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Arsenic distribution in Yellowstone Lake sediments of active hydrothermal vents

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At Yellowstone, the lake water has been found to carry elevated concentrations of arsenic which may have initially originated from magmatic-hydrothermal activities. The presence of high As in the lake water poses an unignorable threat to the Yellowstone ecosystem as well as potentially delivers As into the nearby aquifer and affects the populated districts. Lake sediments are the important buffering medium of arsenic in the lake water, which may play a key role in controlling the As level in the water but also may be a threat that potentially releases significant As due to the instability of chemical-physical conditions as a result of climate change or the magmatic activities underneath Yellowstone. In particular, how As is hosted in the lake sediments and the capability of key As hosting minerals in buffering As are still unknown; their reactivity during fluid-mineral interactions are not well constrained as well which prevents the prediction of As behaviour at Yellowstone. Here, we report data on lake sediments collected using remotely controlled vehicle from active hydrothermal vents of Yellowstone. We found that the lake sediments at or near the active vents are rich in pyrite and pyrrhotite whereas sediments away from the vent are poor in sulfide. We further observed that the framboidal pyrites, and the fine grain pyrites that surround euhedral pyrite are most enriched in As whereas euhedral pyrite are usually very low in As. Such As presence may indicate As were incorporated into pyrite that formed through microbial activities or fast nucleation through fluid-mineral reactions during the cooling of vent fluids. However, these As-rich pyrites seem to be less stable and susceptible to environmental uncertainties, which may make them easily release As back into the lake water. Our new data demonstrate that the As content in lake sediments is strongly affected by hydrothermal activities, which may play a key role in controlling the overall As budget of the Yellowstone aqua environment.