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Iron oxide coloration and concretions of the Lower Triassic Buntsandstein Formation, SE Iberian Chain, Spain

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The Lower Triassic Buntsandstein Formation of Europe is well known for its classic red beds of fluvial cross-stratified sandstones, however relatively little is written on the diagenetic history and the common iron oxide concretions. Examples of red, pink, orange, brown, purple/black, and white coloration and iron-rich concretions are present in the Buntsandstein in the southeast Iberian Mountain Range of Spain. This includes Serra Calderona outcrops, eroded Buntsandstein cobbles in modern rivers (e.g., Palancia River) and beaches (e.g., Puçol) of Valencia, and nearby areas of cobbles of Vall d'Uixo river (Castellón), and outcrops of Cuenca (Castilla la Mancha) and Teruel (Aragon).

Coloration patterns as well as liesegang banding commonly cut across the primary trough cross-stratified Buntsandstein host rock. Spheroidal concretions range from small micro "dots" ($\sim$ 1mm diameter) up through larger sizes of $\sim$ 10 cm diameter. Large well-defined spheroidal concretions typically show a thick, outer iron oxide-cemented rind, sometimes with a center isolated core resembling dark "eyes". Some large concretions show geometric triangular to square shaped iron-rich cores, interpreted as pyrite precursor crystals that later oxidized. Other concretions show multiple thin, wavy, concentric rings comprising the cemented mineral mass. Discrete, self-organized, spheroidal concretions have common cemented rinds that are more resistant to weathering than the sandstone host. Clustered iron oxide concretions typically show weak cemented rinds to form recessive weathering patterns in the host rock. Where clustered forms flare from upper bedding plane surfaces, the distributions suggest relationships to microbial or organic matter that were sites for preferential iron oxide mineralization.

Although it is difficult to decipher the origin and timing of the iron-rich concretions, the Valencia and Castellon areas could have been influenced by hydrothermal fault fluids from the with Triassic and Jurassic volcanism, close to the Caudiel fault. Petrographic studies show common iron-oxide replacement of pre-existing feldspar and mica grains, and strongly corroded monocrystalline and polycrystalline quartz grains in the concretions. More comparative studies of these Triassic iron oxide concretions with other global examples can contribute to a better understanding of complexities in iron cycling, and controls and timing of fluid flow through major porous reservoir sandstones.