



International Commission on Stratigraphy Subcommission on Quaternary Stratigraphy

27 February 2009

Prof. Stan Finney, Chair
International Commission on Stratigraphy

Dear Stan:

Response to objections by the SNS to the SQS proposal that the base of the Quaternary System/Period be lowered to the Gelasian Stage GSSP (at 2.588 Ma), and that the base of the Pleistocene Series be lowered to the same position

We thank you and our colleagues in the Subcommission on Neogene Stratigraphy (SNS) for this opportunity to yet further clarify our position regarding the timing and status of the Quaternary and associated units. We are pleased to address comments raised by the SNS in their letter of 17 February 2009 in response to the proposal of the Subcommission on Quaternary Stratigraphy (SQS) dated 28 August 2008, and we briefly address proposals advanced by Aubry et al. (in press). Before doing so, however, we would like to emphasize several key points:

1. The Quaternary, which traditionally comprises Pleistocene and Holocene, has long been used in both popular and official time scales, including the current IUGS-sanctioned time scale of Remane (2000; Figure 1). This time scale places the Quaternary as a period/system *above* the Neogene, so that the base Quaternary defines its top. Such a configuration reflects an overwhelming body of recent and historical literature (Salvador, 2006a, b), and would have been evident to anyone visiting the International Geological Congress in Oslo last summer (SQS proposal). Our proposal does *not* truncate the Neogene because the orthodox view it espouses has never acknowledged an extended Neogene.
2. The IUGS has already ratified the Quaternary as a period/system (IUGS email of 28 May 2007 to ICS). Contrary to assertions by the SNS and Aubry et al. (in press), the status and rank of the Quaternary are not in debate. We confine our proposal deliberately and appropriately to the position of the base Quaternary and bases of relevant subordinate units (Pleistocene Epoch/Series, Gelasian Age/Stage).
3. We propose that the base Quaternary be lowered from its present IUGS-sanctioned position (Remane, 2000) at the base Pleistocene Vrica GSSP (1.8 Ma) to the Gelasian Stage GSSP (2.588 Ma; Figure 1). This acknowledges fundamental and profound changes to Earth's climate system at around 2.6 Ma, and the manifold associated biotic and physical responses (Head et al., 2008a).

This lowered position can be correlated globally across and between marine and terrestrial realms. No concentration of global events occurs at the current boundary at Vrica (1.8 Ma). Understandably, the ICS has already agreed with our proposed redefinition of the base Quaternary (Ogg and Pillans, 2008), and we note that the SNS themselves “accept that the base of the Quaternary is now defined at 2.6 (2.588) Ma” (SNS letter of February 17, 2009, point 6). We therefore trust that no objections are accorded to this part of our proposal.

4. Any serious proposal must respect the hierarchical nature of the geological time scale. Accepting an age of around 2.6 Ma for the base Quaternary and utilizing a ready-made GSSP (the base Gelasian GSSP), hierarchical principles demand that the base of the Pleistocene be lowered to that of the Quaternary. The Gelasian Stage then becomes the lowermost stage of the Pleistocene, and its establishment by Rio et al. (1998) effectively anticipated this outcome.
5. Users of the geological time scale must be considered, and the Quaternary community numbers 50,000 worldwide with INQUA serving as its voice. INQUA, which has equal status with the IUGS under the International Council of Science (ICSU), unanimously endorses the SQS proposal in its entirety.

Our closing remarks are given at the end of this letter, but we now take this opportunity to briefly counter the 13 points of objection listed by the SNS in their letter of 17 February, 2009.

Point 1. We make the point that the Quaternary as a general concept (Arduino, 1760) and even as a formal term (Desnoyers, 1829) is sanctioned by a long tradition of usage, with its roots predating both the Pleistocene (Lyell, 1839) and Neogene (Hörnes, 1853). The term Quaternary may be etymologically distasteful to some, but to others it is an instructive reminder that stratigraphic classification is dynamic and carries an interesting history. Similar objections might be leveled at the terms Cretaceous and Carboniferous, as these also belonged to once-popular but since abandoned lithology-based classifications (Walsh, 2006). Understandably, the terms Primary, Secondary, Oolitic, Lias and others have fallen out of service because they were not useful; whereas the Cretaceous, Carboniferous, and for that matter Quaternary and Tertiary, have survived because they clearly are (Salvador, 2006a, b; Walsh, 2006). No one would seriously try to suppress the Cretaceous or Carboniferous on grounds that these terms were “antique” or “irrelevant”.

Point 2. We are pleased the SNS acknowledges that our proposal represents the current consensus, but we reiterate that this simply reflects a long-held traditional view in which the Quaternary is placed above, not alongside, the Neogene (Harland, 1989). Scientific advances often result from deductive reasoning, and this holds too for modern stratigraphy. An important event or transition in Earth history is initially recognized (often following a “preconceived idea”). The precise lithological position of the boundary (the GSSP) is then selected with due regard to the practicalities of correlation. This exact methodology was employed for the selection of the Gelasian Stage GSSP (Rio et al., 1998), which was championed by the SNS itself. We use this same boundary and same methodology for the base Quaternary.

Point 3. The SNS seems not to dispute the conclusion of Walsh (2008) that the notion of a Neogene extending to the present day is indeed based on flawed historical interpretation. While most standard global geochronological names have undeniably shifted from their original meaning over the centuries (Walsh, 2008), we note that the Quaternary has always extended to the present day, and has been

exclusively associated with glacial conditions for at least the past 60 years, as our proposal acknowledges.

Point 4. We are pleased that the SNS accepts the decision of the IUGS and does not treat the Holocene as a subdivision of the Pleistocene.

Point 5. We strenuously uphold our assertion that the Vrica GSSP, which presently defines the base Pleistocene, is fundamentally flawed as a boundary of epoch/series rank owing to the paucity of biostratigraphic and physical events at and near the boundary. The “recognition” of this boundary owes mostly to its proximity to the top of the Olduvai Subchron, although this is a full 10 m above the boundary at Vrica. The boundary is even more elusive in the absence of a continuous paleomagnetic record, and especially in continental deposits, but even in high-latitude marine deposits where calcareous microfossils are sparse to absent and marine isotope stratigraphy unavailable. These deficiencies all explain the long history of dissatisfaction with the present base of the Pleistocene (e.g., Suc et al., 1997) and its continuance to the present time only by minority vote (Bowen and Gibbard, 2007). Contrary to the assertion of the SNS, the emergence of the genus *Homo* is not associated with the Olduvai Subchron, but dates to around ca. 2.6–2.45 Ma (Deino et al., 2006; Prat, 2007). This date is closer to our proposed redefinition of the base Pleistocene at 2.6 Ma.

Point 6. We have difficulty in understanding the SNS’s objections to the placement of the base Quaternary at 2.6 Ma, when the SNS avowedly accepts this very position. The base Quaternary is coincident with the Gelasian GSSP, which the SNS states as being “widely correlatable because it is associated with a major paleoclimate event”. We have already noted that cold events occur before the major onset of Northern Hemisphere glaciation. But one simply cannot compare, for example, the isolated event of Marine Isotope Stage M2, occurring as it does within an otherwise stable mid-Pliocene warm interval (e.g., Dowsett, 2007), with the intense, rapidly recurring glacial events at around 2.6 Ma. These later glacial events, and their attendant biotic and environmental manifestations, best serve as a general guide for the base Quaternary, but with the Gelasian GSSP offering the most practical actual definition. The ICS, SQS, SNS, and INQUA all agree with this placement of the base Quaternary.

With respect to the International Geological Congress (IGC) held in London, 1948, King and Oakley (1949) noted that the Pleistocene should include the Villafranchian regional mammal stage. Nearly half of this stage is presently in the Pliocene, and lowering the Pleistocene to include the Gelasian Stage will bring the Pleistocene in closer agreement with the 1948 IGC decision (Ogg and Pillans, 2008).

Point 7. Since it is agreed by ICS, SQS, SNS, and INQUA that the base Quaternary should be placed at 2.6 Ma, which coincides with the Gelasian GSSP, then the base Pleistocene must be lowered to that of the base Quaternary in order to maintain hierarchical order within the time scale (Figure 1). The Gelasian then becomes the lowermost stage of the Pleistocene. It would be incongruous and confusing to have the Gelasian Stage in the Pliocene Series and the Quaternary System.

Point 8. The status of the Quaternary is in fact *closed* for discussion. The “IUGS EC unanimously approves the recommendation [of the ICS] to recognize the ‘Quaternary’ as a formal system/period of the international geological scale” (IUGS to ICS, 28 May, 2007). This decision, far from being premature, resulted from long discussions between the ICS and INQUA, and was facilitated by a special joint working group established for this purpose. The duration of the Quaternary remains open for discussion, but we emphasize that ICS, SQS, and INQUA, and the SNS itself, all agree that the Quaternary should begin at 2.6 Ma.

Point 9. We are heartened that the SNS agrees with our proposal to use the existing Monte San Nicola GSSP (base Gelasian) to define the base Quaternary.

Point 10. We accept that in general terms the standard global chronostratigraphic scale is the responsibility of the ICS/IUGS. However, responsibility for the Quaternary lies jointly with the IUGS and INQUA, as they are equal Science Union members of the International Council for Science. Indeed it might be argued that INQUA has greater jurisdiction over the Quaternary, and therefore the past 2.6 million years of Earth history, because of its larger pool of expertise. In any case, it is important to note that INQUA fully endorses the SQS proposal, which we might add does follow ICS guidelines (e.g., Remane et al., 1996).

Point 11. It is disingenuous to claim that the Neogene is being decapitated. The SQS proposal merely reflects the orthodox scheme in which the Quaternary overlies the Neogene. But this is moot because the IUGS has already ratified the Quaternary as a period/system.

Point 12. We have every confidence that the ICS will reaffirm its earlier full support of the SQS proposal (Ogg and Pillans, 2008). The alternative could bring IUGS and INQUA into direct conflict, which would serve no useful purpose. We consider that the prospect of two independent time scales, one for Quaternarists and another for the remainder of the geological community, as ominously raised by Aubry et al. (in press – their invocation of the NOMA principle), would be a monumental failure of common sense and cooperation. It would be completely unacceptable to us, and no doubt also to IUGS and INQUA.

Point 13. The implication that the SQS does not address the concerns of the marine Quaternary community is fallacious. Since INQUA has a membership of around 50,000, the Quaternary community undoubtedly has many more marine geoscientists than the Neogene community, and much consideration of the SQS position is based on the marine record (e.g., Head et al. 2008a). The SQS and INQUA, in fact, have an uncompromising mandate to provide a solution that will satisfy marine and non-marine geoscientists alike.

Closing remarks

The SQS proposal to lower the base Quaternary to 2.6 Ma has the support not only of INQUA, but also ICS and the SNS itself. Lowering the base Pleistocene to 2.6 Ma simply follows rational and hierarchical principles: the Gelasian, Pleistocene and Quaternary all then share the same GSSP (at Monte San Nicola, 2.588 Ma). The SNS counterproposal appears driven more by desperation than logic: this may explain why just 65% of its members voted in favour of their own proposal.

The publication by Aubry et al. (in press) illustrates two muddled schemes. Both place an “Early Pliocene Epoch” exclusively in the Neogene, and a separate and independent “Late Pliocene Epoch” in a Neogene/Quaternary overlap. Thus, *two* Pliocene epochs are newly created from one, with each occurring counterintuitively in a *different* unit of higher rank. The Piacenzian is transferred to the “Early Pliocene” for which there is no recent precedent. The Quaternary is awkwardly sidelined to the rank of sub-period in one scheme and sub-era in the other, each scheme violating the recently IUGS-re-approved rank of the Quaternary as a period/system. **For the Pliocene, a completely unnecessary schism is created that will only assure future confusion** (Figure 1). Both Aubry et al. schemes, in

their defense, acknowledge that the Quaternary can be justified only if starting at around 2.6 Ma. This one crucial point of agreement is of course the basis for the SQS proposal, and from which our own small adjustments logically follow.

Regarding the Pleistocene, this term was introduced by Lyell in 1839 to represent “ice age” deposits that postdate his already established Pliocene. Because the Pliocene was the last unit of the Tertiary, this opened the possibility for a post-Pliocene Quaternary (Harland et al., 1989, p. 68). The Pleistocene has therefore always been the lowest division of the Quaternary, the correspondence of their bases has existed for more than a century, and our proposal correctly maintains this historical relationship.

The proposal by Aubry et al. (in press) places much weight on the fossil record, and we do not downplay its historical role in the creation of the time scale (although we do note that their fig. 5 suggests stronger evidence of adaptive radiation in the Quaternary than Neogene!). But ultimately, if Earth’s history is to be subdivided into natural units, this requires our planet to be treated as an evolving system that *includes* its climate, along with other factors. We adopt this more holistic approach in acknowledging fundamental changes to planet Earth at around 2.6 Ma.

In closing, the IUGS has ratified the Quaternary as a system/period, and the lowering of the base Quaternary to 2.6 Ma is already accepted by ICS, SNS, SQS and INQUA. Our proposal simply and rationally requests that small adjustments be made in accordance with hierarchical principles: that the base Pleistocene Epoch/Series be lowered to that of the Gelasian Age/Stage and Quaternary Period/System, with each defined/redefined by the GSSP at Monte San Nicola (dated at 2.588 Ma). We trust that the ICS will continue to support this proposal.

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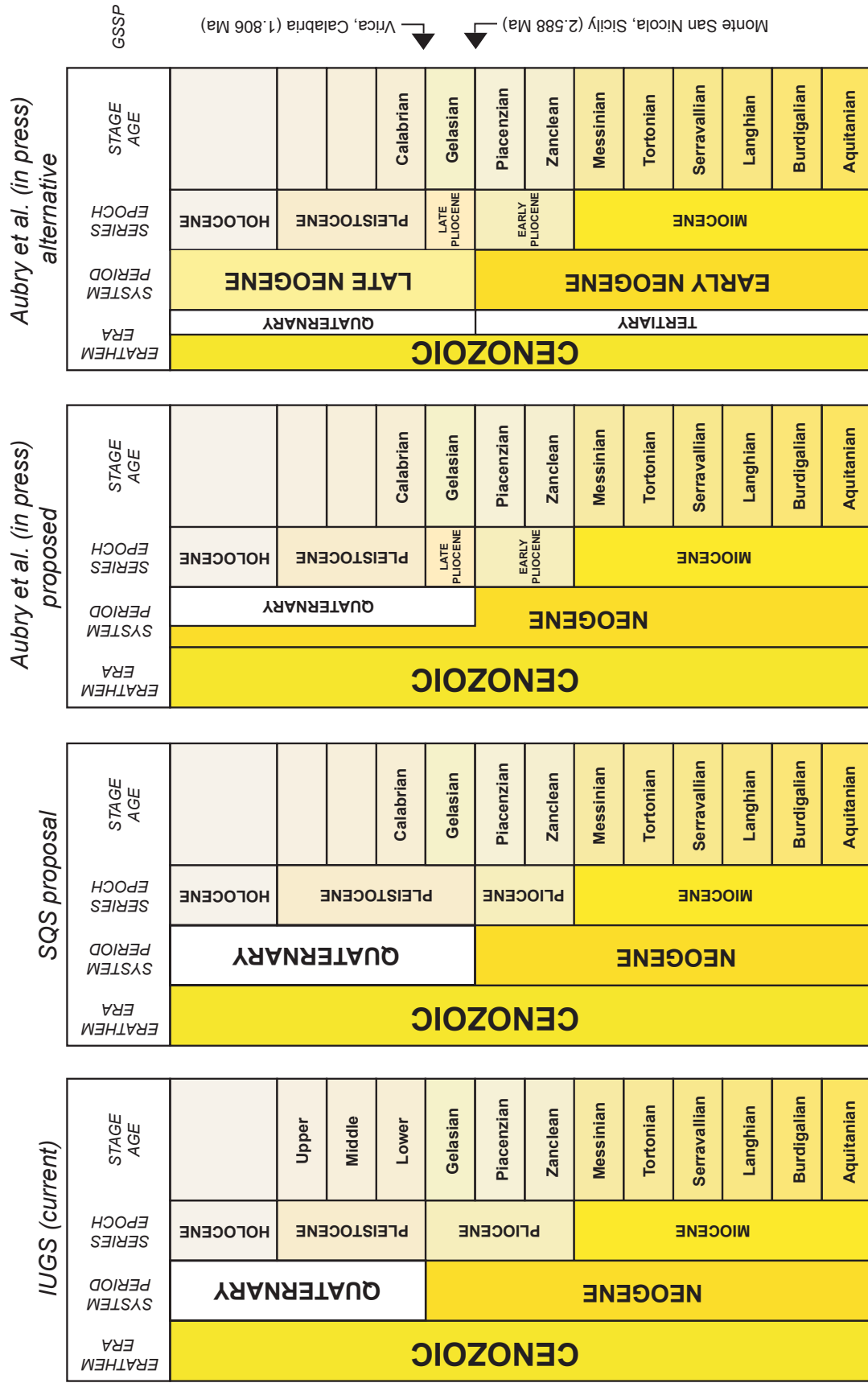


Figure 1. Current IUGS (Remane, 2000; IUGS 2007) time scale compared with proposed SQS and SNS (Aubry et al., in press) schemes¹.

NOTES

1. The SQS and Aubry et al. (in press) proposals all agree on lowering the base Quaternary to that of the Gelasian Stage (2.588 Ma), although the SQS proposal *maintains* the Pliocene Epoch as a single unit and *avoids* splitting the Pliocene confusingly into two separate epochs between the Neogene and Quaternary.
2. The SQS proposal provisionally places the Neogene directly beneath the Quaternary, pending future deliberations on the Tertiary. We note that Aubry et al. (in press – their alternative scheme) and Head et al. (2008a, b) do recognise the Tertiary, although at different ranks.
3. The SQS proposal offers *the least disruptive and confusing solution*, given the recent (2007) IUGS-ratification of the Quaternary as a period/system and unequivocal agreement (ICS, SNS, SQS, and INQUA) that the Quaternary begins at 2.6 Ma.
4. Only the two relevant GSSPs are shown in this figure.

¹ Artwork adapted from Aubry et al., in press, fig. 1