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Isotope methodologies for the protection and management of groundwater resources within the International Atomic Energy Agency water programme.

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The field of isotope hydrogeology started nearly 50 years ago and is a fully recognized discipline of hydrologic sciences today. The present state of isotope hydrology is based in part on the pioneering efforts of the International Atomic Energy Agency (IAEA), whose activities continue to facilitate development and integration of isotope techniques in hydrology through its major areas of activity, which include research and development, global databases and reference materials, education and training, and technology transfer.

More than half of the global freshwater supply for drinking and irrigation presently is obtained from groundwater. Yet, our understanding of the distribution, extent and renewal of groundwater reserves is very limited. Understanding of groundwater flow at local and regional scales is therefore a necessity and isotope techniques are very powerful to get a thorough knowledge of groundwater dynamics.

Among the most important areas where isotopes are useful in groundwater applications, one should list studies of recharge and discharge processes, flow and interconnections between aquifers, and the sources and mechanisms of pollution. Three new activities designed to enhance the scientific understanding of non-renewable and renewable groundwater resources have been initiated. These include mapping of very old water and better characterization of groundwater recharge respective groundwater turnover times. The isotope data, when combined with a hydrogeological map of an aquifer, can provide a wealth of information regarding the distribution and finite

nature of the non-renewable groundwater resources, as well as the present and future trends in groundwater usage. It is planned to develop a series of GIS (Geographical Information System) based global maps of non-renewable groundwater.

A T/^{3}He facility is being installed at the Agency, in order to overcome the limitations in precision and detection limits of tritium measurements by using scintillation or gas proportional counting. This will ensure the applicability of tritium as groundwater dating tool in the next decades even at the low-tritium levels of the equatorial region and southern hemisphere and despite gradually decreasing tritium levels. Due to the nature of the method using a radioactive mother/daughter dating approach, it will be possible to more reliably assess groundwater ages over the period of the last several decades .

Within the TC Agency's programme, isotope techniques are being used in four major projects related to aquifer systems shared by several countries. The projects in Africa (Iullemeden, Nubian Northwest Sahara) and Latin America (Guarani) are implemented in collaboration with UNESCO (United Nations Educational, Scientific and Cultural Organization), UNDP/GEF (United Nations Development Programme/Global Environmental Facility) and the World Bank. These projects focus on isotope hydrology studies to better quantify groundwater recharge and dynamics. The multiple isotope approach combining commonly used isotopes ^{18}O and ^{2}H together with more recently developed techniques (CFC, ^{36}Cl, noble gases) are applied to improve the conceptual model, to study of stratification and groundwater flows.