Applying the Rules: A proposal to unify Cenozoic Chronostratigraphy and Geochronology

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Abstract

Six internationally recognized chronostratigraphic ranks currently support narratives in Earth Sciences as illustrated by the International Chronostratigraphic Chart (ICC; Cohen et al., 2013). These are the eonothem/eon, erathem/era, system/period, series/epoch, and stage/age to which subseries/subepoch has recently been added. These ranks have been approved by the International Commission on Stratigraphy (ICS) and ratified by the Executive Committee of the International Union of Geological Sciences (EC-IUGS). The rank of subseries/subepoch was deemed necessary by many, not only within the ICS but also in the North American Commission on Stratigraphic Nomenclature which has incorporated it in its Code (Aubry et al., 2019). The inclusion of the rank of subseries/subepoch in the ICC reflects the essential role these units continue to hold in Cenozoic geohistory, stemming from their long use since the 1800s, their names indicating position, the subseries being convenient for stratigraphies difficult to narrow to stage rank, and the subepochs being of convenient durations for describing geological and evolutionary processes. Indeed, datasets compiled from Google scholar and Scopus show that some subseries are cited over 30 times more frequently than the corresponding or included stage (e.g., upper Eocene vs. Priabonian). We propose that all Cenozoic subseries should be included in the ICC.

The formalization of Cenozoic subseries and their official incorporation into the ICC have been hotly debated in recent years, with the three relevant ICS subcommissions expressing different views on the subject. The adoption of the Holocene subseries by the Subcommission on Quaternary Stratigraphy (SQS) led to their formalization and official incorporation in the ICC (ratification by the EC-IUGS, 14 June 2018; Walker et al., 2019), a move that effectively conferred formal and official rank to subseries and official representation in the

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ICC (ratification by the EC-IUGS, 1 May 2021; Aubry et al., 2021). This prompted the Subcommission on Neogene Stratigraphy (SNS) to also formalize its five Miocene and Pliocene subseries (ratification by the EC-IUGS, 13 October 2021; Aubry et al., 2022), while SQS proceeded with the formalization of subseries for the Pleistocene Series (ratification by the EC-IUGS, 17 January 2020 for the Middle Pleistocene and 30 January for the Lower and Upper Pleistocene; Head et al., 2021). The eleven subseries of the Neogene and Quaternary systems/periods thus officially belong to the international chronostratigraphic hierarchy and their boundaries are unambiguously tied to the GSSPs of their lowest component stages.
The Paleogene System/Period comprises eight informal but well established and broadly used subseries/subepochs. While the boundaries and content of these units must be defined and approved by the relevant subcommission, Finney and Bown (2017, p. 3) determined that "a mixed solution with formalized subseries/subepochs for one or two of the Cenozoic systems but not the others would be the worst possible outcome and difficult to defend. The ultimate decision should be for all or none". The main argument advanced by Pearson et al. (2017) against the formalization of subseries concerned their potential competition with stages, but this is no longer valid since the two ranks now belong to the same (formal) hierarchy. A greater concern for us is that the wide use to subseries by the broad Earth Science community is not served by clear definition, particularly within recent Geological Time scales (GTSs). Because they are excluded from the ICC, Paleogene subseries are excluded from the iconography of recent GTSs even though the associated texts include multiple references to subseries/subepochs by name, but without specifying their rank and without definition. The potential for destabilization of the Paleogene system is substantial and organizations and individual authors are treating them as if formal. Undefined in the ICC, the Paleogene subseries can be modified inconsistently to suit the needs of individual studies, hindering consistent implementation or communication of chronostratigraphic correlations. If the role of the ICS-IUGS is to effectively serve the needs of the scientific community in an evolving context, then Paleogene subseries/subepochs should be formalized and officially included in the ICC. Omitting them from the ICC is to ignore the needs of the broader scientific community (Aubry et al., in press).

Keywords: Subseries, Cenozoic, Paleogene, timescale, chronostratigraphy