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Anthropogenic Gadolinium in Arid Rivers: Evidence from New Mexico

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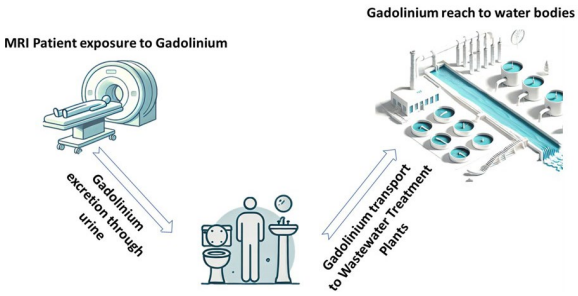

Gadolinium (Gd), widely used in magnetic resonance imaging through gadolinium-based contrast agents (GBCAs), has become an emerging anthropogenic contaminant in aquatic systems. Conventional wastewater treatment plants do not remove these contaminants, and Gd remains in effluent and flows into receiving water systems. While Gd anomalies have been reported in some U.S. water bodies, field-based investigations remain limited, especially in arid and semi-arid regions. This study investigates Gd contamination across New Mexico's rivers. Arid environments differ substantially from humid systems in hydrology and water management. Limited dilution, high evaporation rates, and extensive reuse of surface water and treated effluent affect the transport and persistence of Gd. Despite these conditions, arid regions receive little attention in the literature. New Mexico provides an appropriate setting for this study, with regulated river systems, widespread wastewater inputs, and interconnected surface-water networks that operate under sustained low flows.

To assess the behavior of Gd in surface water, we analyzed both filtered (0.45 micron) and unfiltered acid-digested samples, allowing measurement of dissolved and total Gd. Gd concentrations ranged from <LOD to 0.52 µg/L in filtered samples and from 0.009 to 1.83 µg/L in unfiltered samples. Anthropogenic Gd calculated using the Hissler normalization approach ranged from <0.001 to 0.52 µg/L in filtered samples and from approximately 0.0008 to 0.65 µg/L in unfiltered samples. In several urban-influenced sites (Santa Fe, Las Lunas), dissolved anthropogenic Gd accounted for a large fraction of total Gd, whereas other locations showed elevated total Gd with comparatively low dissolved anthropogenic Gd (Farmington), suggesting particulate association of geogenic contributions. As preliminary results showed the presence of anthropogenic Gd throughout New Mexico's rivers, there is a need to reassess areas with elevated concentrations. Expanding this study to include speciation analysis, other water systems, and agricultural crops will help determine how Gd moves through hydrological and food web networks.