The mine drainage from the spoil tip of a Bavarian pitch coal mine – a history of unmonitored natural attenuation

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For more than 60 years, since the abandonment of coal mining in the Hausham colliery, mine drainage from the site percolates an associated spoil tip over a distance of several hundred meters, before discharging into a nearby lake – the Loidlsee. Generally, coal mine drainage is often characterized by poor water quality, e.g. low pH values, high concentrations in dissolved toxic metal ions and high salinity, posing environmental risks for receiving streams. With this in mind, a closer examination of this apparently unmonitored coal mine discharge was carried out in summer 2020. A coupled elemental and isotopic approach was applied to reconstruct the origin and chemical evolution of mine drainage. Water samples were taken along the mine drainage and from surface waters in the close vicinity of the mine drainage. In addition, solid samples from secondary phases along the mine drainage were analysed. At the discharge location the mine water has a pH-value around 6.5, an electrical conductivity of 2,710 µS/cm and high concentrations of sulphate (> 1,000 mg/l) and iron (2,8 mg/l) and elevated contents of nickel. These values are significantly reduced over the course of the mine water flow, providing the water to enter lake Loidlsee environmentally non-hazardous. Decreasing values are linked to (1) the formation of secondary iron precipitates, (2) the formation of secondary calcium carbonates along the mine drainage and (3) mixing with a different groundwater source along the flow path. $^{34}S/^{32}S$ isotopic ratios of dissolved SO_4^{2-} point to the oxidation of sulphidic minerals such as pyrite. δ^2H_{H2O} and $\delta^{18}O_{H2O}$ values of the mine drainage differ significantly from those of the surface waters which is interpreted as evidence for several flow systems with varying retention times in the catchment.