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Geochemical tracing of As pollution in the Orbiel Valley (southern France): $^{87}Sr/^{86}Sr$ as a tracer of the anthropogenic arsenic in surface and groundwater.

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The environmental impacts of arsenic mining activities and their effects on ecosystem and human health are observed in many stream waters and groundwater. The aim of this study is to identify the origin of As content in a mining environment using Sr isotopes.
At the Salsigne gold mine, before the closure in 2004, high arsenic content has been observed in surface water and groundwater in the Orbiel valley. At the site, immobilization of As, in As rich leachate, is carried out by adding CaO. High contrast in $^{87}Sr/^{86}Sr$ between Arsenic rich minerals associated with Variscan metamorphic rocks (0.714888-0.718835), together with rich As waste water (0.713463-715477), and the CaO (0.707593) allows as to trace the origin of anthropogenic As.
In 2012, Orbiel stream waters were sampled monthly upstream and downstream from the ancient ore processing site and once after an important rainy event (117mm). The upstream valley samples showed low and relatively constant As content with natural regional background of 3.6 and 5.6 μg/L.
The rainy event induced only a slight increase in the As content up to 6.3 μg/L. High $^{87}Sr/^{86}Sr$ ratios suggested an influence of radiogenic Sr issued from the Variscan metamorphic basement. Downstream from the area, the As content was at least10 time as high. In the wet season, stream water As content clearly increased to 13.9-24 μg/L, reaching 120.5 μg/L during the rainy event. Associated $^{87}Sr/^{86}Sr$ ratio showed to be less radiogenic (0.712276-0.714002). The anti correlation observed between As and $^{87}Sr/^{86}Sr$ suggest that As issued from a natural origin is characterised by a high $^{87}Sr/^{86}Sr$ compared to As derived from the CaO treatement used on site and characterized by a low $^{87}Sr/^{86}Sr$ ratio. During the dry season, increase in As content was observed reaching 110 μg/L. These highlights the contribution of alluvial groundwater to base flow, probably associated with As reach leachate from the site. Contribution from the alluvial aquifer is confirmed by results from redox potential (Eh) measurements in both surface and groundwater. Hence, $^{87}Sr/^{86}Sr$ appears as an excellent tracer of the origin of pollution associated with CaO treatment widely used in many water treatment processes.