

When the Rains Come: Hydrochemical Response to Extreme Weather in the Tinto River Estuary (Huelva, SW Spain)

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The Tinto River is significantly affected by acid mine drainage, with substantial seasonal fluctuations in its pollutant load. This study evaluates the effects of the initial rainfall following summer drought period on the pollutant loads received by the Tinto estuary, which also corresponds with an extratropical cyclone in October 2023. Over three days, 72 samples were collected every 30 minutes (12 hours per day) using an autosampler in the fluvial domain of the estuary. The climatic extreme event caused a large fluvial discharge in the estuary with Fe dissolved concentrations two orders of magnitude higher than the annual mean values in the estuary, reaching up to 180 mg/L at the beginning of the event and decreasing to 16 mg/L at the end (Fig. 1). Iron precipitation seemed to buffer the pH at the observed acidic values (2.6-3.0), hindering the tidal influence, which was only recorded by the changes in electrical conductivity (2.8-37 mS/cm); although the typical values of seawater (≈ 55 mS/cm) were not registered. The dissolved concentrations of potential toxic elements, namely Al, Cu, Pb, As, Co, Ni, Cd and Cr, were also remarkably elevated (Fig. 1). Of greater concern, however, are the concentrations associated with suspended particulate matter (SPM), consisting mainly of clays and iron precipitates. In this sense, As concentrations of up to 657 ppb have been recorded in association with SPM. It is anticipated that, upon SPM reaching circumneutral areas, the associated As will be desorbed from the Fe precipitates [1], releasing significant amounts of As into the Atlantic Ocean proving to be of critical significance. It is highly probable that this event recorded the pollution plume resulting from the intense washout of evaporitic salts precipitated during the summer along the Tinto River basin. During such events, large amounts of acidity and metals reach the Atlantic Ocean [2].

Figure 1. Dissolved Fe concentration, pH and EC during sampling period. Potential toxic elements dissolved concentration ranges.

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[1] Papaslioti, Giampouras, Sánchez-López, Basallote, Freyrier, Cánovas & Pérez-López (2024), *Science of Total Environment* 947, 174683.

