Arsenic groundwater contamination in the Vieira de Leiria-Marinha Grande (O12) Aquifer (Portugal): origin, implications, and challenges for environmental awareness and health protection

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Summary

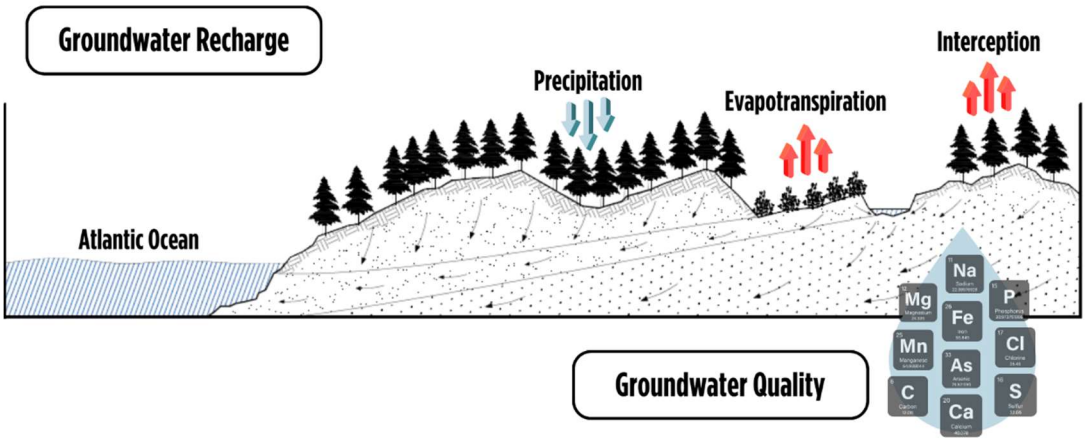
The presence of inorganic arsenic (As) concentrations above the drinking water limit (0.010 mg/L) in the 'Vieira de Leiria-Marinha Grande' (O12) aquifer is a concern for Water and Waste Regulation Authorities (ERSAR), but little is known about its origin, spatial distribution and natural processes involved in its mobilization. Given that groundwater is the only source of water for households and crop irrigation, it constitutes an uncharacterized public health hazard.

This thesis focuses on investigating the mechanisms of arsenic release to groundwater contributing to supporting risk management measures. Firstly, a systematic literature review was conducted in terms of geological and hydrogeological information available, and a database was organized containing all the information including borehole logs and groundwater quality data for geological, hydrogeological, and geochemical characterization of the arsenic distribution. Secondly, an inventory of groundwater wells was prepared, and monthly monitoring campaigns are taking place to collect groundwater level and physical-chemical parameters data to evaluate groundwater recharge processes in the area. Thirdly, the collected data and its interpretation will be used to explain arsenic mobilization and transport.

Finally, a reactive transport model will be built for predicting concentrations and mobilization rates and health risk estimates will be made, and mitigation measures proposed. The next steps of the work will consist of the acquisition of field data using different methodologies to help understand more about the physical properties of the soil and groundwater distribution in order to construct a more robust conceptual model and understand the groundwater flow patterns as well as chemicals' distribution. This will be achieved by: (1) Using geophysical methods (TEM and Georadar) to help determine the vertical heterogeneity and groundwater levels in-depth; (2) Installation of sensors to continuously measure groundwater levels in order to determine groundwater recharge using the water table fluctuation method; (3) Elaboration of unsaturated-zone profiles using tracers to determine infiltration patterns; (4) Groundwater sampling campaign to evaluate the distribution of natural pollutants (As, Fe, Mn, etc.), and (5) Simulating infiltration using undisturbed soil samples to experimentally obtain soil hydraulic characteristics and monitoring water quality.

Keywords

Groundwater, arsenic, contamination, recharge.



Conceptual model of the study area showing the two main topics of interesting in this research.

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