METALLOGENETIC IMPLICATIONS OF THE GEOCHEMISTRY OF THE VILARIÇA FAULT BRECCIAS: A PRELIMINARY STUDY

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The Vilariça strike-slip fault is one of the major sinistral structures of the late-variscan fracture network (Ribeiro, 1974, Serv. Geol. Port. Mem. 24; Cabral, 1989, Tectonics 81:285). In its Northern segment, in Western Trás- os-Montes, the fault zone is underlined by different fault rocks and siliceous hydrothermal precipitates which represent different styles of deformation and fluid flow during the successive seismogenic cycles responsible for fault propagation. The circulation of these hydrothermal solutions produced an im- portant chemical signature in the wall rocks (Mateus, 1989, Thesis U. Lisbon).

In some fault segments, namely at Quintela de Lampaças (N of Macedo de Cavaleiros), late breccias with siliceous and/or hematitic matrix are prominent and locally extremely enriched in iron (oxides-hydroxides), as well as in other metallic elements. In general, these rocks can be classified as infill breccias. Resorption and recrystallisation of fragments is missing and a late siliceous phase is a major matrix component (>60%). Locally, aggregate breccias (matrix composed of quartz-hosted fragments of variable dimension) can be important. Usually the red breccias overlap, and sometimes contain, fragments of an earlier green micro-breccia (sericite-chlorite-enriched), which compri- ses abundant clasts of ultracataclasite of acid-tuffitic nature, and quartz- cataclasites with specular hematite. In other fault domains (e.g. Quinta da Terrincha, N of Moncorvo), the development of late red breccias is more restricted; nevertheless the hydrothermal alteration pattern exhibited by wall rocks supports the circulation of fluids with similar chemical characteristics at identical PT conditions, i.e., oxidising and almost neutral solutions at temperatures and global pressures lower than 150°C and 1 kbar, respectively (Mateus, 1989, Thesis U. Lisbon). The same structural and hydrothermal expressions were found along several branches of the Vilariça system in the França sector (N of Bragança), where the brecciated quartz fillings are frequently enriched in Fe oxides. However, in França there are subsidiary structures of the Vilariça system included in the França lode gold-silver deposit; these include N15-30W subvertical quartz-siderite-sulphide veins with electrum (Mateus & Barriga, Gold'91, Belo Horizonte, in press).

Representative samples from Quinta da Terrincha, Quintela de Lampaças and França red breccias were analysed for 51 elements, including Au and Ag. Petrography and X-ray diffractrometry of breccia matrices show that quartz + hematite ± goethite ± hydrous-phyllosilicates (specially smectites) and sparse manganese oxides are the prevailing mineralogical association; arsenates, sulphates and/or phosphates may be present in some samples.

As expected, there is a general tendency for SiO_2 or Fe_2O_3 enrichment with negligible amounts of MnO and expressive and near constant LOI values. The entire suite

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of analysed breccias is almost devoid of Na_2O; MgO, CaO and K_2O content are consistently low. Positive covariant relationships for Al_2O_3-(CaO+MgO) and Al_2O_3-(CaO+MgO+ K_2O) distributions are consistent with the presence of smectites. In some hematitic samples, where extremely low values of alumina coexist with high LOI content, the behaviour of (Al_2O_3/LOI)-As, As-Pb, As-(Zn+Pb) and (Al_2O_3/LOI)-P distributions suggest the presence of hydrated metal arsenates and phosphates.

The abundances of many trace elements are widely variable, and often clearly anomalous for hydrothermal precipitates, such as (on a silica-free basis) Ba (64-1827 ppm), B (30-214 ppm), Cs (2-61 ppm), Be (17-215 ppm), Ni (2-2129 ppm), V (9-126 ppm), Cr (64-444 ppm), Co (6-112 ppm), Zr (43-490 ppm) and Ti (0.02-0.76 %), Nb (<20-185 ppm), Cd (<2-22 ppm), Sc (<5-29 ppm), U (<4-592 ppm), W (<35-147 ppm), Mo (<20-31 ppm). Enrichments in some of these elements (specially B, W, Cr and Ni) are characteristic of some lode gold deposits in Archean Greenstone Belts (e.g. Fyfe & Kerrich, 1984, Gold'82, Rotterdam: 99). In these deposits the V, Be and Co content and their covariant relationship with Al, Sc and Zr are interpreted as a result of the nature and extent of wall-rock fragments incorporated into veins; significant concentrations of other lode-association elements are suggestive of efficient leaching and/or element selectivity during metamorphic degassing at 400-600°C.

Gold and silver contents of red breccias are quite variable. Ag contents are often below the detection limit of coupled plasma mass spectrometry (0.5 ppm), and up to 151 ppm. Au values are anomalous, ranging from 0.03 to 33 ppm (ore grade Au and Ag in França only). Au distribution shows high positive affinity with As, Pb and Sb, and strong inverse correlation with Fe_2O_3 and MnO. Although scattered, Au - V, Au - Co, Au - Ni and Au - Sc distributions are suggestive of an inverse behaviour; for the Quintela de Lampaças breccias, Au - U are strongly covariant.

The chemical signature of Vilariça's red breccias suggests that they can be interpreted as a surface expression of deep gold-silver-sulphide-carbonate mineralisation. However, it is necessary to explain why Au concentrations are below the values normally associated with exploitable occurrences. We envisage three main possibilities:

(1) mineralisation stood out in relief at the time of late seismic activity, under unsuitable conditions for formation of an enriched iron-hat. The abrupt increase in permeability due to fracturing could even have leached primary, free precious metals, via pyrite oxidation and carbonate breakdown, coupled with Au and Ag dissolution in thiosulphate complexes; these could be reprecipitated at or near the water table (Butt, 1989, Econ. Geol. Mon. 6:460);

(2) Au-enriched red breccias may have formed, to be subsequently leached, through action of nearly neutral, saline and oxidising hydrothermal solutions, perhaps related to Late Pliocene regional pedi-planation. Late Pliocene/Early Quaternary climatic fluctuations from humid to (semi)-arid conditions could, also, gradually impoverish the remains of the oxidised gold-silver enriched zone and lead to electrum deep deposition;

(3) High-grade Au-Ag mineralisation has never been exposed at surface. In this case, the red breccias derive from sulphide-carbonate rich parageneses above Au-Ag ore material, which is nearly quantitatively preserved under the surface. Research in progress will hopefully enable selection of one of these hypotheses.