

Mineralogy and Geochemistry of Paleozoic Black Shale in the Priorat DOQ Region (Catalonia, Spain) and the Concept of Geochemical Terroir

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Paleozoic black shale underlying Priorat vineyards in Catalonia (Spain) is composed of Ca-pyroxene, amphibole, feldspar, biotite, calcite, siderite and biogenic carbon along with accessory magnetite, bacterioform pyrite, pyrrhotite, zircon, rutile, titanite, sphalerite, fluorite, monazite-(La, Pr), (Dy, Gd, Er)-xenotime, native copper and osmium as well as hydrothermal goethite and portlandite. Ubiquitous Ag minerals include jalpaite (Ag_3CuS_2), argentite (Ag_2S), sternbergite (AgFe_2S_3), cerargyrite (AgCl), bromargyrite (AgBr) and native Ag. Priorat shale is enriched in K, Cu, Zn, Se, Sr, U and depleted in Nb, Hf, Zr, Y reflecting subduction-related magmatic sources (high-K andesites, shoshonites, collision-type granites). Priorate shale displays high concentrations of Au (up to 1161 ppb), as well as Pt, Ru, Rh and Ir. Three stages of Paleozoic sediment formation are recognized: 1) accumulation of detrital igneous material; 2) hydrothermal mineral formation and 3) biogenic mineral formation. Ag, Au, Pt, Zn, Cu and Se enrichments may influence (mostly as catalysts) 1) rates and types of chemical (e.g. alcoholic fermentation) reactions; 2) levels of plant metabolites; 3) vine stress response to micronutrient components, and 4) expression of specific genes that are involved in the production of compounds that determine flavor. We propose a term “geochemical terroir” for specific geochemical environment of vine growth defined as a coherent association of chemical elements in rock and soil, resulting from certain petrologic and tectonic processes, that might have influence on grape growth and related wine characteristics.