo do Lobo Terrane were 20, 55, 20-30 ppm to Cu, Zn and Pb, respectively.

In the IPB the regional threshold values were displaced on a wide spectrum to each of these three elements (Cu, Zn, Pb) and higher than revealed to PLT results. The proximity to mineralized rocks is indicated by values of Cu, Zn, Pb above 100, 120-150 and 250 ppm, respectively, defined as a first order threshold. For these anomalies, the geochemical maps designed considering multifractal character and the calculation of the regional and local threshold, display strong anisotropy. The separation of Cu, Zn and Pb soil anomalies frequently reflect the existence of distinct metal sources related to original compositional differences or to chemical changes. Usually these three elements display non-coincident anomalies related to the bedrock. Metavolcanics represent the prevailing sources of Cu ±

Pb; for Zn the prevalent source are metassediments from Phyllite-Quartzite Group and the Chança mine area (Luz et al 2014a, b).

The stream sediments evaluation covers six elements and their regional threshold values are 20, 45, 30 and 15 ppm for Cu, Zn, Pb and Co, respectively. Thus, it is possible to estimate the first order local threshold to Cu, Zn, Pb, Co, Cr and Ni (40, 94, 70, 21, 37 and 42 ppm) are delimited, thus producing the geochemical maps. The analysis of these samples allow to infer: the most of these anomalies are clustered to E-SE of the surveyed region, revealing contributions from a variety of sources, mainly related to different metavolcanic rocks with a local contribution of metapelites, contamination from old (generally abandoned) mining activities and hydrothermal mineralization controlled by different fault zones. The last example is particularly visible in the PLT with carbonates ± sulphides infillings of these faults (Luz et al. 2012)

Conclusions

The results show that the methodology used for the exploration geochemical data processing is suitable to estimate threshold values and recognize anomalies which were confirmed in the field. The main anomalies on the surveyed region reflected contributions from a variety of sources, namely different volcanic units with local contributions from pelite rocks, contamination from old (abandoned) mining activities and hydrothermal mineralization controlled by different fault zones.

References:

Cheng, Q., Agterberg, F. P., Ballantyne, S.B., 1994. Separation of geochemical anomaly from background by fractal methods. J. Geochem. Explor., 51, 109– 130.

Gonçalves, M. A., 2001. Characterization of geochemical distributions using multifractal models. Math. Geol., 33, 41-61

Halsey, T.C., Jensen, M.H., Kadanoff, L.P., Procaccia, I. and Shraiman, B.I. 1986. Fractal measures and their singularities: the characterization of strange sets, Phys. Rev. A, 32A, (2), 1141-1151.

Luz, F., Mateus, A., Matos J.X., Gonçalves, M.A., 2012. Geochemistry of stream sediments southwards of the SW Variscan suture in Portugal (Guadiana and Chanc¸a river basins): insights into element anomalies of variable origin and intensity, Applied Earth Science (Trans. Inst. Min. Metall. B), 121, 137- 150.

Luz, F., Mateus, A., Matos J.X., Gonçalves, M.A., 2014a. Cu- and Zn-Soil Anomalies in the NE Border of the South Portuguese Zone (Iberian Variscides, Portugal) Identified by Multifractal and Geostatistical Analyses, Nat. Resour. Res., 23, 195-215.

Luz, F., Mateus, A., Matos J.X., Gonçalves, M.A., 2014b. Cu, Zn and Pb soil geochemistry data from the NE domain of the Iberian Pyrite Belt in Portugal; implications to mineral exploration, Geochemistry, Explor., Environ. Anal., 14, 331-340.