Enhanced arsenic leaching due to iron and arsenic phase transformations during ceramic water filter production

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Ceramic water filters (CWF) are produced globally using local clay sources and effectively remove bacterial pathogens during point-of-use (POU) water treatment. Ceramic firing at 800-900 °C causes mineralogical changes to arsenic (As) and iron (Fe) that increase As leaching from CWF material compared to source clay. We present whole-filter leaching and wet chemical extraction data combined with X-ray diffraction and X-ray absorption spectroscopy to show that firing converts As from primarily associated with Fe-oxides to ~30% As in a phase similar to arsenate evaporite minerals. The higher solubility of evaporite As phases combined with increased As-Fe bond distance and Fe incorporation into the ceramic matrix are each consistent with the observed increase in As leaching. Improved understanding of molecular-scale processes governing increased As leaching from CWFs provides a basis for assessing arsenic leaching potential prior to CWF factory capital investment as well as engineered solutions (e.g. modified firing temperature, material amendments, enhanced leaching prior to distribution) to mitigate As exposure from CWFs. Enhanced As leaching using hot water provides an option to mitigate As exposure from CWFs.