

LETTER BY M.P. AUBRY TO D. RIO CONCERNING CHRONOSTRATIGRAPHIC PRINCIPLES AND THE PALEOCENE/EOCENE BOUNDARY CONTROVERSY

May 21, 2000

Dear Domenico,

I sent you last week a preprint of a manuscript entitled "Should the Golden Spike Glitter?" that John Van Couvering, Fritz Steininger, Bill and myself have prepared for publication in *Episodes*. I intended to write to you sooner regarding the objectives of the manuscript, but unexpected obligations have delayed my message.

I am writing here on behalf of my co-authors, and request that you consider the current state of chronostratigraphy. The work of the Working Group on the Paleocene/Eocene boundary (P/E WG) has led us to identify a number of problems with the ICS rules so that conflicts between them and Hedbergian principles may arise at times. Our main concern is the destabilization of chronostratigraphy in the long-term. Allow me to describe below the current situation of the P/E WG, as a way of explaining the conflict between rules and principles.

At the 27th IGC in Washington, a Working Group was set up to designate a GSSP for the Paleocene/Eocene (P/E) boundary, with Eustoquio Molina, Secretary, and myself, President. Prior to the setting of the WG, the International Subcommission on Paleogene Stratigraphy (ISPS) reiterated its commitment to use the Ypresian Stage as the basic chronostratigraphic unit of the Eocene. Thus the Paleocene/Eocene boundary was to be understood as the Thanetian/Ypresian boundary. The WG first proceeded to reexamine the Thanetian/Ypresian succession in NW Europe, and determined a "boundary interval" so that formal definition of the P/E would not conflict with the historical concept of Ypresian Stage, and consequently with that of Eocene.

We determined a broad boundary interval extending for Zone NP8 (Chron C25r) to Zone NP11 (Chron C24n) because the top of the Thanet Sands (Zone NP8, Chron C25r) and the Division B (Zone NP11; Chron C24n) of the Ieper (Belgium) and London Clay (England) Formations constitute two firm anchor points that proved decisive for correlation with the deep sea record. Our re-examination of this succession resulted in its detailed sequence stratigraphic analysis, and the recognition that the base of the Ypresian Stage was located high in Zone NP10 and was best approximated by the FAD of the calcareous nannofossil species *Tribrachiatus digitalis*. The obvious conclusion, following Hedbergian principles of chronostratigraphic hierarchy and respect for prior usage, as well as the basic concept of the Eocene boundary specifically established by ISPS, is that a formal boundary stratotype for the Thanetian/Ypresian Boundary should be defined at a lithostratigraphic horizon correlatable to the FAD of *T. digitalis*.

At the same time as the P/E WG was beginning its work, the Shipboard scientists on Leg 113 were discovering a major 3 to 4% carbon isotope excursion (CIE) located in Chron C24r and (calcareous nannofossil) Zone NP9. This event was subsequently recognized in terrestrial sequences, first in North America (basal Wasatchian) and subsequently in Northwest Europe, where it occurs in levels assigned to the Thanetian Stage, >1 My older than the base of the Ypresian Stage. For many of us, the CIE is simply a late Paleocene event. But for others, in particular vertebrate paleontologists and paleoceanographers, the CIE is seen as the criterion for global correlation that satisfies in an exemplary fashion the ICS rules, in which "correlation precedes definition", and in opposition to Hedbergian principles of chronostratigraphy in which definition precedes correlation. The appeal of the CIE is enhanced by the fact that it occurs synchronously with major biotic turnovers in land mammal and in deep sea (benthic foraminifera) communities.

The P/E WG is currently divided, with one group favoring the respect of Hedbergian principles, with the base of the Ypresian Stage (correlated on the basis of the FAD of *T. digitalis*) in the stratotypic area serving as the base of the Eocene; and the other engrossed with the ICS rules, arguing for the definition of the base of the Eocene based on the CIE. In this latter group, one subgroup favors the lowering of the base of the Ypresian Stage so as to fit the definition of the Eocene, whereas another subgroup recognizes the need to introduce a new, lowermost, Eocene stage below the Ypresian Stage, in order to lower the base of the Eocene so as to correspond to the base of that new stage (base correlatable on the basis of the CIE).

In the WG, with its experience in the matter, it is well understood that the base of the Ypresian cannot be distorted *ad hoc* and so the "digitalis" party and also many of the "CIE" party have combined to vote 82% in favor of the recognition of a pre-Ypresian stage, such as the Ilerdian, whose boundary-stratotype will conform to the CIE, and accordingly, a proposal to this effect has been submitted to the ISPS. However, no such overwhelming majority was reached with regard to the location of the P/E (52% in favor of the CIE). Yet, the ICS and ISPS have jointly rejected the introduction of the new stage. Instead, the ISPS is about to ask the following question to the ISPS voting members: "Do you agree that the CIE serves as the criterion on which to correlate the Paleocene/Eocene boundary?" Because the idea of an intervening stage has been removed from consideration, we are very much concerned that if the answer is yes, the Ypresian Stage will be arbitrarily redefined so as to fit the revised concept of the Eocene.

This is in flagrant conflict with Hedbergian principles and also precisely against the vote of the working group, in denial of democratic process that is supposed to govern IUGS.

A review of the procedures followed by various WGs for the definition of Cenozoic GSSPs shows an heterogeneous treatment of chronostratigraphic boundaries. The WGs dealing with Neogene GSSPs are essentially respectful of Hedbergian principles, but this has not been case for the P/N, E/O WGs, and is unlikely to be the case for several Paleocene and Eocene WGs. Many of us in the P/E WG are respectful of the Hedbergian principles, but the ICS and ISPS force us to depart from them.

I have had the opportunity to discuss with J. Remane the problems that the ICS rules represent with regard to the chronostratigraphic principles of the Guide. Remane has rejected my call for the adjustments of the rules and invited me to write a paper for Episodes (the preprint just sent to you) so that he could respond to the concerns that John, Fritz, Bill and I have expressed in our recent paper on Tarnished GSSP published in Earth Sciences Review and of which I believe we sent you a reprint.

John, Bill and I are now calling for a meeting at the IGC in Rio, to discuss what we see as weaknesses in the ICS rules governing chronostratigraphy, and primarily to evaluate the role and the integrity of the stage in higher-level boundaries. We urge you to join us in a discussion so as to resolve the conflict. If you are interested as we hope, may we ask you to please circulate the memo below to the SNS members.

I/we thank you for considering our concern and look forward to hearing from you.

Best regards, Marie