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The long way of planktonic Foraminifera from biostratigraphy to paleoceanography (Jean Baptiste Lamarck Medal Lecture)

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The mid of the last century was a time of flourishing studies concerning the importance of planktonic foraminifera in precisely dating and correlating sedimentary successions after the publication of the first biostratigraphic schemes provided by the Suisse Group (i.e. Kugler, Bolli, Broennimann) from the Caribbean region and former Southern USSR (Subbotina). Soon after Bolli's Trinidad scheme was widespread, planktonic foraminiferal distribution from Upper Cretaceous to Miocene was investigated intensively for dating the Neogene stratotypes, whose identifications were mainly based on poorly age-diagnostic, facies-controlled macrofossils, and for calibrating Paleogene larger foraminiferal distributions.
Since these early works planktonic foraminiferal biostratigraphy was continously ameliorated, extended in time from Early Cretaceous to Recent by several authors and from different settings and domains, reaching progressively the current higher resolution, now calibrated to calcareous nannofossil distributions. To be mentioned, the detailed biostratigraphic studies on the Gubbio section (central Italy) provided (1) the first carefull documentation of the mass extinction of Cretaceous planktonic foraminifera, the presence of tiny Cretaceous survivors, and the rapid recovery of Danian assemblages, and (2) the first calibration of the Upper Cretaceous to Eocene reversal polarity scale in which the K/Pg boundary was demonstrated to fall within the magnetic reversal C29r.
A major step forward was the recovery, since 1968, of several thousand of cores from over 1000 holes drilled in all oceans by the DSDP, ODP and IODP projects. The recovery of deep-sea sediments from all latitudes opened a new research field, the paleoceanography.
Based on the large knowledge acquired on modern organisms in the '60s, for the Paleogene and Cretaceous reconstructions we started from the assumption that these extinct organisms lived in the water column like their modern counterpart and were controlled by similar environmental factors
(temperature, nutrient supply, current system, etc.), then the fluctuations in abundance and composition of planktonic foraminiferal assemblages could be interpreted in term of paleobiogeography and paleoceanography.
The first studies, rigorously quantitative, have been conducted in the '70s on the Paleogene of the Atlantic Ocean, the interval with the best latitudinal coverage at that time. From the areal distribution and variations in assemblage composition through time we (with A. Boersma) were able to identify first the biogeographic indices, then their paleoclimatic significances, from which we could reconstruct the paleoclimatic and paleoceanographic evolution. The associated isotope analyses (with N. Shackleton) on single species allowed to confirm the species latitudinal connotations as well as their position within the water column (mixed layer vs deep dwelling habitats) and preferences for nutrient supply. In the '90s we (with W.V. Sliter) extended the paleoceanographic reconstructions to the Cretaceous exploring the planktonic foraminiferal evolutionary patterns and latitudinal changes in assemblage composition through time. Like in the Paleogene, it was possibile to identify that the more ornamented keeled forms were very sensitive to temperature, liked warm waters and were more abundant in the tropics, the simpler morphologies were less sensitive, more tolerant and cosmopolitan, while, for instance, whiteinellids proliferated in upwelling regions. In the last decade, taking advantage of the wealth of paleoecological and biogeographical data previously collected, we started a new phase of deep taxonomical and stratigraphical revision of planktonic foraminifera. Increased biostratigraphic resolution from tropics to high latitudes is facilitated by the integration with other fossil group biostratigraphies and magneto-, isotope-stratigraphies.