

# Water Resources

## Objective

*To improve the integrated management of water resources, geothermal resources and specific water supply infrastructures through the use of isotope technology.*

## Isotope Methodologies for the Protection and Management of Surface Water, Groundwater and Geothermal Resources

Water resources management continued to be a priority issue on the international agenda during 2004. Following the 2003 International Year of Freshwater, the United Nations declared 2005–2015 as the “Decade for Action: Water for Life” to highlight the critical linkage between water and human development at all levels.

The Agency continues to be active in promoting this key linkage. A major initiative in this regard was the assistance provided to Egypt, Chad, the Libyan Arab Jamahiriya and Sudan for improving the management of the shared Nubian Aquifer system. Within the overall objective of strengthening the institutional, legal and analytical frameworks for the rational management and use of the aquifer, the Agency is assisting in building technical capacity for using isotopes to obtain critical hydrological data. The project is receiving funding from the UNDP/Global Environment Facility, and includes other partners such as UNESCO.

In cooperation with the International Association of Hydrologists, the Agency co-sponsored a roundtable meeting on the “World Groundwater Vision”. Held in Zacatecas, Mexico, in October, the roundtable was an important step in the process through which international organizations will develop a global strategic vision for groundwater use and protection, to be launched at the 4th World Water Forum in 2006. The quantification of the residence time of groundwater and the recharge parameter, for which isotope techniques such as tritium–helium isotope dating provide crucial information, will be among the key elements of this vision and the resulting strategic plans.

A key aspect of the Agency’s work in water resources management is building partnerships with international and national organizations. Notable

efforts to establish or strengthen such cooperation included:

- Collaboration with UNEP to publish a dictionary of analytical methods for the chemical and isotopic analysis of water;
- A joint workshop with the United Nations Economic and Social Commission for Asia and the Pacific to formulate strategies for the assessment and mitigation of groundwater contamination by arsenic and fluoride in the Mekong region of Southeast Asia;
- Participation in special sessions at meetings of the American Geophysical Union at which the Agency’s efforts in the global monitoring of isotopes in river water and precipitation were highlighted and discussed;
- Cooperation in the development and publication of a world hydrological map by the International Association of Hydrogeologists (IAH), German Geological Survey and UNESCO;
- Participation in a new initiative led by UNESCO/IHP, IAH and the United Nations Economic Commission for Europe to develop “Guidelines for Delineation of Protection Zones around Public Groundwater Supplies and Management Policy”;
- Expansion of the operational activities of the IAEA–UNESCO Joint International Isotopes in Hydrology Programme, including the convening of a regional training course in Egypt on the use of isotopic techniques for artificial recharge to address the increasingly critical issue of managing the recharge of aquifers in arid areas for drinking water.

A hydrological database to support Ethiopia’s national groundwater resource assessment programme was completed in cooperation with the US Geological Survey. The database will be a critical tool for groundwater assessment to supplement food production and drinking water supplies in times of drought. In addition, it is expected to help improve the planning and implementation of isotope based investigations through the Agency’s technical cooperation programme.

A regional project in Latin America on the sustainable management of groundwater resources was completed. Using a combination of tools, including isotope techniques, the major hydrogeological characteristics of aquifers in Chile, Colombia, Costa Rica, Ecuador, Nicaragua, Peru and Uruguay were determined. In some of the countries,

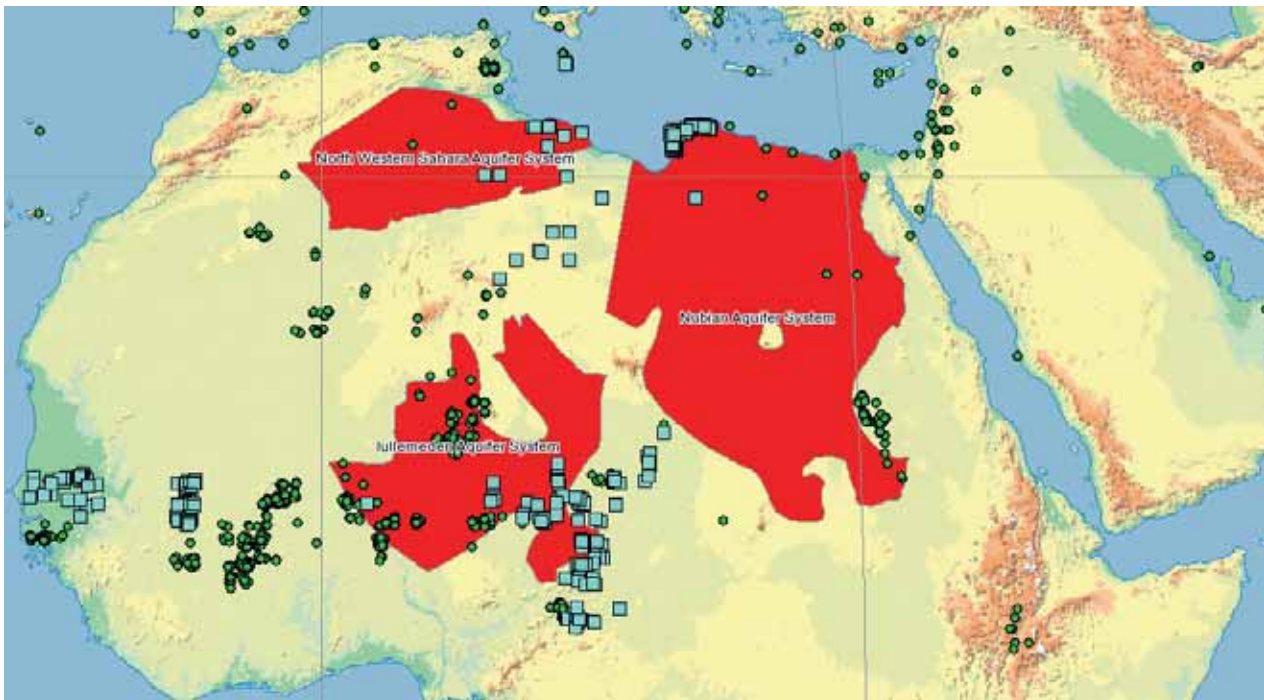


FIG. 1. Major shared aquifers (shown in red) in arid regions of Africa. The green circles represent ISOHIS stations and the greenish-blue squares depict water sampling points from the ISOHIS database that were used to generate this map.

project results were used to construct numerical models of aquifers, while in others information obtained on the aquifer recharge and residence time helped national water managers in their efforts to improve water supply and protection practices.

Eight countries in Asia received assistance in the use of isotope techniques for evaluating geothermal resources. The project strengthened national technical capacity for high quality chemical analysis of geothermal waters and in the planning and implementation of field investigations using isotope techniques. In related work, stable and radioactive isotope tracers were used to monitor reservoir hydrodynamics and inter-well hydraulic connections in China, Indonesia and Philippines.

A preliminary version of an Internet based cartographic system was completed in cooperation with the University of Vienna. The system will facilitate dissemination of the Agency's ISOHIS database for isotopes in precipitation, rivers and groundwater. Figure 1 shows an example of a map generated from the information in ISOHIS, depicting shared aquifers in arid regions of northern Africa, including the Nubian Aquifer system. Another important application of the precipitation isotope data is in improving the performance of global circulation models for simulating the Earth's water cycle.

## Reference Isotope Data and Analysis for Hydrological Applications

An international symposium on "Quality Assurance for Analytical Methods in Isotope Hydrology" was held in Vienna in August. This was the first such meeting to focus on the state of the art in analytical techniques in isotope hydrology. The participants agreed that there was a need to expand efforts to ensure data quality through the establishment of laboratory quality systems. The Agency's role in providing international standards for isotope measurements was considered central to this task.

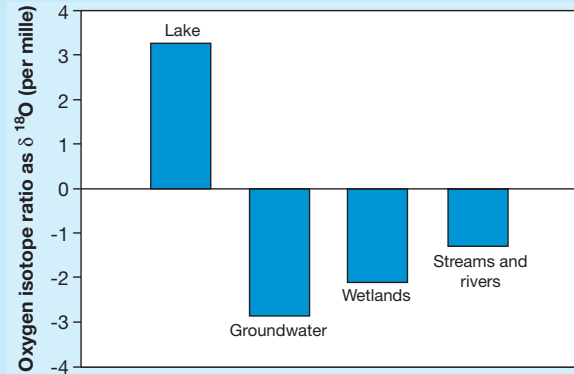
A CRP on the isotopic composition of precipitation in the Mediterranean basin in relation to air circulation patterns and climate was completed. The focus of the research was on providing a relationship between the origins and trajectories of respective air masses and the isotope contents in precipitation and atmospheric water vapour. The results are significant for the investigation of the processes responsible for precipitation and the impact of climate change and its variability on water resources in the Mediterranean region.

A guidebook on the use of chlorofluorocarbons (CFCs) in hydrology was completed, providing an

### Isotope Studies for Better Management of Limited Water Resources

A sound understanding of the dynamics of water inflow and outflow is essential in order to better manage limited water resources within the Nile Basin. The Agency, together with the three Lake Victoria riparian countries and within the framework of the Nile Basin Initiatives, is implementing a project to improve capabilities for determining the water balance of Lake Victoria. The project is expected to provide crucial information on the different elements of the water balance, especially the groundwater and swamp components.

Isotope investigations in the Lake Victoria basin provided strong evidence that wetlands in the vicinity of the lake do not originate from lake water (see figure). This information, which was previously unknown, is critical to the understanding of the hydrology of the basin and for sustainable water management.



overview of dating groundwater with CFCs. The publication will help researchers in choosing an appropriate method for dating modern groundwater

under different hydrological environments, thus assisting Member States in their water resources management programmes. ■