A Recent Literature Cycle Mystery (And a Return to an Early Palaeogene World With a Large and Dynamic Organic Carbon Capacitor)

Gerald R. Dickens
Department of Earth Science, Rice University, Houston, Texas 77005, USA;
Institutionen för Geologiska Vetenskaper, Stockholms Universitet 106 91 Stockholm, Sweden

An interval of the early Palaeogene (~58-51 Ma), including brief events within, has become a magnet for examining past climate change. The underlying primary reasons – extremes in global temperature, environmental change, and carbon input – have been known for over 10 years. Oddly, with the escalation of people attracted to this time interval, and the ensuing scientific output, key concepts have become blurred rather than clarified. For example, and in contrast to suggestions in high-profile papers over the last 5 years, there never have been good arguments to suggest that, during the PETM, the carbon isotope composition of the ocean and atmosphere shifted by more than 3.5 per mil, the carbon input associated with this excursion drove all associated warming, the global CCD rose by 2 km, sea-level dropped and exposed epeiric seas, volcanism increased tremendously, seafloor methane was minimal, terrestrial biomass disappeared, etc. The emphasis on setting stratigraphic points without deep rationale, the focusing on mean annual temperature rather than seasonal temperature (especially at high latitudes), and the finding and naming of multiple hyperthermal events without definition has muddled studies further. Despite the obfuscation, the most fundamental aspects concerning early Palaeogene global climate change and carbon cycling have not only remained but have become amplified. Between about 58 and 51 Ma, Earth's surface warmed by about 6°C, and carbon fluxes to the ocean and atmosphere increased. Superimposed on these changes were a series of events marked by rapid global warming and massive carbon injection. For both the long-term and short-term intervals, warming led carbon input, and the carbon input was depleted in 13C; moreover, successive carbon inputs decreased in magnitude. All indications still point to an early Paleogene world with at least one large and dynamic (and probably microbially mediated) "carbon capacitor" that operated as a positive feedback to changes in temperature. Once this framework is appreciated, testable hypotheses emerge and widespread (often disparate) records of environmental change can be understood and linked at a basic level. The capacitor could have been methane in marine sediment, solid organic carbon in terrestrial sediment, or both; each has merits and demerits.