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Ratification of subseries/subepochs as formal rank/units in international chronostratigraphy

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*The IUGS Executive Committee has voted unanimously to ratify the proposal for formal adoption of the chronostratigraphical/geochronological unit divisions subseries/subepoch within the International Stratigraphic Guide as approved by the International Commission on Stratigraphy and forwarded to the IUGS EC on 24 March 2021**. The subseries/subepochs are now incorporated in a six-tiered chronostratigraphic hierarchy of units that are formally defined by a designated GSSP (Global Stage Stratotype and Point) at the base of designated type stages. Henceforth, subseries/subepochs of the Cenozoic are to be denominated by capitalised positional adjectives -- Lower/Early, Middle, and Upper/Late -- added to the names of the relevant series/epochs.*

Introduction

Indecision and controversy have clouded discussions on the status of subseries/subepochs since the Second International Congress on Stratigraphy (Strati 2015, Graz). This concept, introduced by Charles Lyell (1833) as part of his chronostratigraphic subdivisions of the “Tertiary” (Cenozoic), has played a crucial role in the development of modern chronostratigraphy (Aubry, 2016). Ever since their inception, subepochs have consistently remained a key temporal unit for generalized international communication across disciplines in Earth Sciences, well-recognised in the Cenozoic.

The chronostratigraphic value of the Cenozoic subseries/subepochs has never been questioned, and in scientific publications, including the timescales, their boundaries have been consistently aligned with the boundaries of global stages defined by GSSPs. The point of contention, however, has not been their definition but the question of their status. Should they be recognised as the second rank in a formal six-tiered chronostratigraphic hierarchy from stage to eonothem, or

should they remain informal subdivisions of series and epochs in a five-tiered hierarchy? This dilemma was at the heart of the conflicting positions expressed in Head et al. (2017) and Pearson et al. (2017). A temporary resolution to the situation was recommended, so that sub-commissions had the freedom to choose between formal and informal status based on individual preference (Finney and Bown, 2017). This led to glaring inconsistency in Cenozoic chronostratigraphy, in that the Subcommittee on Quaternary Stratigraphy (SQS) adopted a formal status for subseries whereas the subcommissions on Neogene and Paleogene Stratigraphy (SNS and ISPS) continued to use subseries as informal units despite their obvious ties to stage GSSPs.

The breakthrough that led towards procedural reunification of Cenozoic chronostratigraphy emerged from the simultaneous ratification of subseries/subepochs for the Holocene and Pleistocene series (Aubry and Piller, 2021). The ratification of the Lower/Early, Middle, and Upper/Late Holocene subseries/subepochs corresponding respectively to the Greenlandian, Northgrippian and Meghalayan stages/ages (Walker et al., 2018, 2019) and the subsequent ratification of the Lower/Early, Middle, and Upper/Late Pleistocene subseries/subepochs corresponding respectively to Gelasian + Calabrian, Chibanian and “Upper” (unnamed) stages/ages (Head et al., 2020) formalised the rank of subseries/subepoch for the Holocene and Pleistocene in the geological timescale. A new question then arose, as to whether the terms subseries/subepoch should be formally defined in the *International Stratigraphic Guide*. The members of the International Subcommittee on Stratigraphic Classification (ISSC) voted a 76% majority in favour of this inclusion (Aubry et al., 2021).

The *International Stratigraphic Guide*, first edited by Hedberg (1976) and re-edited by Salvador (1984), is currently under further revision under the auspices of the ISSC, with the objective of updating the *Guide* in areas where new concepts and/or practices have been introduced. With regard to chronostratigraphic units (Chapter 9) the recent developments described above will require the inclusion of subseries/subepochs in the chronostratigraphic/geochronologic hierarchy, allowing subcommissions the freedom to choose whether to replace infor-

mally recognised subdivisions for their systems/periods with formal units of identical definition. The ISSC thus submitted on 19 January 2021 a proposal to the International Commission on Stratigraphy (ICS) for *Subseries/subepochs to be accorded the status of formal chronostratigraphic units in a new/revised version of the International Stratigraphic Guide, when published*^{*}. On 1 May 2021, the IUGS Executive Committee issued the ratification of *the proposal for formal adoption of chronostratigraphical/geochronological unit divisions subseries/subepoch within the International Stratigraphic Guide as approved by the International Commission on Stratigraphy and forwarded to the IUGS EC on 24 March 2021*.

The ratification of formal subseries/subepochs has several ramifications. First, subseries/subepochs are no longer mere subdivisions of series/epochs, but as explicitly stated, *Subseries can be defined as chronostratigraphic units in a formal rank intermediate between stage and series. They are comprised of one or several consecutive stages, and their boundaries are defined by the GSSPs of the oldest included stage and that of the oldest stage in the subsequent unit. The temporal equivalent of a subseries is a subepoch*. Second, the rank is now available for any chronostratigraphic interval for which their use may be beneficial, for instance when the range of a series represents a very long epoch comprised of several stages/ages. Third, following Lyell (1833), Cenozoic subseries/subepochs have been identified using simple positional adjectives applied to the name of the series/epoch, and this tripartite logic would be clearly appropriate for some newly established units, although double positional adjectives would not be suitable. Fourth, the possibility for unification of chronostratigraphic practices in the Cenozoic Erathem (Aubry and Piller, 2021) is now enhanced, which is highly desirable not only in consideration of their common chronostratigraphic history but also to facilitate the dialogue between subcommissions. Fifth, a conceptual double standard, whereby some subseries defined by the GSSPs of their bounding stages at present have informal status based on a preconception that formal subseries could eclipse stages, is now corrected in view of the fact that broadly used chronostratigraphic units which are defined by the *same unique* criterion — the GSSPs of lower bounding stages — have equal status for the sake of scientific rationality. Finally, the recognition of the formal rank of subseries/subepochs by the IUGS restores harmonious chronostratigraphic practices between the North American Code of Stratigraphic Nomenclature (2005; Aubry et al., 2020) and the *Guide* (see Piller and Aubry, 2021).

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**[E-mail message from IUGS Secretary General Stan Finney to ICS Secretary General Philip Gibbard, 1 May 2021.]



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