

Radioisotopes in Hydrology

➤ A number of radioisotopes are used in hydrological studies.

➤ Determining the age of ground water is important for several Reasons -

- Groundwater age translates roughly to circulation and renewability, which is critical for water resource planning.

- The age of groundwater relates also to its vulnerability to contamination.

- Modern groundwaters will have more direct pathways from the surface, facilitating infiltration of contaminants from surface activities in the recharge area. Old groundwaters are isolated from the surface and perhaps less vulnerable to anthropogenic contamination.

TABLE 8.1

Tracers for Age Dating Groundwaters

Isotope	Half Life	Typical Half-Life Range	Source (Parent Nuclide)	Typical Concentration
Modern Groundwaters				
^3H	12.32 y	<1 y	Cosmogenic ($^3\text{H}_2$)	Steady state
Tracers, ^3H	12.32 y	<1 y	Thermoluminescent dosimeters	1000-10 ⁵ or 10 ⁶ cps
^3He	12.32 y		Cosmogenic (^3H)	0.10-10 ³
$^3\text{H}_2$	12.32 y		Unknown, but evaporating	1.0-1000, increasing
$^3\text{H}_2\text{O}$	Stable	100 y	Electron-capture reactions	7 ppm, increasing
CFC	Stable	100-200 y	Anthropogenic emissions, constant	CFC-12: 100 ppb in 2000
Sub-Modern Groundwaters				
$^3\text{H}_2$	12.32 y		Cosmogenic ($^3\text{H}_2$)	10-1000 ppb
^3He	>12 y	>1 y	Cosmogenic (^3H)	2 ppm-10 ³
Old Groundwaters				
^{14}C	5730 y	>1 y	Cosmogenic (^{14}C)	100-1000, <1000 ppb
$^{14}\text{C}_2$	223,000 y		Cosmogenic (^{14}C)	1-10 ppb
^{13}C	5730, 223,000 y	<1 y	Cosmogenic (^{13}C)	<100 ppm
			Subsurface (^{13}C)	$^{13}\text{C}/^{12}\text{C} = 98.9 \times 10^{-3}$
^{18}O	11.4 My	<1 y	Cosmogenic (^{18}O)	100,000 ppm
			Subsurface (^{18}O) (up to 1000)	>1000 ppm
^{16}O	Stable		Subsurface (^{16}O) and ^{18}O in oxygen	1.200-10 ³ ppm
$^{18}\text{O}_2$	Stable		Subsurface (^{18}O)	0.001
$^{16}\text{O}_2$	Stable		Subsurface (^{16}O) (up to 1000)	0.01-10 ³ ppm

Clark, 2015

Radioisotopes In Hydrology

J Spring



Radioisotopes In Hydrology:

Radioisotopes in Hydrology International Atomic Energy Agency,1963 **Practical Isotope Hydrology** S. M. Rao,2006
In Indian context Isotope Techniques in Hydrology International Atomic Energy Agency,1968 **Introduction to Isotope Hydrology** Willem Gerrit Mook,2006 This publication presents in a simple but scientifically rigorous manner the consequences of natural processes to stable isotope concentrations and radioactivities and discusses the implications of these processes *Isotopes in Hydrology, Hydrogeology and Water Resources* B. P. Singh,Bhishm Kumar,2005 Table of Contents
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Agency,1963 *Isotope Hydrology* Pradeep Kumar Aggarwal,2012 Isotope Hydrology uses stable and radioactive isotopes of
water and its dissolved constituents to trace hydrological processes including the pathways of rainfall and snowmelt to and
interactions between aquifers lakes and rivers The potential of using stable isotopes of water was recognized in the 1930s
but not fully explored until the 1950s since when the scope and nature of isotope applications in hydrology have blossomed
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become mainstream as documented in this volume of reprinted papers and accompanying commentaries An excellent
resource for graduate and post graduate level courses in hydrology reproducing many important papers which are otherwise
difficult to access **Environmental Isotopes in Hydrogeology** Ian D. Clark,Peter Fritz,1997-07-23 Groundwater is an
increasingly important resource to human populations around the world and the study and protection of groundwater is an
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occurring nuclides in water and solutes have become fundamental tools for tracing the recharge history and contamination of
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Radioisotopes in Hydrology ,1963 *Isotopes and Radiation Technology* ,1967 Environmental Isotopes in
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fundamental tools for tracing *Tokyo, 1963. Application of Radioisotopes in Hydrology. Symposium, Tokyo, Japan, 5-9
March 1963. A Programme.* Symposium on the Application of Radioisotopes in Hydrology (INTERNATIONAL ATOMIC
ENERGY AGENCY),1962 Isotope Hydrology: A Study Of The Water Cycle Joel R Gat,2010-01-08 Within the realm of the

newly evolving discipline of environmental sciences the stable isotope methodology is being used to an ever increasing extent especially in the study of the water cycle and of paleo climatology This book introduces the rules of the game by reviewing the natural variability of stable isotopes in the hydrosphere describing the physico chemical basis of isotope fractionation and applying this knowledge to natural waters as they move through the hydrologic cycle from the ocean to the atmosphere the biosphere and the lithosphere There is a special focus on the processes at the surface atmosphere and land biosphere atmosphere interfaces since these are the sites of major changes in isotope composition In response to the increasing awareness of our changing climate a discussion on the global view of the changing water cycle in the past and future winds up the presentation a

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Radioisotopes in Hydrology. Proceedings of the Symposium on the Application of Radioisotopes in Hydrology held by the International Atomic Energy Agency in Tokyo, 5-9 March 1963 Symposium on the Application of Radioisotopes in Hydrology (INTERNATIONAL ATOMIC ENERGY AGENCY),1963

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directly into an adult 9 as a group echinoderms can obtain food by filter feeding scavenging or preying on other organisms 10 the phylum chordata contains only animals with a backbone 11

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