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Integrated biostratigraphy and the larger benthic foraminiferal extinction across the Eocene/Oligocene at Noroña, Western Cuba

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The extinctions of some major and widespread larger benthic foraminifera groups are associated with the Eocene-Oligocene transition in the Caribbean shallow water carbonates, including the orthophragminids, agglutinated conical forms and some species of Nummulitids and Lepidocyclinids. However, it is difficult to precise the exact timing of the larger foraminifera extinctions as only very few sections are complete across the boundary and the planktic biostratigraphy is not well defined. A continuous marine section across the Eocene/Oligocene boundary at Noroña, Western Cuba provides a good opportunity to constrain the larger benthic foraminiferal biostratigraphic ranges as they co-occur with abundant planktic foraminifera and calcareous nannofossils. Three levels containing late Eocene larger benthic foraminifera represented by the *Discocyclina-Asterocyclina*, *Pseudophragmina-Nummulites-Heterostegina-Fallotella-Lepidocyclina* assemblages are found in the lower and middle part of the planktic foraminiferal O1(P18) and in the middle part of the calcareous nannofossils Zone NP 21 (CP 16) (Rupelian). Although the larger foraminifera have been displaced from their original habitats, evidence of reworking, such as mixture of species from different ages or prior fossilization, have not been observed. Furthermore, the traditional Late Eocene marker *Fallotella cookie* is an abundant taxa in the Oligocene at Noroña section, consistent with the strontium isotope stratigraphy data from lower Oligocene sediments from Jamaica.

Our data from Noroña, as well as other previously studied sections across the Eocene/Oligocene boundary suggest that a number of long-ranging and widespread Eocene larger benthic foraminiferal taxa are present in the lower Oligocene. Based on our hypothesis, their extinction could be diachronic, disappearing near the Eocene/Oligocene boundary in low latitudes (e.g. Tanzania) and becoming extinct in the Rupelian (lower Oligocene) in the Caribbean-American bioprovince (e.g. Cuba and Jamaica) and at low-middle latitudes of the Tethys (e.g. Italy and Spain).