

## Water quality degradation and Nitrate source in the Massa catchment (Morocco), using $\delta^{15}\text{N}$ and $\delta^{18}\text{O}$ tracers

The Massa basin in Morocco suffers from water scarcity and water quality degradation largely due to salinity and nitrate contamination. In this study, a multi-tracer approach, was used that integrated water chemistry, stable isotopes of water ( $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$ ) and stable isotopes of nitrate ( $\delta^{15}\text{N}$ ,  $\delta^{18}\text{O}$ ), to investigate mineralisation and nitrate contamination in the Massa catchment. The main objective was to identify, for the first time in the area, water pollution sources, with an emphasis on nitrate-originated contamination using the  $\delta^{15}\text{N}$  isotope. Water samples were collected from rivers, dams, wells, boreholes and springs, from different parts of the area (irrigated farms, along Massa River, Anti-Atlas Mountains and coastal areas). The results show a large variability of water mineralisation in space indicating rock-water interaction, sea-water intrusion and anthropogenic influence. The lowest mineralization value is measured in spring water located in the Anti-Atlas Mountains while the highest one is measured in Massa River. The results also show a large variability of  $\text{NO}_3$  with high contents in many sites. Some domestic wells showed the highest  $\text{NO}_3$  concentrations. The field investigation reveals a practise where domestic wastewater is being poured directly into traditional septic tanks.  $^{15}\text{N}$  results indicate mixing origins of nitrate related to sea-water intrusion,  $\text{NH}_4$  fertilizers and manure septic which constitute the main issue. Our results will be an essential recommendation for decision-makers for the implementation of wastewater treatment systems before they are discharged into the environment. Improving individual septic systems is also a necessary condition.

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