Preservation of biosignatures in sulfates and iron oxides at Rio Tinto, Spain: implications for the astrobiological investigation of chemically analogous deposits at *Meridiani Planum*, Mars

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The NASA rover *Opportunity*'s onboard instruments have recognized sedimentary deposits containing abundant sulfates and hematite in the *Meridiani Planum* region of Mars. Modern, Holocene, and Plio-Pleistocene terraces of the Río Tinto, southwestern Spain, are considered as a partial sedimentary analog to *Meridiani Planum* rocks, facilitating our understanding of the genesis and diagenesis of the *Meridiani* minerals and informing considerations of Martian astrobiology. Headwaters enriched in sulfuric acid and ferric iron are generated by groundwater oxidation of pyritic ore bodies in the source area of Río Tinto. Seasonal evaporation of river water precipitates hydronium jarosite and schwertmannite, while copiapite group minerals, coquimbite, gypsum, and other sulfate minerals occur nearby as salty efflorescences where locally variable source waters are transported to the surface by capillary pumping: In the rainy season, meteoric waters hydrolyze sulfate salts, inducing the precipitation of nanophase goethite; during diagenesis, an increase in goethite crystallinity is followed by goethite replacement by hematite. Diverse microorganisms inhabit the acidic Río Tinto environment, but organic matter does not persist in Río Tinto sediments. Nonetheless, biosignatures are imparted to modern sediments and retained in ancient sediments as macroscopic textures of coated microbial streamers, surface blisters formed by biogenic gas, and microfossils preserved as casts and molds in iron oxides. Such features suggest that if life existed at Meridiani when the outcrop rocks were deposited, it may have a preservable signature. In this way, Río Tinto geobiology provides a guide to future astrobiological exploration of the *Meridiani* sedimentary record.