

# How isotope techniques are contributing to the management of groundwater resources in the Gulfs of Morrosquillo and Urabá, Colombia

## The challenge

Groundwater is the main source of supply for the aqueducts of the coastal municipalities of the Gulf of Morrosquillo (Sucre) and for agricultural use in the Gulf of Urabá (Antioquia), where banana cultivation is economically important. However, limited knowledge about groundwater resources in these regions and inadequate resource use planning have resulted in the overexploitation of the main aquifers. This situation has increased the risk of contamination and has threatened the water supply to populations using these aquifers.

Isotopic techniques can be used to understand the water flow mechanism of the coastal aquifers of Morrosquillo and Urabá. Such techniques support the identification of recharge zones, determine the residence time and age of groundwater, and can establish the relationship between surface water and groundwater. Together with hydrogeochemistry techniques, isotopic techniques can be used to verify the main chemical reactions occurring in the aquifer from recharge to discharge, and to confirm

conceptual hydrogeological models prepared using conventional hydrogeology techniques.

## The project

With IAEA support through a technical cooperation project, the environmental authorities of Sucre (CARSUCRE) and the Coastal Zone of Antioquia (CORPOURABA) have been able to strengthen their capacities to manage water resources. As part of the project, the analytical infrastructure of the Morrosquillo Environmental Quality Laboratory was enhanced to support the analysis of stable isotopes and other isotopes, and specialized equipment was provided to better monitor and assess water resources at the Urabá Environmental Laboratory.

Professionals and technicians from each participating counterpart received specialized training in hydrogeochemistry, isotope hydrology, mathematical modelling of aquifers, hydrogeochemical sampling, field methods, equipment maintenance, isotope data interpretation and the use of specialized software packages.



Members of the Water Group from CARSUCRE and CORPOURABA at a training course on the utilization of equipment to measure Radon-222 in surface and groundwater (photo: CORPOURABA, Colombia).

## The impact

Through the project, detailed information on the state of groundwater resources in the two regions has been acquired. This new information has enabled the elaboration and validation of conceptual hydrogeological models of the coastal aquifers of Morrosquillo and Urabá, as well as their hydrogeochemical and isotopic characterization. With this new data analysis and additional modelling work, plans for the sound management and rational exploitation of these aquifers have been developed and implemented.

Experience and knowledge gained through the project will now be replicated in other aquifers, and institutions in other parts of Colombia will be assisted in elaborating conceptual hydrogeological models and hydrogeochemical models, which will be validated with isotopic techniques with the goal of formulating and implementing management plans for these aquifers.



A laser spectrometer model LGR DLT-100 provided by the IAEA for stable isotope analyses, operating at the Morrosquillo Environmental Quality Laboratory (photo: CARSUCRE, Colombia).

## The science

Isotope hydrology is a branch of the hydrological sciences that uses environmental isotopic and other naturally occurring geochemical tracers to assess the origin and movement of water within the hydrological cycle. Environmental stable isotope tracers provide unique information to characterize and define the sources, flow paths and interactions between water bodies including mixing processes. In addition, radionuclides such as tritium and carbon-14 are routinely used to estimate groundwater ages, providing key information to assess present-day replenishment rates of groundwater, transport processes in aquifers, and their vulnerability to pollution.

## PROJECT INFORMATION

**Project No:** COL7001

**Project title:** Improving Water Resource Development in the Gulf of Morrosquillo (Sucre) and the Gulf of Uraba (Antioquia)

**Duration:** 2012–2014 (3 years)

**Budget:** €100 736

**Contributing to:**



### Partnerships and counterparts

The counterparts of the project are the environmental authorities of Sucre (CARSUCRE) and the Coastal Zone of Antioquia (CORPOURABA), the key government institutes in this part of Colombia with a mandate for water resource assessment and management, including the evaluation, monitoring and adoption of policies on water resource allocation and management. Partnerships have been established with the University of Antioquia; National University; University of Sucre; and Ministry of Environment and Sustainable Development.

### Facts and figures

- Counterpart institutes equipped with laser spectrometer analyser, used for the measurement of isotope ratios in natural water samples (oxygen-18 and deuterium). A total of 70 isotopic analyses of deuterium and oxygen and 200 physical and chemical analyses and 93 bacteriological analyses were performed.
- Staff trained in planning and conducting isotope hydrology studies with minimal external support.
- Radionuclide analyses for groundwater age dating carried out. A total of 49 samples for tritium analysis and 40 samples were performed for carbon-14 and carbon-13 analyses.