Spatial analysis of geological structures favorability for the occurrence of Sn and W mineral deposits in Bejanca Mine (Viseu – Portugal)

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Abstract

The geographic information systems (GIS) are very useful tools for compilation and management of information of different types and sources. These may be used to produce potential or predictivity maps for the definition of areas of high potential for occurrence, but that are not yet known deposits. The integration of different data in the same referential may allow a better understanding of the parameters that control the metallogeny of the region.
In order to better understand the structural influence in Bejanca Tin and Tungsten Ore Deposit, we chose to evaluate the spatial correlation between the known occurrences of tin and tungsten and fracturing. These correlations can be very useful in the future development of a predictability map for tin and tungsten deposits.

Fig 1.- Ancient Bejanca Mine.

Fig 2.- Actual aerial image view were we can identify the lake (resulting from the open pit), the mine tailings and the dense vegetation coverage surrounding the mine..

Introduction

Bejanca Mine is located in the district of Viseu, more specifically in Queirã, Vouzela. This Mine begun cassiterite and wolframite exploitation in 1917.

This region consists of greisenized masses included by porphyritic two mica granite, with dominant biotite. Some quartz veins cut the greisen in different directions. This granite contains tourmaline and is traversed by small greisenized veins, oriented NW-SE. Faults are often filled by quartz, cassiterite, wolframite and clay.

The mine area is crossed by a fault system N30 º W, there is a fault system oriented N20 º whose box failure is filled with clay, as well as other well-marked direction N55 º E and N70 º E (Cotelo Neiva, 1944).

The numerous Sn-W mineralizations located in the study area are arranged roughly in the peripheral borders of granitic batholith (Viseu). It is envisaged that the transfer may have occurred from the region adjacent to batholith and was thermally induced by the granitic intrusion. Matter would be obtained from the leaching of the moscovitic-biotitic granites and eventual primary Sn-W mineralization that they contained.

The concentration of tin and tungsten occurrences are bounded laterally by two faults on the west by the Ribama Fault approximate N-S direction and by a fault of this approximate direction NW-SE. These mineralizations are agglomerated in a region of dense fracturing.

Regional fracturation is organized in families arranged mainly according to the following directions: N45-60° and N300-310°, corresponding to the most common directions, followed organized by frequency N20-35°; N335-355° and N80-90° (Ferreira *et al*, 2010).

The highest concentration of mineralization is located on NW of the Geological Map 17 A – Viseu (Fig. 3), in a region composed by the Abraveses granite. It allows us to suspect of a strong structural control, since this tin and tungsten occurrences concentration are laterally bounded by two faults.

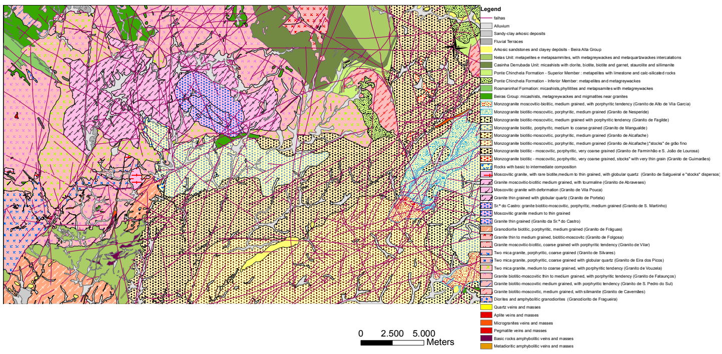

Fig 3.- Geological context of Bejanca Mine (Extract of Geological Map of Viseu 17-A at scale 1/50000).

Methodology

Delfim de Carvalho (1977), attempted to correlate spatial distribution of endogenic deposits known in Portugal with the main lineaments patterns. He found that a large part of the deposits are located on or near lineaments intersections, suggesting structural control as a factor in their location.

For the geological structures spatial analysis, we used the algebraic method (Knox-Robinson and Groves, 1997) to quantify the criteria associated with different fault classes.

Our set of data points correspond to deposits as well as linear data correspond to fault structures, identified in the geological map of Viseu 17A at scale 1/50000 (LNEG, Portuguese Geological Survey). A value of 1 is assigned to deposits (points), regardless of their size. Placing a value on the line consists of looking for deposits located inside a band parallel to the line, so all deposits within a certain maximum distance (dmax) of a fault was assigned to the line (Fig.4).

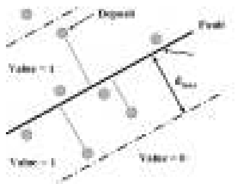

Fig 4.- Diagram that ilustrates assignement criteria for each fault.

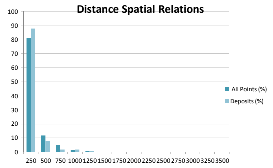

Fig 5.- Spatial Relation of distance between mineral depósits and faults.

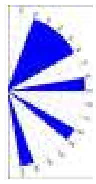

Fig 6.- Most common fault directions

The maximum distance (d max) used in the study was 250 meters. This was determined graphically on a cumulative frequency histogram of mineral deposits on the distance to the closest faults (Fig.5). In this diagram it was found that about 88% of ore occurrences are located within 250 meters of a fault, so this was the area of influence considered in our study.

Note that the same deposit can be included in the area of influence of various faults. Values were assigned to failure criteria according to its direction, using class intervals of 10 º, ranging from 0 º to 180 º. The weight was assigned (ni) of failures of category i was calculated from the favorability of the line that is the sum of weights of each fault belonging to each category. The calculated favorability FAVI it is the relative index weight quotient (Pri=weight of each fault category, ni, over the total weight of all the categories, Ntot), weighted by the relative length (Lri =length of family i, or Length, over the total length of all the faults in the area studied, Length tot), (Eqs. (1), (2), (3), and Table 1).

$$Pr_i = \frac{ni}{Ntot} \quad (1)$$

$$Lr_i = \frac{Lengthi}{Lengthtot} \quad (2)$$

$$Fav_i = Log10\left(\frac{Pri}{Lri}\right) \quad (3)$$

Results

The favorable values for mineral deposits occurrence for each Fault Class are summarized in the graph (Fig.7) as well as in the table1.

Classes	Faults N.	Length	Mean	Lri=Lengthi/ Lengthtotal%	ni	Pri=ni/Ntotal%	Favi	Favorability
0º-10º	170	71106	418,2706	5,699633042	31	31,63265306	0,744289	0,744289
10º-20º	197	86266	437,8985	6,914810902	10	10,20408163	0,168994	0,168994
20º-30º	271	121348	447,7786	9,726873546	11	11,2244898	0,062193	0,062193
30º-40º	299	127647	426,913	10,23178155	4	4,081632653	-0,39912	0
40º-50º	280	110091	393,1821	8,824547875	6	6,12244898	-0,15877	0
50º-60º	186	81762	439,5806	6,553784445	23	23,46938776	0,55401	0,55401
60º-70º	220	108364	492,5636	8,686116994	12	12,24489796	0,149129	0,149129
70º-80º	144	60367	419,2153	4,83882862	4	4,081632653	-0,07391	0
80º-90º	156	65875	422,2756	5,280332555	9	9,183673469	0,240355	0,240355
90º-100º	161	60590	376,3354	4,856703598	16	16,32653061	0,526552	0,526552
100º-110º	66	23745	359,7727	1,903324425	13	13,26530612	0,843204	0,843204
110º-120º	106	42688	402,717	3,421735652	10	10,20408163	0,474527	0,474527
120º-130º	196	77446	395,1327	6,207827477	5	5,102040816	-0,0852	0
130º-140º	65	25681	395,0923	2,058508089	17	17,34693878	0,92567	0,92567
140º-150º	49	18238	372,2041	1,461900647	21	21,42857143	1,166075	1,166075
150º-160º	95	30546	321,5368	2,448471168	18	18,36734694	0,875151	0,875151
160º-170º	151	57376	379,9735	4,599079479	10	10,20408163	0,346103	0,346103
170º-180º	163	78418	481,092	6,285739936	19	19,3877551	0,489171	0,489171
Total	*2975*	*1247554*	*419,3459*	*100*	*98*	*100*	----------	----------

Table 1.- Favorability assignment.

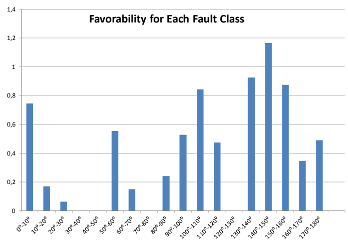

Fig 7.- Favorability estimated for each fault class.

Conclusion

The spatial relations analysis between the fault and the known occurrences of tin and tungsten in the region revealed that, despite the most common fractures being N45º-60 ° and N300º-310º, followed ordered in terms of frequency, N20 º -35 °; N335º-355º and N80 °-90 °, the fractures more favorable for Sn and W deposit occurrence are those having N130º-160º, N100º-110º and N0º-10º directions.
The results obtained by spatial analyses can result in great importance for future deposits unknown occurrences predictive analysis.

References

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