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Rifting, deformation, metamorphism, hydrothermalism and gold precipitation recorded in volcanic rocks (The Truchas Syncline, Variscan Belt, NW Spain)

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Ordovician volcanic rocks outcrop in several locations of the NW Iberian Variscan belt. Composition is bimodal (basalts and rhyolites) and they occur as volcanic-volcanoclastic deposits within shale formations. This work focuses on the basaltic rocks (near to Cunas village) which outcrop within a prominent Variscan structure, the Truchas Syncline. We studied field relations, petrography, petrology-geochemistry and conducted T-XCO_2 modelling to review the petrogenesis and establish the subsequent evolution of these volcanic rocks. In addition, its relationship with local orogenic gold deposits is evaluated.

1. Incipient Ordovician rifting: The studied rocks are alkaline basalts with an OIB signature (high Ti/Y, Nb/Y and Nb/Yb ratios). Where altered and sheared, they may display other signatures. Crustal contamination is absent or very minor, given the low SiO_2, K2O, and Rb contents, and the elevated Nb/La ratios (1-1.5). These features indicate an origin by low melting degrees of the upper mantle and a continental rifting environment in its incipient stages.

2. Marine conditions: The finding of orthid brachiopods in some of the volcanoclastic rocks suggests a shallow marine environment for the volcanic sedimentation. The small volume of the basalt debris and its rapid cooling due to water interaction favored the preservation of this biota. In other deposits, a scum layer (30-40 cm) shields massive volcanic flows. These scums probably developed through rapid H_2O-rock interaction.

3. Variscan deformation and metamorphism: This ($\approx$ Lower-Middle Mississippian) occurred at lower greenschist conditions (chlorite-temperatures: 370-420ºC). Where shear zones affected the volcanic rocks, strong cleavage and metasomatism were developed. The sheared volcanics show losses in Si, Mg, Ca, Na, Sr, V and gains in Fe, K, Rb, Th, Pb, Ba, Y, Nd and Yb.

4. Relation with the orogenic gold: Fe-bearing dolomite grew over previous minerals (plagioclase and chlorite). Quartz+carbonate veins cut across the rest of the phases. These veins indicate that H_2O-CO_2 hydrothermal fluids traversed some of the volcanic rocks, reacting with Ca-Fe-Mg phases to produce the observed carbonates. T-XCO_2 modelling indicates temperatures below 350ºC and XCO_2 between 0.10 and 0.45. Such fluids are known to be important carriers of Au in the form of the bisulphide complex Au(HS)2. Gold deposited in adjacent quartzites may have been transported in this way, by these late orogenic fluids, whose imprint is in the carbonation of the volcanic rocks.

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