HID 362
MESLEKİ İNGİLİZCE 2

Hafta 8

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2020-2021 Bahar Dönemi #evdekal

GROUNDWATER TRACERS

Tracers are used widely to determine the direction and velocity of ground-water movement.

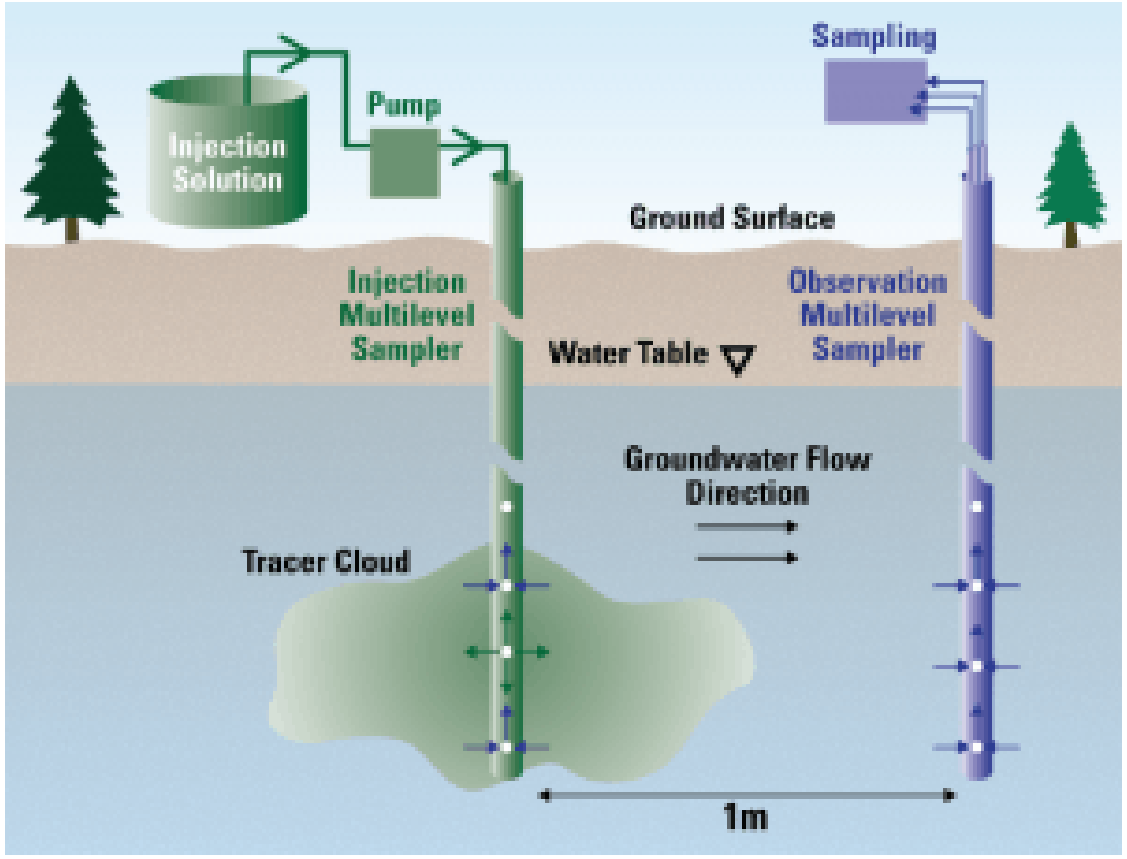
Artificial tracers: dyes (Rhodamine), salts

Evironmental tracers: isotopes, gases

Event markers: CFC, 3H

anthropogenic (or anthropic) - created, caused, or induced by human actions.

DYE-TRACER TEST

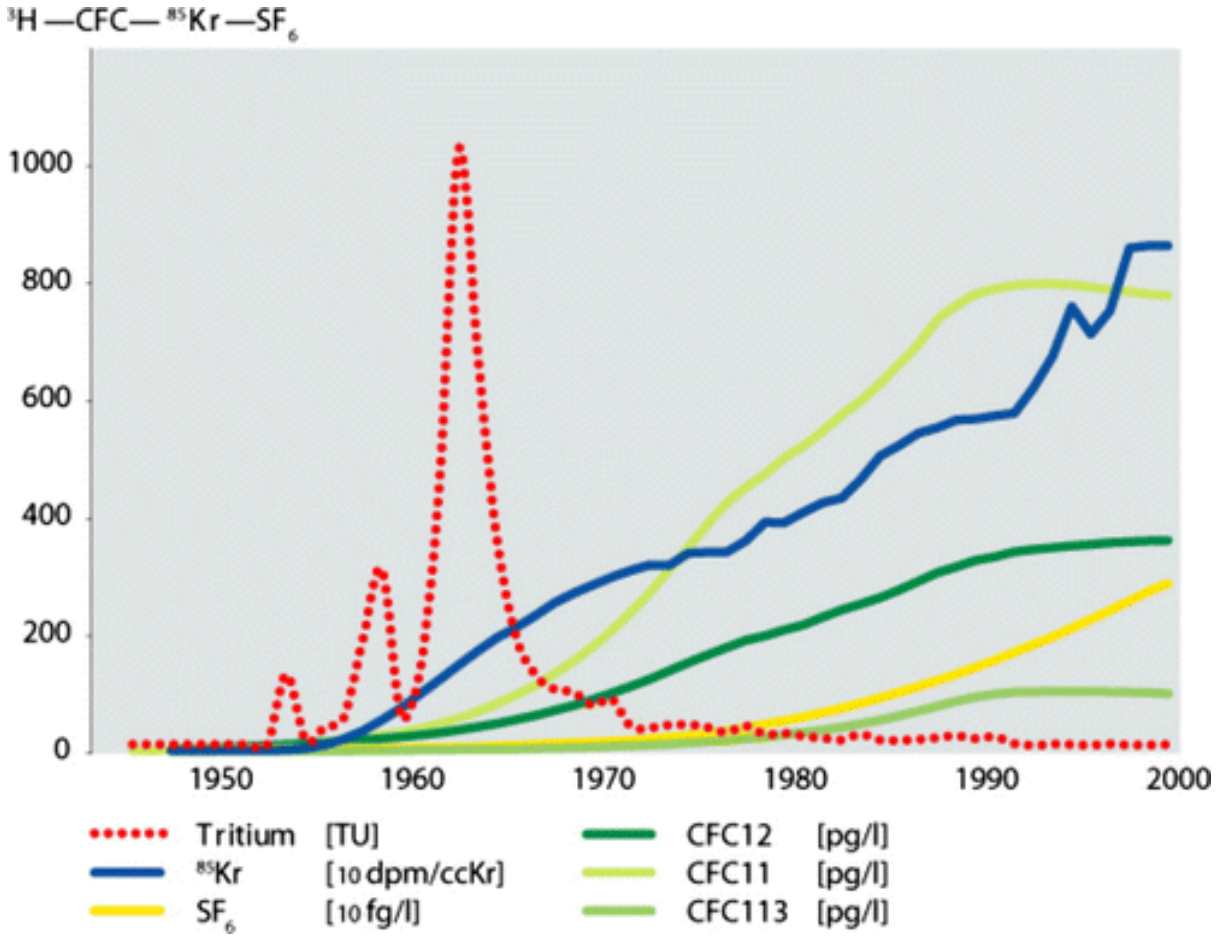


ENVIRONMENTAL TRACERS

Environmental tracers are any natural or anthropogenic chemical compound or isotope in groundwater that can be measured and used to interpret sources of recharge and discharge, rates of groundwater movement, and groundwater age.

Groundwater age is a relative concept that assumes groundwater begins as recharge and steadily aquires “age” as it moves along a flow path. Under this assumption, groundwater is youngest near areas of recharge, and its relative age increases with distance from the recharge area.

https://geology.utah.gov/map-pub/survey-notes/what-do-environmental-tracers-tell-us-about-groundwater-in-snake-valley/



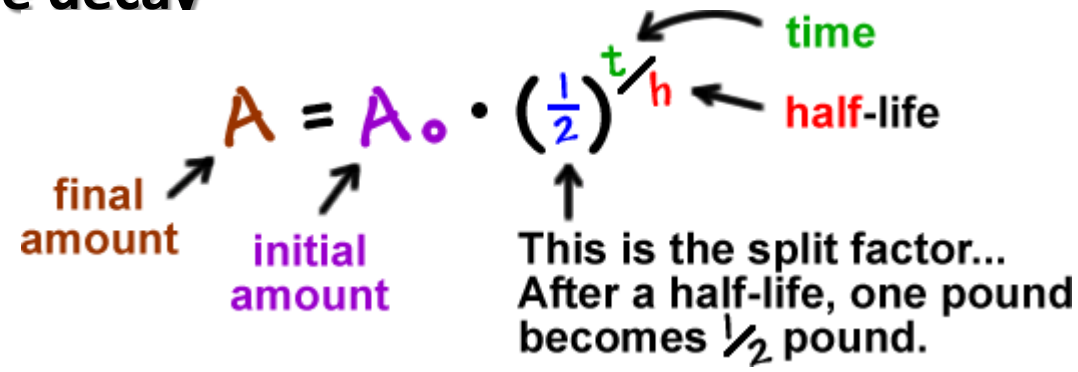
Tritium (3H)
Chlorofluorocarbon (CFC)
Kyrpton 85 (85Kr)
Sulfur hexafluoride (SF6)

Isotopes are atoms that have the same number of protons and electrons but different numbers of neutrons and therefore have different physical properties.

Stable isotopes vs **Radioactive isotopes**

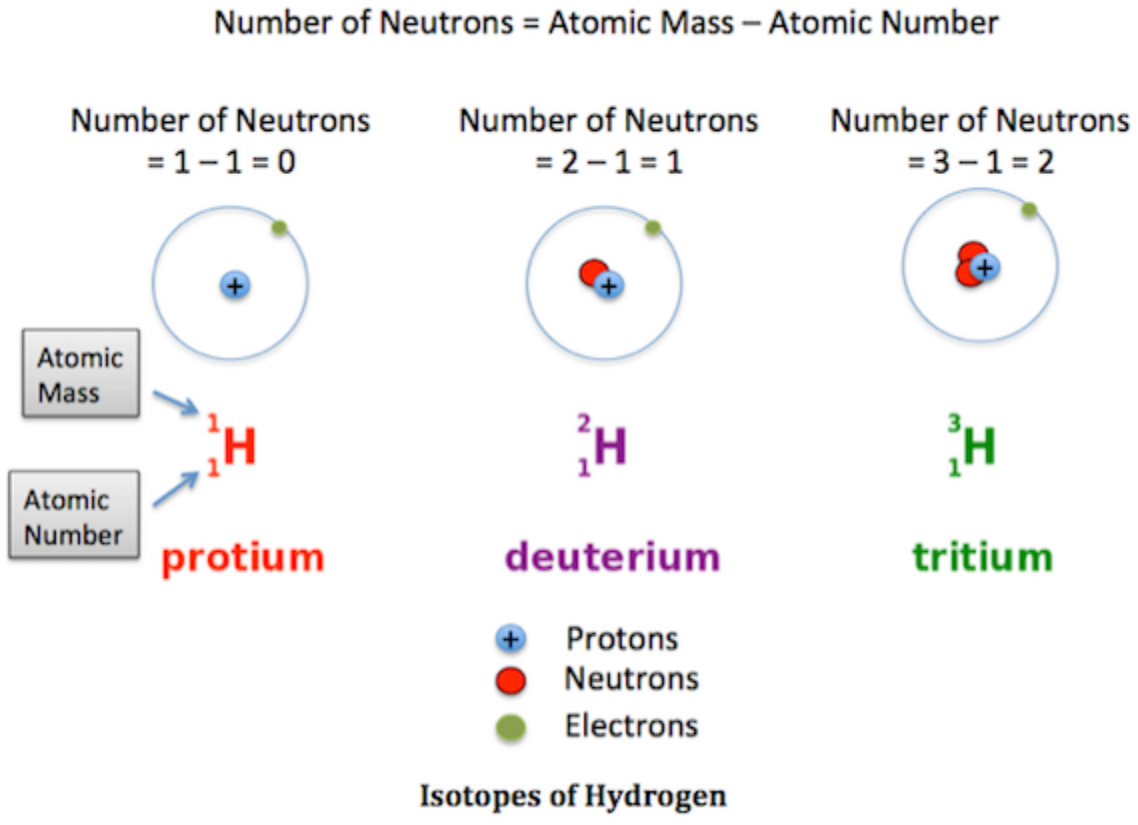
Some isotopes are stable, meaning they do not decay to any other form over time, and others are unstable, or radioactive, meaning they spontaneously decay at a predictable rate to form a new element.

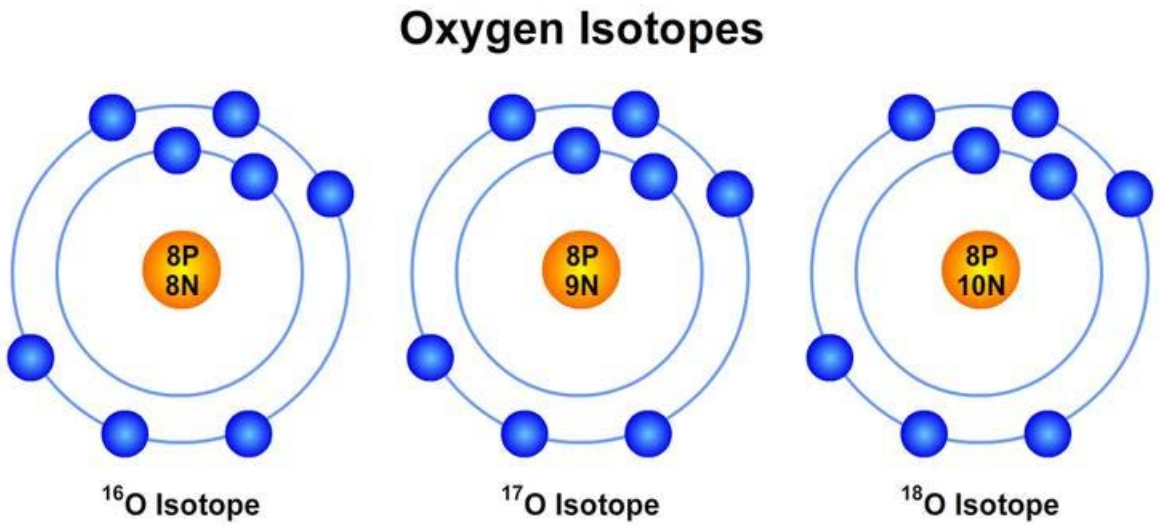
Radioactive decay



half life - the time required for 50% of a radioactive element to decay.

Half lives of tritium and carbon-14 are 12.3 and 5730 years, respectively.


Number of Neutrons = Atomic Mass – Atomic Number
Number of Neutrons = 1 – 1 = 0
Number of Neutrons = 2 – 1 = 1
Number of Neutrons = 3 – 1 = 2
Atomic Mass
Atomic Number
$^{1}_{1}H$
$^{2}_{1}H$
$^{3}_{1}H$
protium
deuterium
tritium
Protons
Neutrons
Electrons
Isotopes of Hydrogen


Oxygen Isotopes
8P 8N
8P 9N
8P 10N
^{16}O Isotope
^{17}O Isotope
^{18}O Isotope

Stable Isotopes: Oxygen-18 & Deuterium

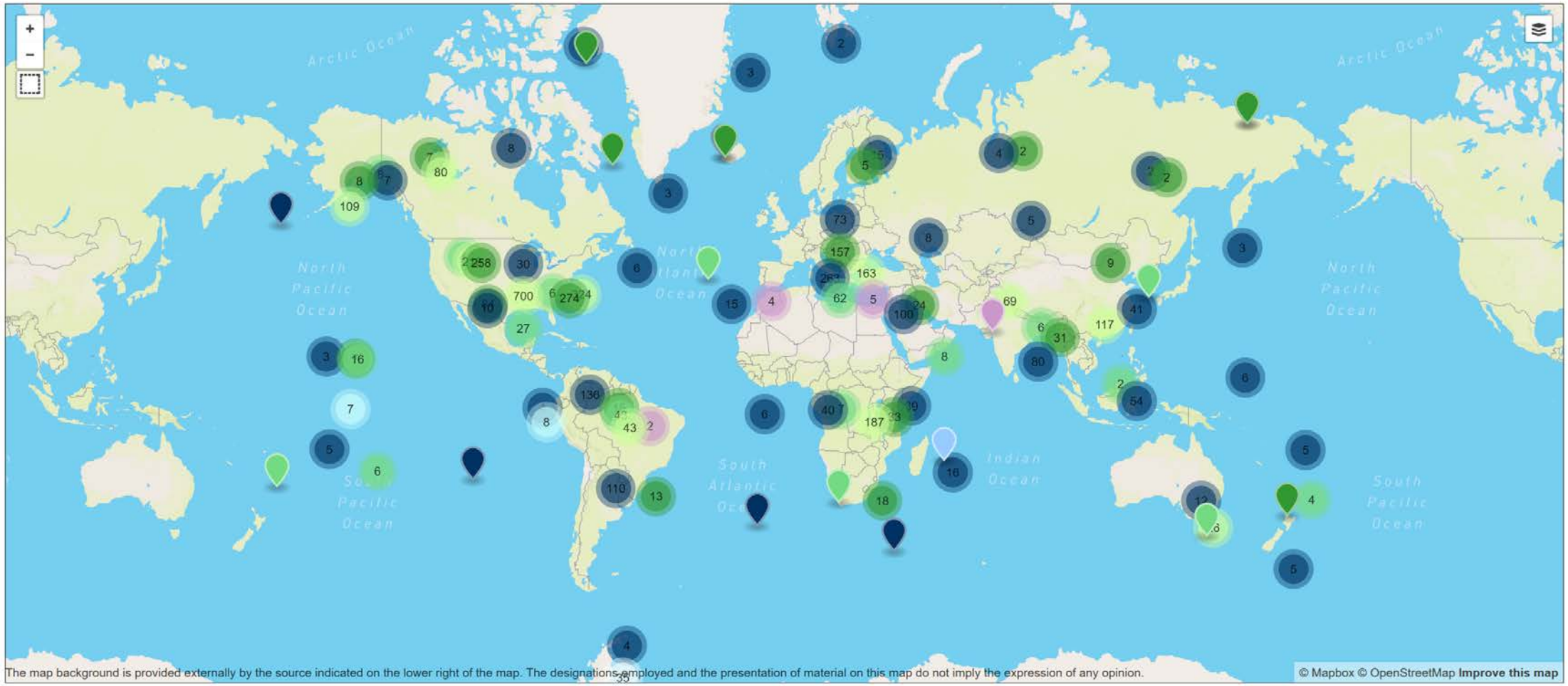
$$R = \frac{[^{18}\mathrm{O}]}{[^{16}\mathrm{O}]} \quad \delta^{18}\mathrm{O}$$

$$^{18}R = \frac{\text{rare isotope abundance}}{\text{abundant isotope abundance}} = \frac{[\mathrm{H_2^{18}O}]}{[\mathrm{H_2^{16}O}]}.$$

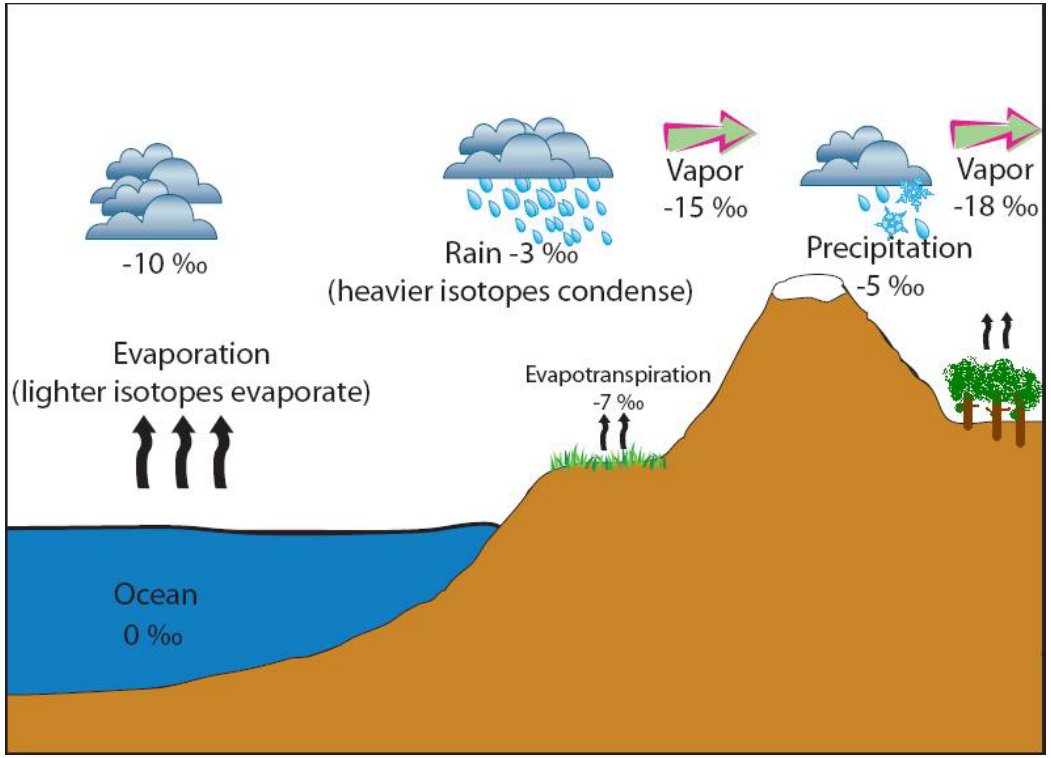
$$\delta^{18}\mathrm{O} = \left(\frac{^{18}R_{\text{sample}} - ^{18}R_{\text{std}}}{^{18}R_{\text{std}}} \right) \times 1000 = \left(\frac{^{18}R_{\text{sample}}}{^{18}R_{\text{std}}} - 1 \right) \times 1000 \ \ (‰)$$

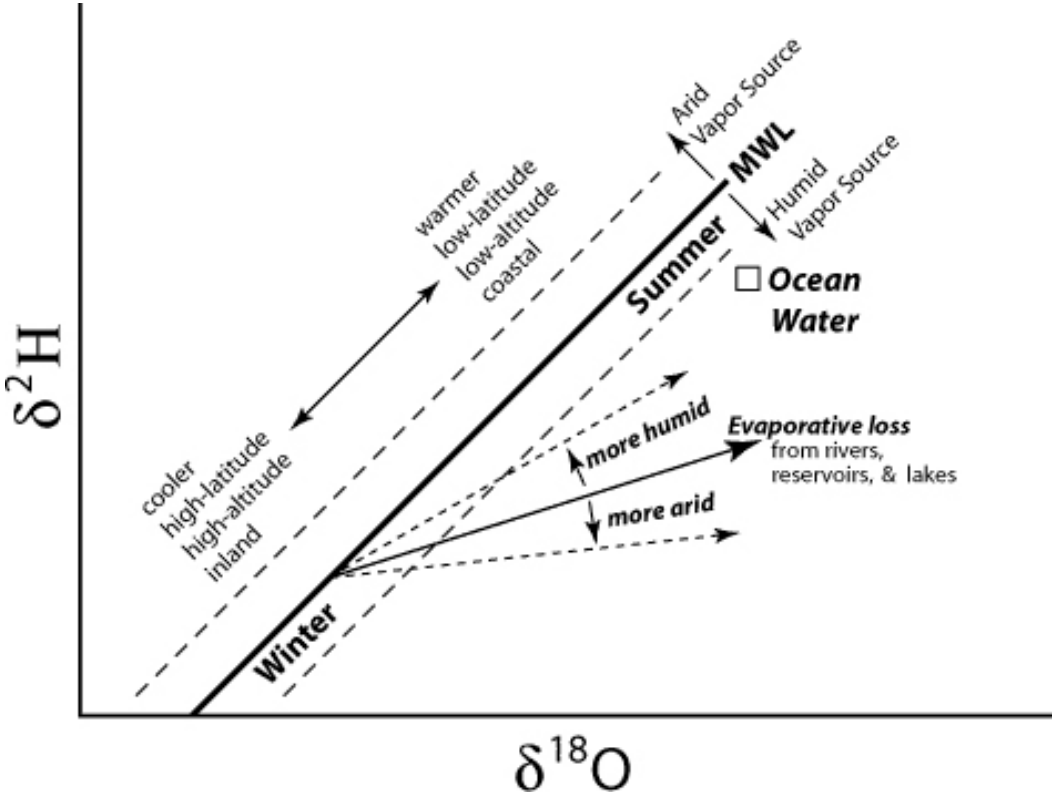
Any standard can be used, but the most commonly used is "Standard Mean Ocean Water" (SMOW) or Vienna SMOW (VSMOW).

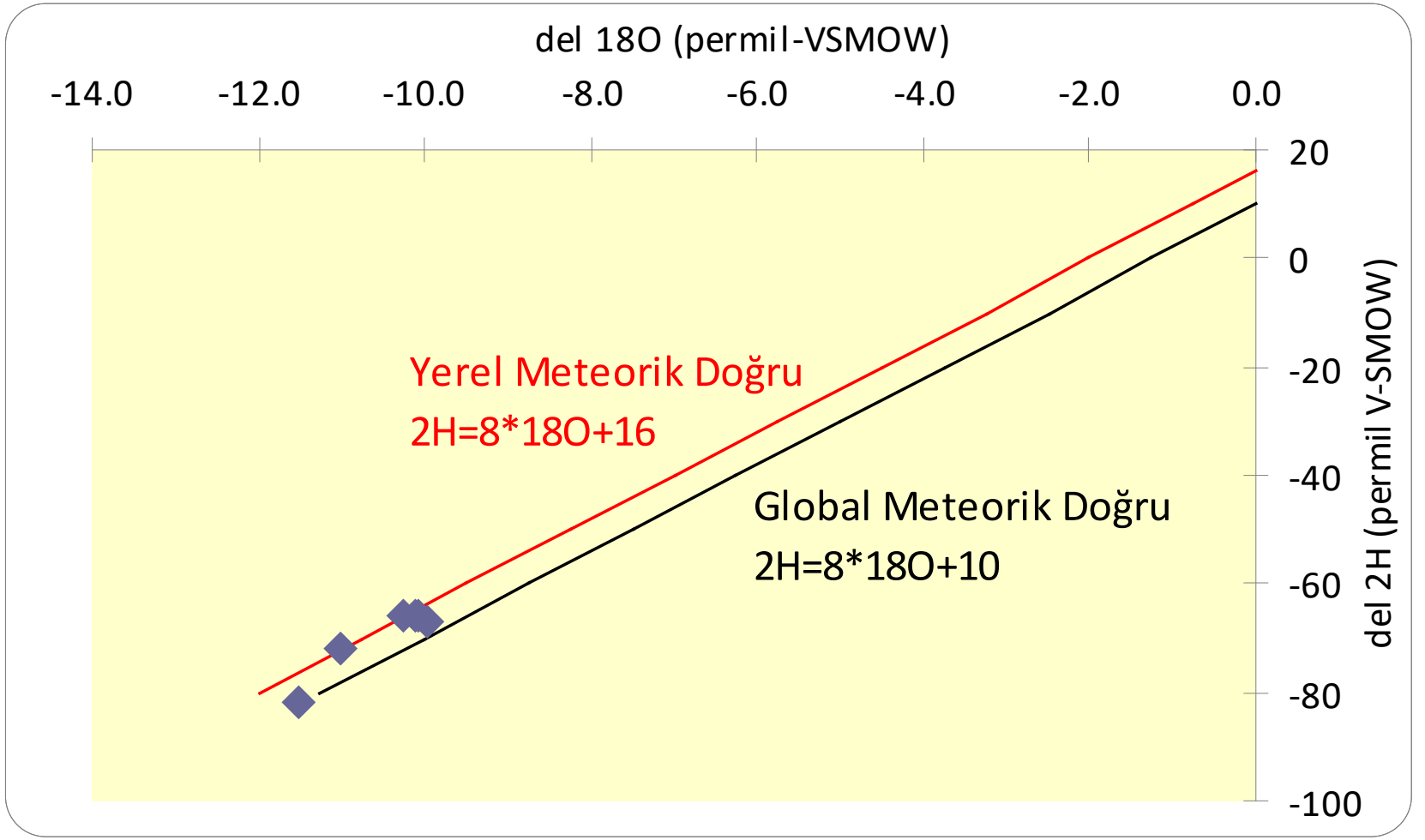
IAEA GNIP DATABASE
https://nucleus.iaea.org/wiser/index.aspx



Estimation of recharge temperature and altitudes of groundwater






del 18O (permil-VSMOW)
-14.0
-12.0
-10.0
-8.0
-6.0
-4.0
-2.0
0.0
20
0
-20
-40
-60
-80
-100
del 2H (permil V-SMOW)
Yerel Meteorik Doğru
2H=8*18O+16
Global Meteorik Doğru
2H=8*18O+10

Groundwater residence time (age) calculations