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Divisions of Geologic Time—Major Chronostratigraphic and Geochronologic Units

Introduction.—Effective communication in the geosciences requires a consistent nomenclature for stratigraphic units and, especially, for divisions of geologic time. A geologic time scale is composed of standard stratigraphic divisions based on rock sequences and is calibrated in years (Harland and others, 1982).

Geologists from the U.S. Geological Survey (USGS), State geological surveys, academia, and other organizations require a consistent time scale to be used in communicating ages of geologic units in the United States. Many international debates have occurred over names and boundaries of units, and various time scales have been used by the geoscience community.

Updated time scale.—For consistent usage of time terms, the USGS Geologic Names Committee (GNC; see box for members) and the Association of American State Geologists developed the **Divisions of Geologic Time**; the 2018 update shown in figure 1 contains the unit names and boundary age estimates ratified by the International Commission on Stratigraphy (2018). Scientists may use other published time scales, provided that these are specified and referenced (for example, Palmer, 1983; Harland and others, 1990; Haq and Eysinga, 1998; Gradstein and others, 2012; Walker and others, 2012; Ogg and others, 2016).

Advances in stratigraphy and geochronology require that any time scale be periodically updated. Therefore, the **Divisions of Geologic Time** is dynamic and is modified as needed to include accepted changes of unit names and boundary age estimates. This fact sheet updates the **Divisions of Geologic Time** released in two previous USGS fact sheets (U.S. Geological Survey Geologic Names Committee, 2007, 2010).

The **Divisions of Geologic Time** (fig. 1) shows the major chronostratigraphic (position) and geochronologic (time) units; that is, from largest to smaller, enonothem/eon to series/epoch divisions. The National Geologic Map Database (https://ngmdb.usgs.gov/Geolex/stratres/timescales) has additional resources and information (such as stage/age terms). The systems of the Mesozoic are subdivided into formal series designated by the terms "Lower," "Middle," and "Upper." The corresponding periods are subdivided into formal epochs designated as "Early," "Middle," and "Late." Similarly, the Ordovician and Devonian Systems and the Mississippian and Pennsylvanian Subsystems of the Paleozoic are subdivided into formal series designated as "Lower," "Middle," and "Upper"; the formal epochs are designated as "Early," "Middle," and "Late." The Silurian and Permian are divided into series/epochs that have individual names. Because some of the series/epoch names for the Cambrian have been set and some have not, the placeholders "Lower/Early," "Middle," and "Upper/Late" may be used. All other uses of "lower/early," "middle," and "upper/late" are acceptable only as informal units (lowercase). The GNC will not include new series/epoch names in the **Divisions of Geologic Time** until all are named for a specific system/period.

Cenozoic.—A controversial issue during the first decade of the 21st century was the position of the base of the Quaternary System/Period and its status as a formal division of time. After much debate, the International Union of Geological Sciences formally ratified a new definition of the base of the Quaternary and the corresponding base of the Pleistocene Series/Epoch, changing it from 1.806 Ma to 2.58 Ma (see box for age terms) (Gibbard and others, 2010). Although the Tertiary is not recognized by many international time scales, the GNC agrees that it is important that it be recognized as a system/period (Orndorff and others, 2010); the map symbols "T" (Tertiary) and "Q" (Quaternary) have been used on geologic maps for more than a century and are widely used today. However, the use of "Paleogene" and "Neogene" is encouraged.

Anthropocene.—The term "Anthropocene" is used by scientists and nonscientists to highlight the concept that we are living in a time when human activities have significant effects on the global environment. The Anthropocene currently has no formal status in the **Divisions of Geologic Time** and is not recognized by the GNC. If international agreement is reached, it could be become a series/epoch above the Holocene.

Precambrian.—The informal term "Precambrian" lacks a specific stratigraphic rank, but it is capitalized because of tradition. For technical discussions, researchers should seek the most accurate terms and refer to the Proterozoic Eon or other formal divisions. The term "Precambrian" may be used informally when communicating with the public and for general discussions.

—By the U.S. Geological Survey Geologic Names Committee

Members of the U.S. Geological Survey Geologic Names Committee, 2018

Randall C. Orndorff (chair), Nancy Stamm (recording secretary), Lucy Edwards, Julie Herrick, Leslie Ruppert, Janet Slate, David Soller (all USGS), and Berry (Nick) Tew, Jr. (State Geologist of Alabama).

Age Terms

The age of a stratigraphic unit or the time of a geologic event may be expressed in years before present (before A.D. 1950). The "North American Stratigraphic Code" (North American Commission on Stratigraphic Nomenclature, 2005) recommends abbreviations for ages in SI (International System of Units) prefixes coupled with "a" for annum: ka for kilo-annum (10^3 years); Ma for mega-annum (10^6 years); and Ga for giga-annum (10^9 years). Duration of time should be expressed in millions of years (m.y.): for example, "deposition began at 85 Ma and continued for 2 m.y."

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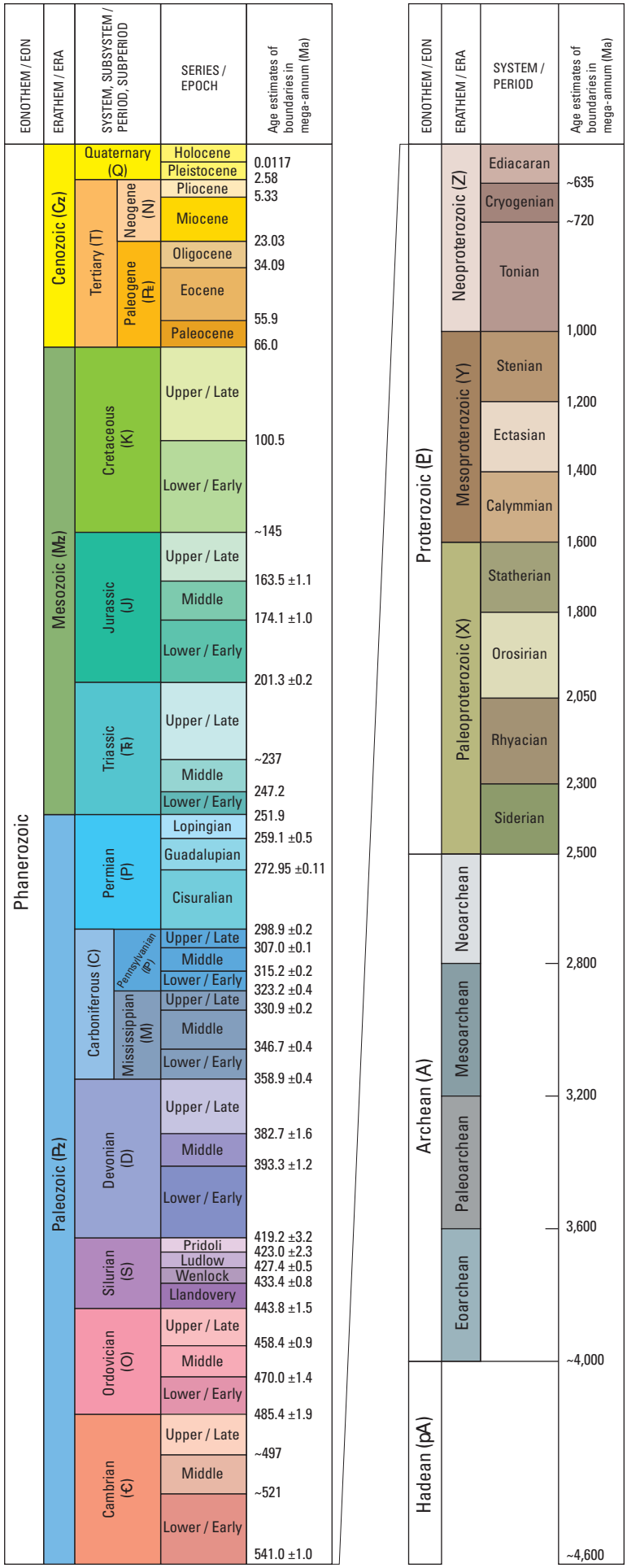
Figure 1. Chart of the **Divisions of Geologic Time** approved by the U.S. Geological Survey Geologic Names Committee, 2018. The chart shows major chronostratigraphic and geochronologic units. It reflects ratified unit names and boundary estimates from the International Commission on Stratigraphy (2018). Box heights are scaled to the relative duration of time periods named; different scaling factors are used for the Phanerozoic column on the left than for the column on the right, which represents a longer time period. Map symbols are in parentheses.



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