Anthropogenic gadolinium in surface water as a tracer of wastewater leaking from sewage pipelines

THAÍS DE PAULA MARTELETO[1] AND JACINTA ENZWEILER[2*]

Institute of Geosciences, University of Campinas UNICAMP, Campinas, Brazil
[1]thais.paula@ige.unicamp.br
[2]jacinta@ige.unicamp.br

Several studies mention the presence of anthropogenic gadolinium (Gd_{anth}) in water bodies. The source of this truly dissolved Gd_{anth} are chelates of this lanthanide employed to enhance magnetic resonance images (MRI). Patients that receive a dose of a Gd-chelate for such purpose excrete most of it in few hours. The Gd-chelates are very soluble and stable and consequently behave distinctly from the remaining lanthanides, resulting in anomalies in water bodies that receive both treated and raw wastewater. Gd_{anth} is not expected in surface water in the absence of such effluents. In this work, we tested Gd_{anth} as a tracer of the presence of wastewater in the water of streams and artificial lakes found in a relatively small area (ca. 20 km^2), most of it the campus of our university, and where three hospitals have MRI facilities. According to the available information, all local sewage is piped to the nearest treatment plant, located about 5 km downstream. Systematic sampling and analysis of surface water along the stream and of the lakes confirmed the presence of Gd anomalies, given by Gd/Gd*, where Gd represents the measured value of Gd in the water sample and Gd* is its expected value, obtained by interpolation with the PAAS normalized values of Sm and Tb. The absence of correlation between the concentrations of Gd and the remaining lanthanides in the samples confirmed the presence of a distinct Gd species. The Gd/Gd* values ranged between 1 and 50, the first in the most pristine water samples with no Gd anomaly. The proportion of Gd_{anth} compared to its total ranged from 10 to more than 95%. The values of the Gd/Gd* increase significantly at the sites where the channeled stream drains in the main lake possibly because most pipe leakings are in the near vicinity. The Gd/Gd* value also presented time variability, which relates to the frequency of MRI exams and if examined patients stay at the hospital or leave it immediately. Correlations of anomalous Gd/Gd* with other wastewater tracers (dissolved organic carbon, boron, and ammonium concentrations) confirmed that Gd_{anth} in the surface water of the area is associated to the unexpected presence of sewage due to its leaking from underground pipes.