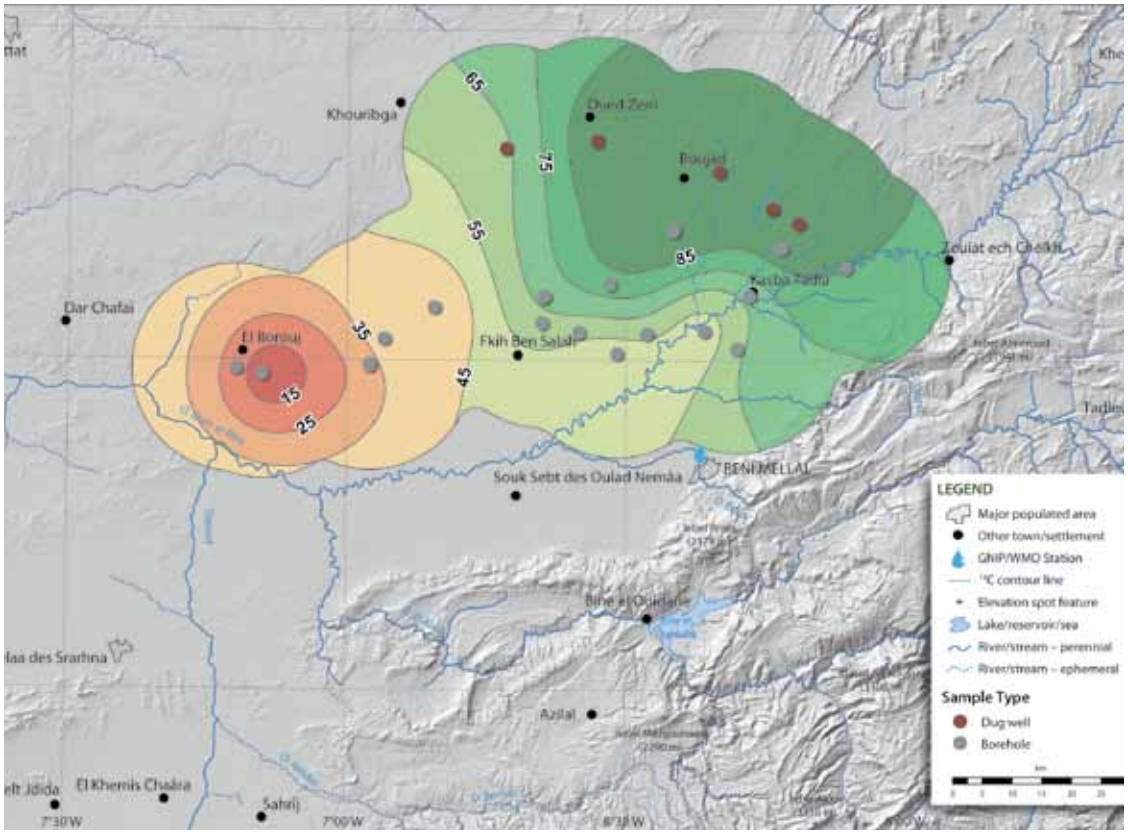
Treasure Maps

by Peter Kaiser

The IAEA's Hydrological Atlases Reveal Hidden Resources



The plate from the *Hydrological Atlas of Morocco* showing water that is only minimally recharged as red areas. The green areas indicate water that is recharged.

The IAEA's water experts have published a unique series, the Atlas of Isotope Hydrology, including volumes devoted to regions of Africa, the Americas, as well as Asia and the Pacific, and the first national Atlas that profiles Morocco. Pradeep Aggarwal, the Isotope Hydrology Section Head, explains why the Atlases were produced and how they help water planners ensure access to fresh water for the future.

Above, the plate from the *Hydrological Atlas of Morocco* shows older water that is only minimally recharged as red areas, while the green areas indicate water that is recharged. Water that is not recharged, is considered to be water that is mined as an exhaustible resource.

The Guarani aquifer, one of the largest fresh water reservoirs in the world, stretches between Argentina, Brazil, Paraguay and Uruguay. In a plate from the *Hydrological Atlas of the Americas* (see page 16), the sampling points located in the four countries overlying the aquifer are shown.

When did this global project begin?

We started to compile information in the hopes of producing an atlas about ten years ago. We wished to bring together data that already existed, much of which was available in our archives, yet was rarely seen or used. We invested a considerable amount of time searching for data in the IAEA and external archives. We published the first volume on Africa in 2007. Over 100 countries' data are included in this series.

Had anyone ever tried to integrate the available water databases into one cohesive document like the Atlas before this effort began?

No. No one had and that was the driving force behind this effort. For more than 50 years, the

IAEA has been publishing the Global Isotopes in Precipitation databases, which are used to understand hydrology. The Atlases contain data collected mainly through IAEA projects conducted in developing countries. These data were not available to anyone outside these projects. It was a great concern to us that the countries whose water systems were studied could not access this data.

As a result, when we visited countries in the 1990s and early 2000s, we would come upon a situation in which no one knew whether studies had been previously conducted, thus projects were conducted without understanding what was done in the past. If we did learn that a project had been conducted previously, the data was often no longer accessible. Therefore, to be able to offer Member States a resource that can be used to achieve progress, rather than treading water by repeating studies that simply collect similar information, as well as to offer researchers around the world comprehensive data, we decided to produce these Atlases to advance the science of hydrology.

What insights can be gained from a database of isotopes in precipitation?

Isotopes in precipitation help us understand climatic systems. The product of a hydrological system is precipitation. So, we are trying to understand atmospheric processes by using isotopes in precipitation, which tell us how climate influences precipitation, or how precipitation results from a certain climate.

Once precipitation reaches the surface, it then enters lakes or rivers or the ground water systems. If you want to understand how your rivers function, if you want to know how water supplies will be impacted by climate change, or by land use changes, or if you need to know whether you can control the pollution that results from agricultural activities, you have to know where the water comes from and how it flows through the hydrological system.

The same holds true when trying to understand the underground water systems. As with rivers and lakes, when studying aquifers, you need to know where the water came from and how the aquifer is recharged and how quickly. All of that information relates back to precipitation. And it is isotopes that allow us to trace precipitation.

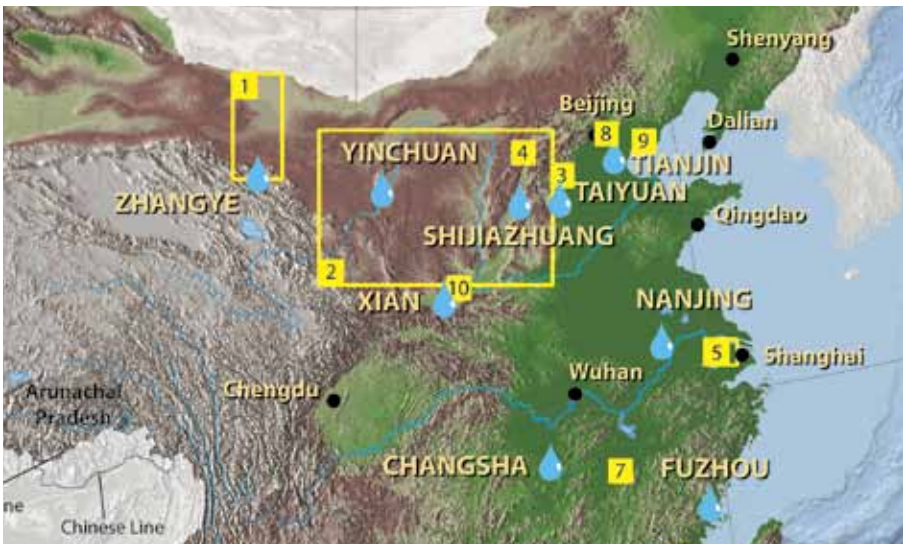
When an expert views these maps, what can they decipher from these symbols and figures?

For instance, if you compare the isotopic data in groundwater with precipitation at a given location, you can determine whether the underground reserves are being recharged and can help identify the source of the water that recharges the reserve, such as a local source or a distant mountain. If the precipitation and the groundwater data do not match, regardless whether you compare local sources or distant sources upstream in the mountains, then potentially the underground reserve was recharged in the past by a very different climate system.

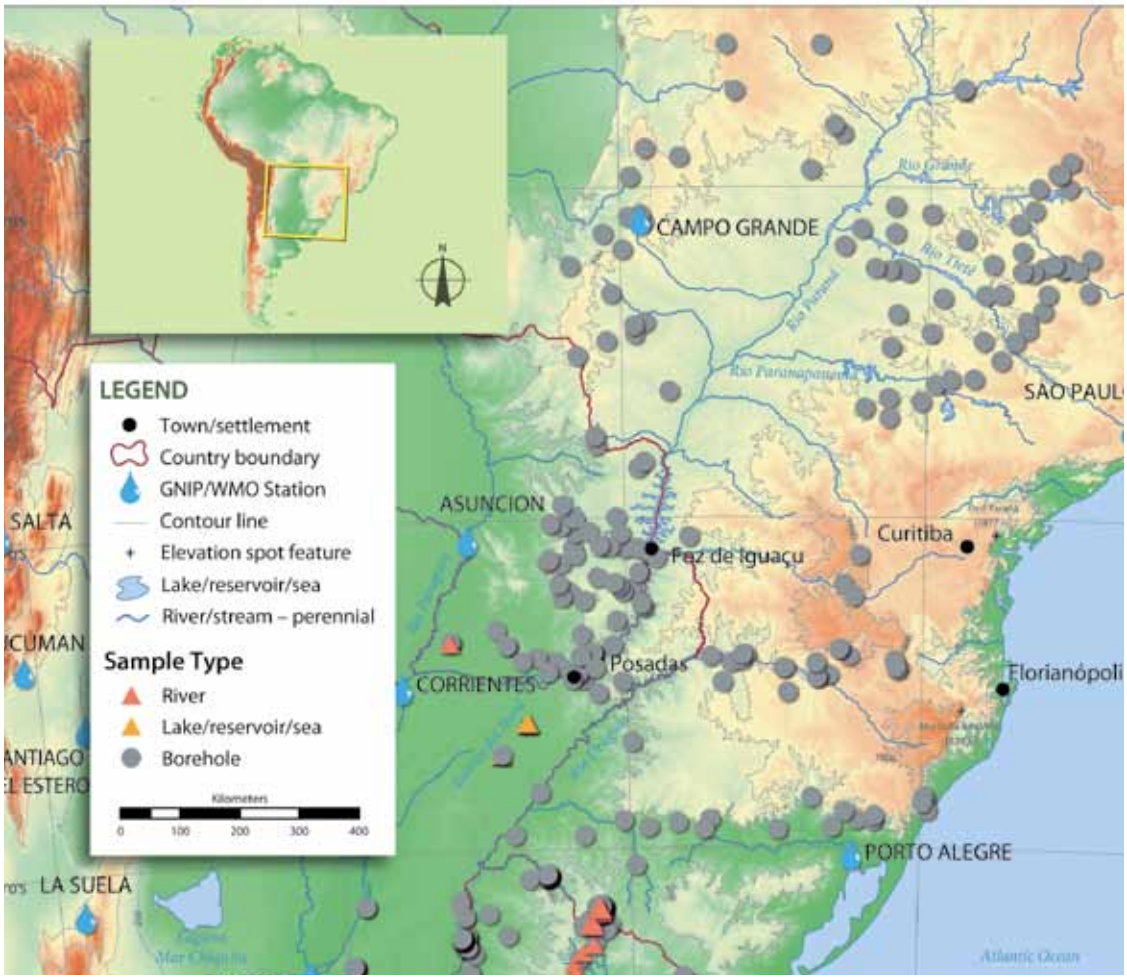
Therefore the isotopic database and the Atlas can help you understand a vital process for water management, whether an underground reserve is recharging and how quickly.

Does this Atlas help planners find water and use it sustainably?

Yes, it will. The primary purpose for using isotopes is to acquire information about the water system in a timely and cost-effective manner. I could spend 50 years in a country, measuring the rain and water levels in rivers and aquifers, and I would have a reasonably accurate picture of what happens to water in that system. Or, I could review the isotopic composition of the water now and acquire the same level of understanding fairly quickly.



A detail from an isotopic overview map of China taken from IAEA's *Hydrological Atlas of Asia*.



From the *Hydrological Atlas of the Americas*, this plate displays the Guarani aquifer, one of the largest fresh water reservoirs in the world. The map provides information about sampling points in the four overlying countries.

If you have an Atlas, it gives you instantaneously a hydrological picture of a large area over a long time period. You can use those data to refine future water investigations to garner more accurate insights into this complex system, and, as your investigations proceed, the data can be placed in a cohesive framework which then gives you an understanding of the inter-relationships between systems. The Atlas helps you deepen and broaden your understanding of water systems. The Atlas facilitates the investigations of water.

If planners invest in learning how to interpret isotopic information, they will save money by avoiding drilling wells that will run dry or not deliver safe water. That is the purpose of the Atlas: we build these "larger-than-local" maps to show where the water is located and how it flows between different rock systems so that you have a better ability to tap these waters sustainably and economically.

Is the Atlas a "treasure map"?

To some extent, because otherwise you would have to make physical measurements of all of those systems in the hopes of acquiring the same understanding that you can acquire by studying isotope data. This is not a panacea – additional work, investigation and investment is needed to understand these "treasure maps". They are a valuable resource that offer an instant picture of how the underground system is configured, how it works and where to focus your investigation and thus speed your search for the treasure you seek or the knowledge you need to protect the water resources.

Where do you wish to go from here?

We now hope that the series will expand to include many, many national Atlas projects that will be carried forward by our partners at the national level.

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