GEOMORFOLOGÍA

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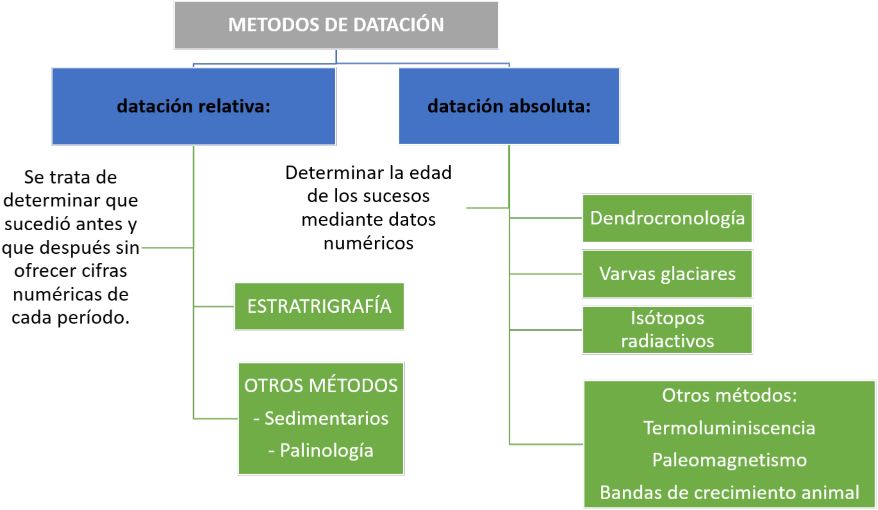
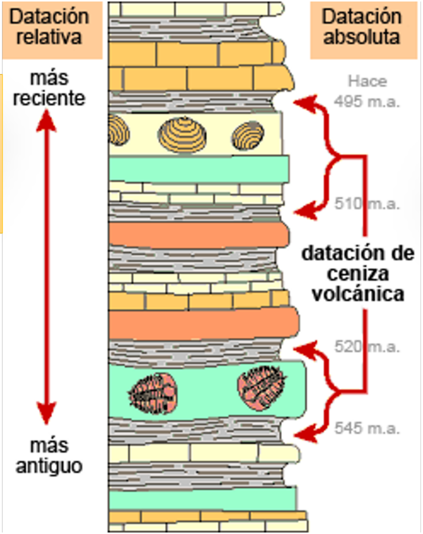
UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE MEDELLÍN

Morfocronología



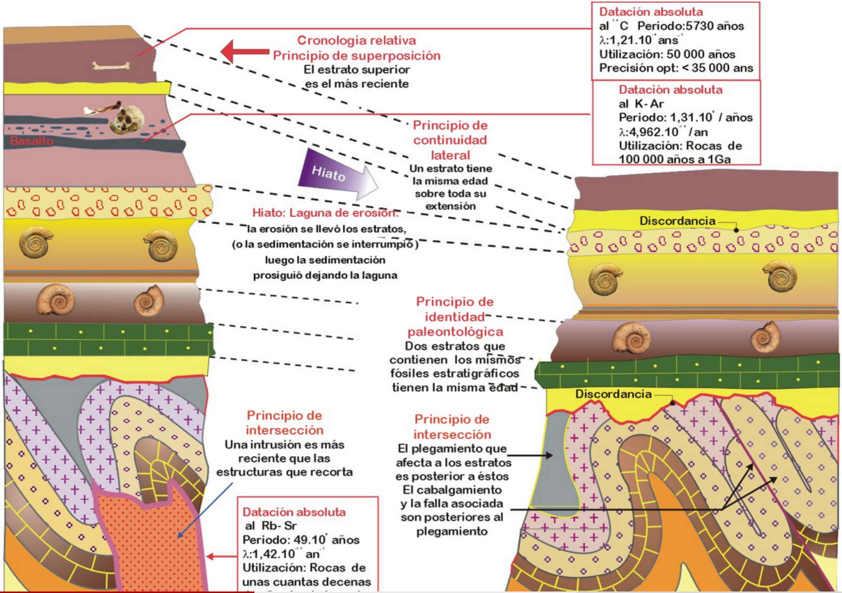
Técnicas de datación en geomorfología

Mediante el estudio y la comparación de estratos y/o fósiles podemos establecer secuencias temporales

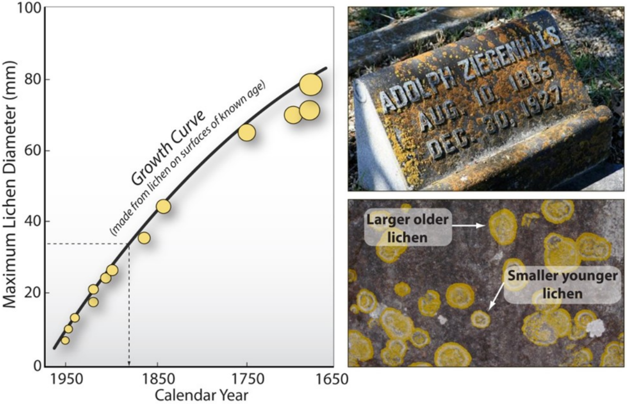


Se basa en la desintegración de elementos radiactivos.

Técnicas de datación en geomorfología



Líquenes



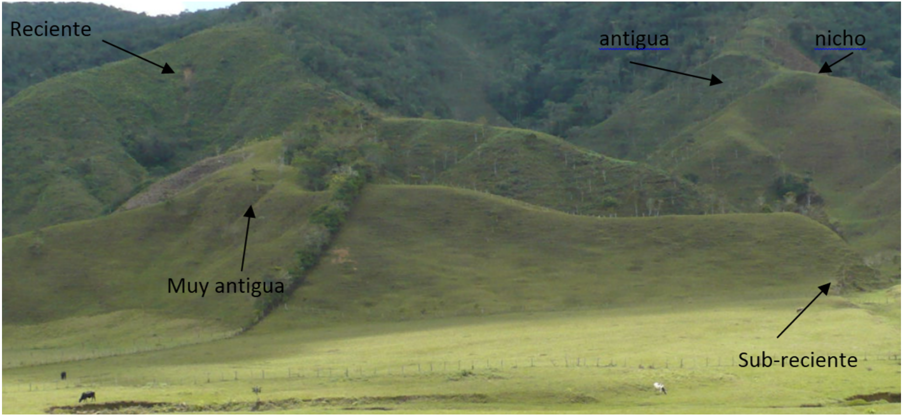
Lichenometry is a calibrated relative dating method which relies on the observation that lichens of a single species have similar growth rates. Thus, by calibrating a **growth curve** on surfaces of known age, such as buildings and tombstones, the maximum width of a lichen found on a surface of unknown age (such as a glacial moraine) can be used for dating.

Líquenes

Bloques de rocas lisos, Dr. Eduardo Parra

Clasificación de cicatrices

Dr. Eduardo Parra



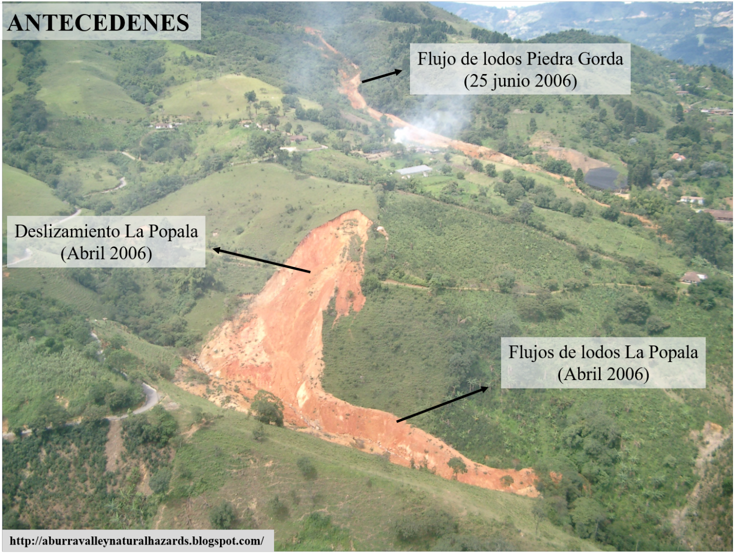
Criterios temporales

Dr. Eduardo Parra

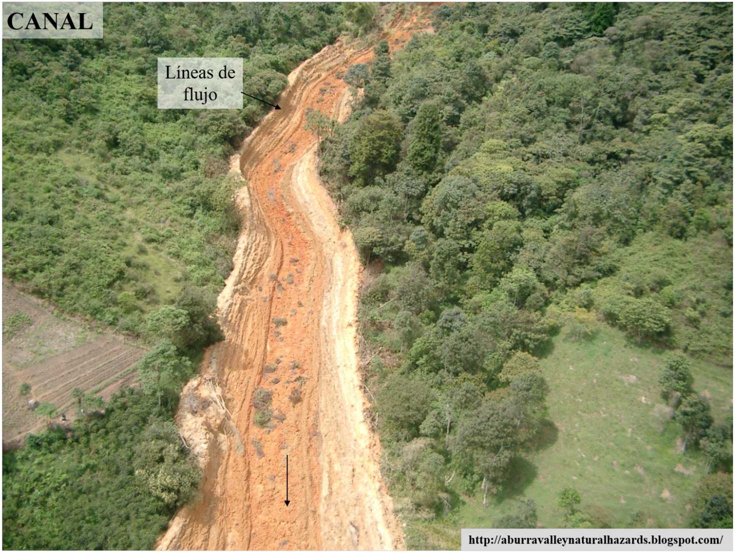
Resumen de los dominios en el tiempo de indicadores en cicatrices y depósitos del Dr. Eduardo Parra.
en zona de arranque, # en zona de depositación, a=años.

Indicador	Dias	Sem.	Meses	Años	10^1	10^2	10^3	10^4	10^5	10^6	10^7
Superficie saturada	##										
Superficie seca		##									
Retoña vegetación			#	#							
Rastrojo bajo				#	#						
Rastrojo alto					#	#					
Árboles maduros						##					
Líquenes en bloques de roca Negros$_{20}$→ Blancos$_{40}$→Verdes$_{60}$						→N					
Flancos Redondeados							200a				
Corona Redondeada							800a				
Meteorización matriz							#	#			
Horizonte edáfico A+B							1?	10_{cm}	<40		
Perfil meteorización C								10	100	K	10K

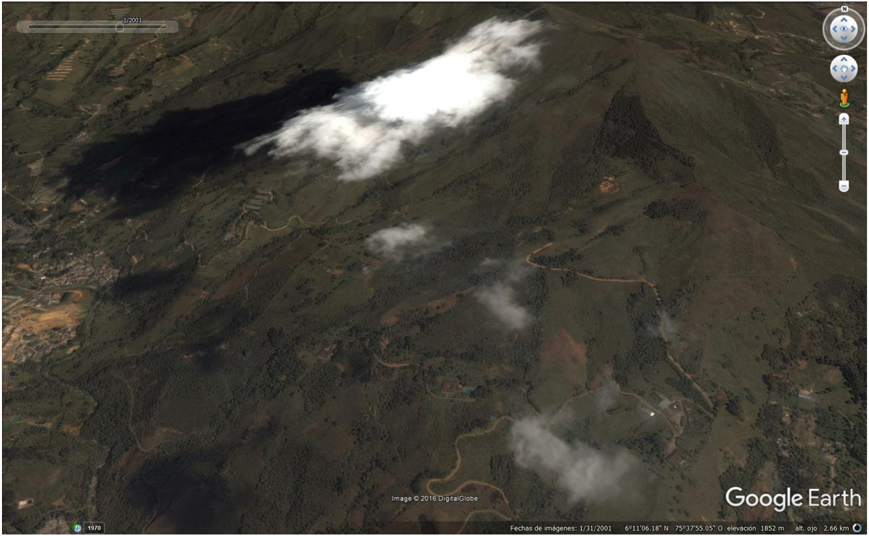
Ejemplo


ANTECEDENES
Flujo de lodos Piedra Gorda
(25 junio 2006)
Deslizamiento La Popala
(Abril 2006)
Flujos de lodos La Popala
(Abril 2006)
http://aburravalleynaturalhazards.blogspot.com/

Ejemplo


CANAL
Líneas de flujo
http://aburravalleynaturalhazards.blogspot.com/

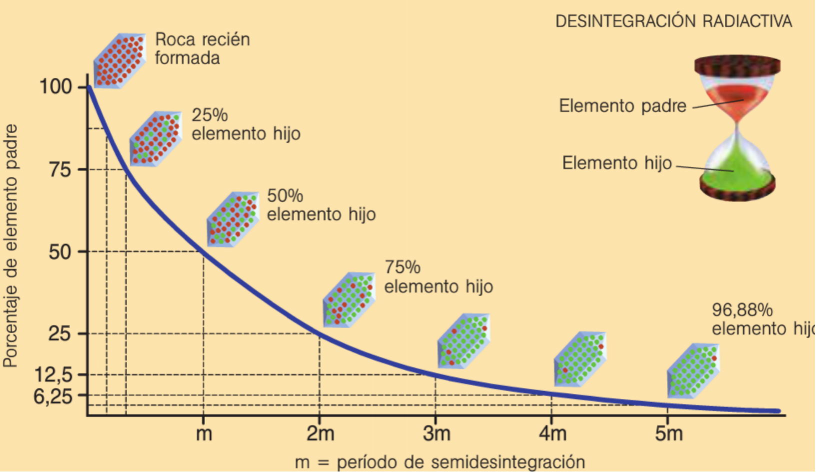
Ejemplo: Antes



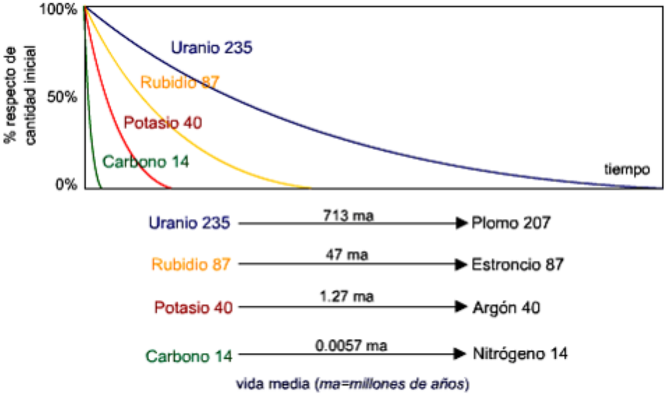
Ejemplo: Durante

Ejemplo: Despues

Desintegración de elementos radioactivos



Desintegración de elementos radioactivos



Métodos de datación absolutos

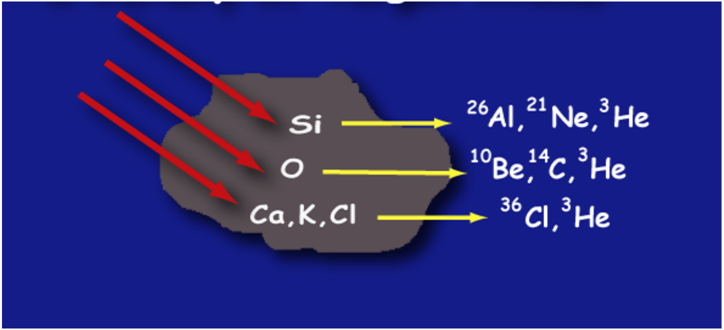
Table 1
Summary of the application ranges, materials and minerals used and the time ranges for absolute dating methods

Dating method	Application range	Materials/minerals	Time span
Radiocarbon	Sediments, lacustrine carbonates, alluvial fans, glacial deposits, fault movement rates, archaeology	Charcoal, cellulose, soil organic carbon, plant fibres, wood, shell, bone	< 40 ka
Cosmogenic isotopes	Sedimentation, volcanic events, meteorite impacts, rapid erosion, landslides	Quartz, rocks, olivine, orthopyroxene	0.01 – 20 Ma
Luminescence	Sediments (colluvial, alluvial and aeolian)	Quartz, feldspar	< 120 ka (possibly 400 ka)
Uranium series	Travertines, speleothems, corals	Uranium-bearing minerals deposited from water	< 500 ka
Argon	Formation of igneous and metamorphic rocks, landscape elevation and exhumation, tephra deposits, start of weathering	Feldspar, other rock-forming minerals	> 100 ka
Electron spin resonance	Sedimentation, fault activity, loess, sands	Foraminifera, flint, speleothems, travertine, shell, coral, quartz-rich volcanics	< 100 Ma
Palaeomagnetism	Volcanic rocks, laterites	Iron oxides	< 70 Ma

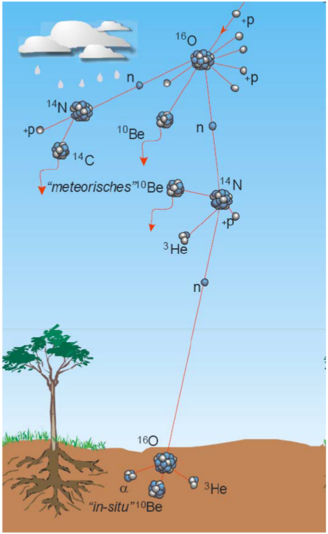
Fuente: Watchman & Twidale (2002)

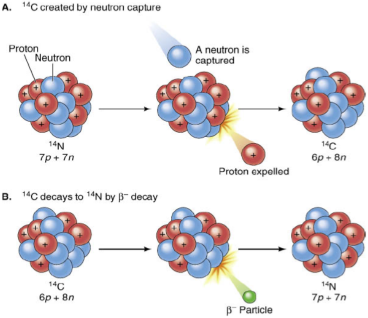
Isótopos cosmogénicos

Los isótopos cosmogénicos terrestres (TCN) producidos In Situ se producen por el resultado de la colisión de una partícula de alta energía (neutrones y muones) denominados rayos cósmicos contra un nucleido, el cual es roto en diversos fragmentos (espalación) que pueden ser: (i) radioactivos (14C, 10Be, 26Al, 36Cl), (ii) estables (3He, 21Ne). Para el caso de los estables la concentración del cosmogénico siempre se acumula en sucesivas exposiciones, el radioactivo no.

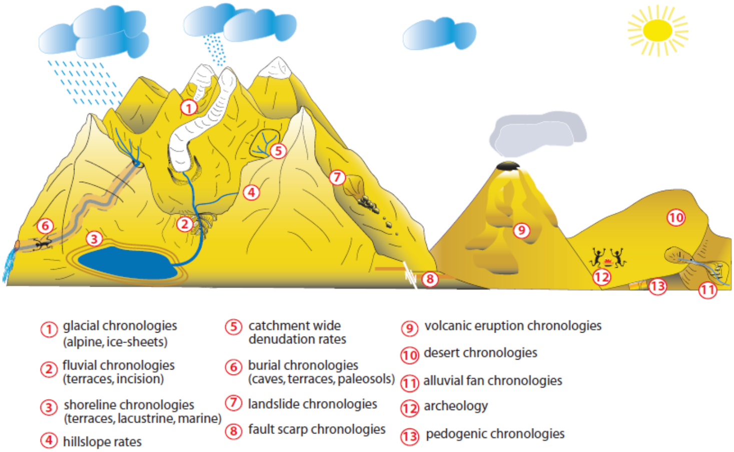


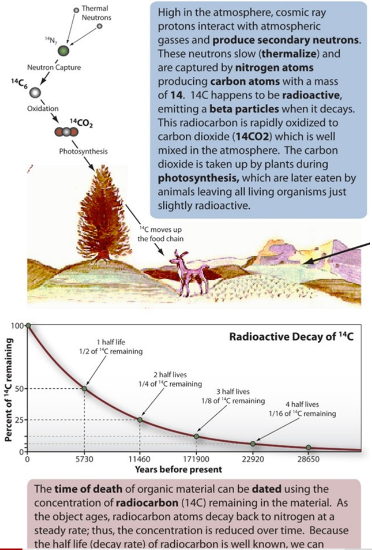
Isótopos cosmogénicos





Isótopos cosmogénicos




Thermal Neutrons
$^{14}N_7$
Neutron Capture
$^{14}C_6$
Oxidation
$^{14}CO_2$
Photosynthesis
High in the atmosphere, cosmic ray protons interact with atmospheric gasses and **produce secondary neutrons**. These neutrons slow (**thermalize**) and are captured by **nitrogen atoms** producing **carbon atoms** with a mass of **14**. 14C happens to be **radioactive**, emitting a **beta particles** when it decays. This radiocarbon is rapidly oxidized to carbon dioxide (**14CO2**) which is well mixed in the atmosphere. The carbon dioxide is taken up by plants during **photosynthesis,** which are later eaten by animals leaving all living organisms just slightly radioactive.
^{14}C moves up the food chain
Radioactive Decay of ^{14}C
Percent of ^{14}C remaining
100
50
25
0
1 half life
1/2 of ^{14}C remaining
2 half lives
1/4 of ^{14}C remaining
3 half lives
1/8 of ^{14}C remaining
4 half lives
1/16 of ^{14}C remaining
0
5730
11460
171900
22920
28650
Years before present
The **time of death** of organic material can be **dated** using the concentration of **radiocarbon** (14C) remaining in the material. As the object ages, radiocarbon atoms decay back to nitrogen at a steady rate; thus, the concentration is reduced over time. Because the half life (decay rate) of radiocarbon is well known, we can

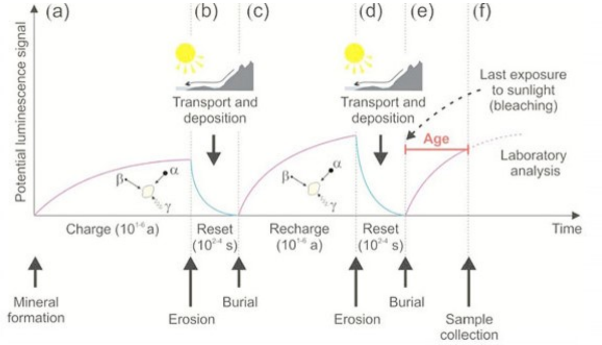
Isótopos cosmogénicos

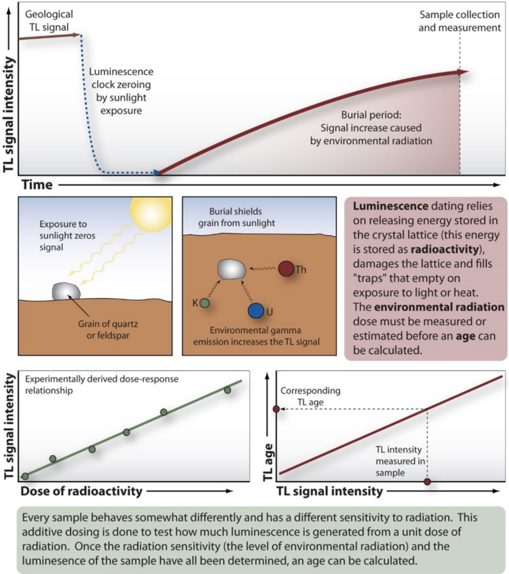
Tiempos de vida media

Table 23.1 Principal long-lived cosmogenic radionuclides and their uses in isotope geoscience

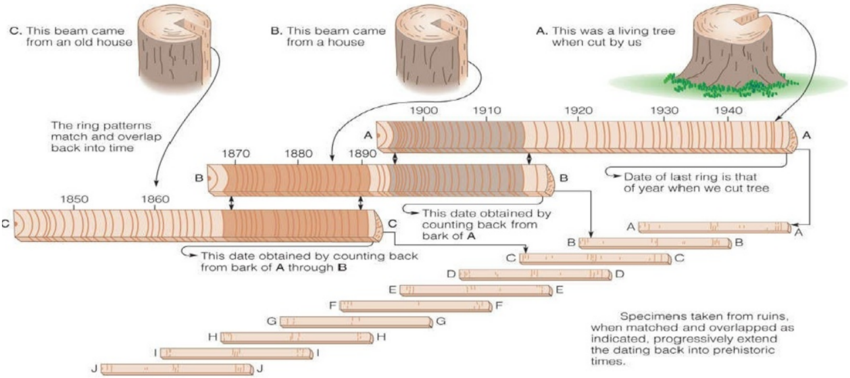
Nuclide	$T_{1/2}$ y	λ y^{-1}	*Principal Uses*
^{10}Be	1.5×10^{6}	0.462×10^{-6}	Dating marine sediment, Mn-nodules, glacial ice, quartz in rock exposures, terrestrial age of meteorites, and petrogenesis of island-arc volcanics
^{14}C	5730 ± 40	0.1209×10^{-3}	Dating of biogenic carbon, calcium carbonate, terrestrial age of meteorites
^{26}Al	0.716×10^{6}	0.968×10^{-6}	Dating marine sediment, Mn-nodules, glacial ice, quartz in rock exposures, terrestrial age of meteorites
^{32}Si	276 ± 32	0.251×10^{-2}	Dating biogenic silica, glacial ice
^{36}Cl	0.308×10^{6}	2.25×10^{-6}	Dating glacial ice, exposures of volcanic rocks, groundwater, terrestrial age of meteorites
^{39}Ar	269	0.257×10^{-2}	Dating glacial ice, groundwater
^{53}Mn	3.7×10^{6}	0.187×10^{-6}	Terrestrial age of meteorites, abundance of extraterrestrial dust in ice and sediment
^{59}Ni	8×10^{4}	0.086×10^{-4}	Terrestrial age of meteorites, abundance of extraterrestrial dust in ice and sediment
^{81}Kr	0.213×10^{6}	3.25×10^{-6}	Dating glacial ice, cosmic-ray exposure age of meteorites

Luminiscencia

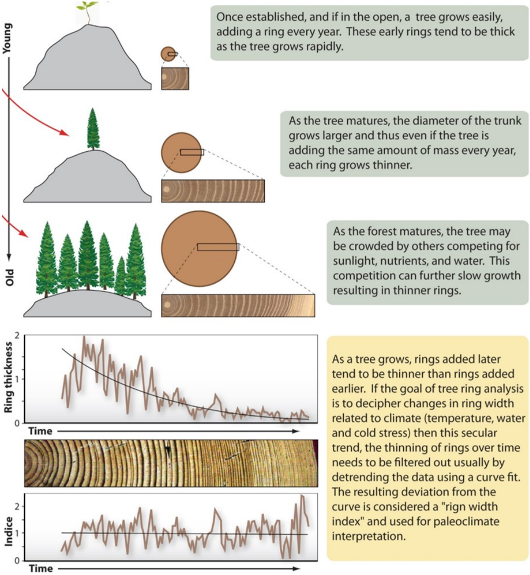



Geological
TL signal
Sample collection
and measurement
Luminescence
clock zeroing
by sunlight
exposure
Burial period:
Signal increase caused
by environmental radiation
TL signal intensity
Time
Exposure to
sunlight zeros
signal
Grain of quartz
or feldspar
Burial shields
grain from sunlight
Th
K
U
Environmental gamma
emission increases the TL signal
Luminescence dating relies on releasing energy stored in the crystal lattice (this energy is stored as **radioactivity**), damages the lattice and fills "traps" that empty on exposure to light or heat. The **environmental radiation** dose must be measured or estimated before an **age** can be calculated.
Experimentally derived dose-response
relationship
TL signal intensity
Dose of radioactivity
Corresponding
TL age
TL intensity
measured in
sample
TL age
TL signal intensity
Every sample behaves somewhat differently and has a different sensitivity to radiation. This additive dosing is done to test how much luminescence is generated from a unit dose of radiation. Once the radiation sensitivity (the level of environmental radiation) and the luminesence of the sample have all been determined, an age can be calculated.

Dendrocronologia



Dendrocronologia



Dendrogeomorfología