

What is the Quaternary?

To a chronostratigrapher, the Quaternary is the most recent geologic period in the standard geologic time scale.

The name "Quaternary" originated in a now-archaic time scale of Primary, Secondary, Tertiary, and Quaternary. "Primary" and "Secondary" dropped out of use long ago,

and "Tertiary" was declared invalid in the late 1900s when "Paleogene" and "Neogene" were declared chronostratigraphically correct. The term "Quaternary" almost met the same fate,

but the term's applicability as a geological concept (as in the last two definitions here) and as an institutional label in the names of journals and societies led to its preservation.

Chronometrically-oriented

To a geochronologist, the Quaternary is the most recent 2.588 million years.

There is nothing inherently significant about 2.588 million years, but it is roughly

the duration of the two most recent magnetic chrons, which provide a globally recog-

nizable signal by which to define effectively, though not formally, the Quaternary.

To a magnetostratigrapher, the Quaternary is the most recent two chrons, the present Brunhes Chron of normal polarity and the Matuyama Chron of reversed polarity.

Earth's magnetic field has switched its

north-south polarity randomly through time, and the most recent reversed-to-normal switch

occurred at a time convenient to defining the Neogene-Quaternary boundary.

To a chemostratigrapher, the Quaternary is the last 104 marine isotope stages.

The recognition of 104 marine isotope stages from the Quaternary is arbitrary, in that we would now downgrade at least two

of those stages (MIS 3 and 4) to substages. However, the coincidence that "the Quaternary is roughly the last one hundred marine isotope

stages, or last fifty glacial cycles" provides a number that is easy to remember.

Process-oriented

To a geologist, the Quaternary is the time of major glaciation in the Northern Hemisphere, leading to tills, other glacial deposits, and glacial landforms.

Earth has undergone major periods of glaciation during the last few million years, during the late Paleozoic (mostly in the Pennsylvanian) roughly 300 million years ago, and before that in the Proterozoic. In

the most recent episode, sea ice and ice sheets on land developed first in Antarctica, more than ten million years ago. Major glaciation in the Northern Hemisphere began gradually two to three million years ago. Thus "the

Quaternary is the time of major glaciation in the Northern Hemisphere" is a process-oriented but imprecise definition for which the Brunhes-Matuyama paleomagnetic shift provides a precise, but not process-oriented, marker.

Isotopically-oriented

To an isotope geochemist, the Quaternary is the time in which $\delta^{18}\text{O}$ of benthic foraminifera during glacial stages has surpassed +4.0 ‰ vs. VPDB.

The $\delta^{18}\text{O}$ of seawater, and thus of marine minerals, increases with increasing glaciation, because ice stores ^{18}O -depleted H_2O . The

$\delta^{18}\text{O}$ of marine benthic forams abruptly surpassed +4.0 ‰ relative to the VPDB standard ~2.54 million years ago, in MIS 100, indicating

a sharp increase in the volume of glacial ice and thus providing a distinct and meaningful isotopic marker of enhanced NH glaciation.