

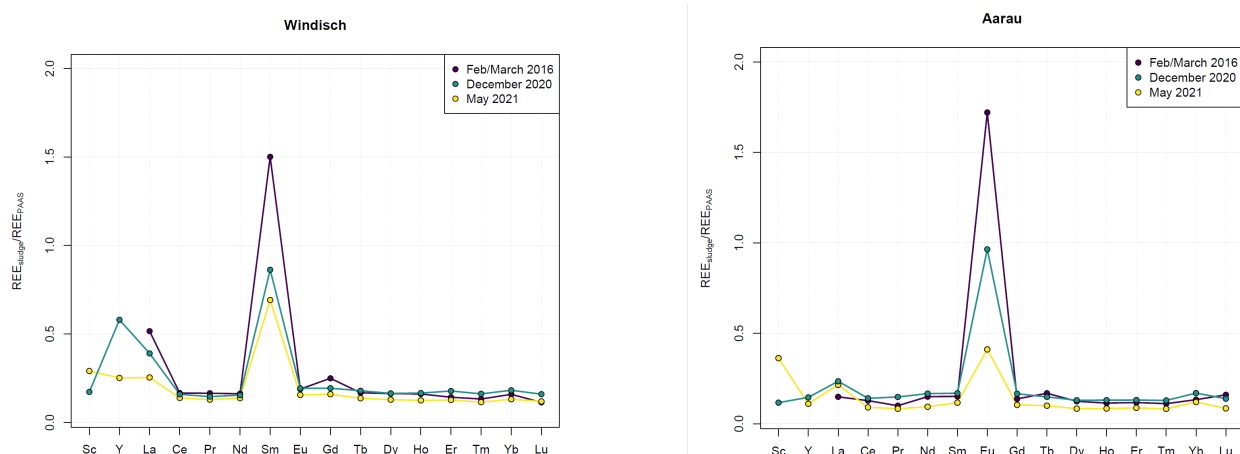
Europium and samarium anomalies in wastewater treatment plants of Windisch and Aarau

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The increasing use of Rare Earth Elements (REEs) for technological applications will likely lead in increased amounts REEs discharged to the environment, with only poorly understood consequences for the receiving compartments. Results from initial screening studies demonstrated the presence of most of the REEs in wastewater [1] and sewage sludge samples [2] collected for more than 60 wastewater treatment plants in Switzerland. Of special interest is the fraction of REEs which is related to anthropogenic activities and in selected sewage sludge samples high fractions of Ce, Sm, Eu and Gd were associated with anthropogenic activities. Additional sampling campaigns confirmed exceptionally high concentrations of Sm and Eu in sewage sludge collected from the wastewater treatment plants of Windisch and Aarau.



In this work, the Sm and Eu anomalies from the Windisch and Aarau WWTPs were, therefore, studied in further detail. Sewage sludge samples were analyzed by triple-quadrupole inductively coupled mass spectrometer (ICP-MS) and normalized to the Post Archean Australian Shale (PAAS). This revealed that PAAS normalized Eu and Sm concentrations were higher compared to their neighboring (PAAS normalized) REEs, suggesting a substantial (anthropogenic) contribution of Sm and Eu to the respective wastewaters. A single-particle time-of-flight ICP-MS (sp-ICP-TOFMS) system was used to analyze the particulate and dissolved fractions of REEs in influent and effluent wastewater, and to estimate the removal efficiency of REEs during wastewater treatment. Low dissolved concentrations of Eu and Sm were found both in the influent and effluent, and no Eu NPs were observed, but Sm NPs were detected. However, the presence of high levels of Eu and Sm in the sludge indicate that further investigation is necessary.

- [1] B. Vriens, A. Voegelin, S.J. Hug, R. Kaegi, L.H.E. Winkel, A.M. Buser, M. Berg, *Environ. Sci. Technol.* **2017**, 51 (19), 10943–10953.
 [2] R. Kaegi, A. Gogos, A. Voegelin, S.J. Hug, L.H.E. Winkel, A.M. Buser, M. Berg, *Wat. Res. X* **2021**, 11, 100092.