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Stratigraphie intégrée du Jurassique et du Crétacé : un hommage à Jacques Rey (1940–2018)

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The Groupe Français du Crétacé and Groupe Français d'étude du Jurassique are pleased to join and offer this thematic issue as a tribute to our colleague and friend, Professor Jacques Rey, for his remarkable career as a specialist of stratigraphy. Jacques Rey was a pioneer in Sequence Stratigraphy.

Jacques Rey passed away at home, in Toulouse, on March 5th, 2018. He had carried out his academic career at Paul Sabatier University of Toulouse. He began as a teacher in 1962 until he retired in 2002. During these forty years, he successively passed all academic degrees: laboratory assistant (1964), assistant lecturer (1967), lecturer (1975) and professor (1979), jumping up to the exceptional level (1993). Since 2002, he was professor emeritus.

1. Academic activities: *teaching, management, expert assessment*

Jacques Rey taught geology at all academic levels, undergraduate and graduate, but also for public administrations, secondary schools, or industrial managers. He also gave over 30 lectures on the evolution of life on Earth, and in the palaeontology, stratigraphy and geology of the Pyrenees in different towns and universities of southern France, Spain, Portugal and Morocco. In 1983, he published a book on stratigraphy (Technip). Finally, during 10 years long he taught sequence stratigraphy at the National High School for Oil and Motors in Paris.

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He directed nearly 30 PhD theses and took part in many doctoral boards in France, Portugal, Spain and Morocco. He also organized 14 scientific meetings and participated to 53 congresses, including the International Geological Congresses of Paris (1980), Moscow (1984) and Beijing (1996).

Jacques Rey has been involved in many administrative positions, at different levels:

- *International*: member of the International Subcommission on Stratigraphic Classification (IUGS, 1990–1998); member of the Valuation Committee of Earth and Space research Units of Portugal (1990–1998);
- *National*: President of Commission 2 within the 36th section of the National Committee of the Universities (1992–1995); President of the National French Committee of Stratigraphy (1990–1998) which published a book titled "Stratigraphie, terminologie française" [Rey, 1997]; Director of the Research Unit 1405 of the National Centre for Scientific Research (1990–1994); President of the French Group of the Cretaceous (1978–1982);
- *Local*: member of the Board of Directors of Paul Sabatier University (1986–1990); Provisional Administrator of the Research Formation, Unit "Life and Earth sciences" (1984–1987); President of the Commission for Teaching (1986–1990).

Finally, Jacques Rey has been involved as an expert in different fields such as the hydrogeology of the French departments of Lot, Tarn and Tarn-et-Garonne, the Administrative Tribunal of Toulouse, or the Scientific Council of the Regional Natural Parc of Quercy.

2. Geological research: *from biostratigraphy to sequence stratigraphy*

After a Master thesis dedicated to the geological study of the Northern part of the Arize Massif in the Central Pyrenees (1963), Jacques Rey moved to Portugal where he worked up to the last years of his life. His State Doctorate concerned the Lower Cretaceous of the Lusitanian Basin [Rey, 1972], then he carried out cooperative studies in a widened area involving different Atlantic-verging basins from France (Aquitaine Basin), Portugal (Lusitanian and Algarve basins) and Morocco (Essaouira Basin). All along these over 40 years of intense activity, he developed three main stratigraphic approaches regarding the Jurassic and Cretaceous infillings of the considered basins.

2.1. *Biostratigraphy*

In his doctorate thesis, Jacques carried out a detailed stratigraphic study of the Lower Cretaceous of the Estremadura Basin, defining different units and providing new data on their age and correlation, both for marine and terrestrial paleoenvironments. Age dating was based on micro-(foraminifera, algae) and macrofauna, especially echinoderms, one of his main palaeontologic specialities. This biostratigraphic approach led to the definition of different, newly correlated units, using sequence stratigraphy concepts and giving way to new palaeoenvironmental and palaeogeographic reconstructions.

A synthesis of his main results was published in 2002 and 2008 [Dinis et al., 2002, 2008]. In the same way, more studies were carried out in different Atlantic bordering basins such as the Algarve, Aquitaine and Essaouira ones.

2.2. *Sequence stratigraphy*

Since 1984, Jacques Rey took interest in the concepts and methods of sequence stratigraphy, the source documents being published by Vail et al. (American Association of Petroleum Geologists, [1977]). Following this new interpretation, "cycles of relative sea level changes on a global scale are evident throughout Phanerozoic time. The evidence is based on the facts that many regional cycles (third order sequences) developed on different continental margins are simultaneous and that the relative magnitudes of the changes are generally similar".

In the study area (Aquitaine, Portugal and Morocco), Jacques and his colleagues described all third order sequences (genetic sequences) developed in Jurassic and Early Cretaceous times. Detailed biostratigraphic, sedimentological and tectonic data were gathered within third order sequences made up of system tracts and separated by unconformities, providing good correlations at the scale of the different studied basins. The respective control of the relative sea-level change, subsidence and sedimentary supply was pointed out within the accumulation process. New data were provided in regional

studies: normal faulting may occur suddenly and provide more accommodation than eustatic sea level changes (Jurassic series from Quercy); third order sequences can be diachronous when they are included within basin infillings provided by different tectonic plates (Lusitanian and Moroccan basins).

2.3. *Relationship between system tracts and micropaleontological associations*

Considering that foraminifers and ostracods constitute good stratigraphical and palaeoenvironmental markers, Jacques Rey used these microfossils for his interpretations of variations in sea level change, palaeogeographic communications between basins, nourishing supplies and physicochemical properties impacting benthic communities. In turn, micropalaeontological associations could also help identify system tracts.

A first study concerning Toarcian Foraminifera from Northern Aquitania (Quercy, France) showed the existence of a close relationship between the composition of Nodosariidae communities and sea-level changes. Later on, working on Foraminifera from the Carixian and Domerian of Quercy and Grands Causses (France) he confirmed these interpretations and highlighted the contribution of quantitative methods to appreciate depth variations in platform environments. Other studies dealing with the factorial diversity of deposits and the factorial amplitude of species led Jacques Rey to draw three main conclusions: (i) microfossil associations allow identifying sedimentary system tracts even in homogeneous series (such as in marls, for example), low and high sea levels providing different biocoenotic signals; (ii) the statistical analysis of micropalaeontological communities can lead to "factorial correlations" at basin scale; (iii) sea level changes influence the species composition of assemblages and speciation processes.

In his last years, Jacques began new studies on the North Pyrenean foreland basin infilling but his declining health broke this new project.

Jacques Rey was the Fontannes (1975) and Bourcart (1990) prices winner given by the French Geological Society. He had a decoration (Palmes Académiques) given by the French Ministry of Education (1990) and was Doctor Honoris Causa of the Universidade Nova de Lisboa, Portugal (2012) (Figure 1).

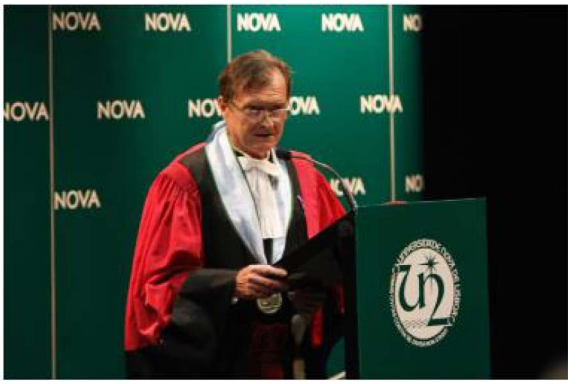

Figure 1. Jacques Rey during his talk of "Doctor Honoris Causa" at the Universidade Nova de Lisboa (Portugal).

Jacques Rey was a great specialist of stratigraphy and developed an integrated stratigraphy approach in order to give a temporal framework to sedimentary series and reconstruct the evolution of paleoenvironments and sedimentary basins, particularly during Jurassic and Cretaceous periods.

The present thematic issue was an opportunity for his former students and colleagues to celebrate Professor Jacques Rey for his remarkable career and achievements in the promotion and development of integrated stratigraphy. We are deeply honoured and pleased to contribute to such a tribute to him in this thematic issue of *Comptes Rendus Geoscience* entitled "Integrated stratigraphy of the Jurassic and the Cretaceous".

Illustrating the value of integrated stratigraphic approaches to sedimentologists and paleontologists for high-resolution evaluation of past climatic, oceanographic, sedimentary, ecological and biogeographic processes in Earth history, the present issue includes six original contributions to the fields of sedimentology and palaeontology, based on original Jurassic and Cretaceous case studies. Two of them highlight the value of linking fossil and stratigraphic studies, not only in taxonomy, evolution, and biostratigraphy, but also in biogeography and for the reconstruction of paleoenvironments. Studying ammonites of the Lower Jurassic (Pliensbachian) series of Southern Vendée (France), Fauré and Bohain [2022] contribute to improving our understanding of

the paleobiogeography of the Lusitanian Basin and Southern Vendée, and more widely of the North-West European Bioprovince with regards to the dispersal of Tethyan marine fauna to the western Europe. Picollier [2022] explores the rich belemnite faunas of early Cretaceous deposits (Berriasian–Albian) of the Vocontian Basin (southeast of France) and reminds the value of well-delineated paleontological species in biostratigraphy based on quantitative and statistical approaches. The four other contributions show the interest of an integrated approach for determining the factors controlling sedimentation. Chemostratigraphic ($\delta^{13}C$) and biostratigraphic correlations between the Poigny borehole (Paris Basin) and other European sections, associated to other data (palynological assemblages, dinoflagellates, clay mineralogy), allow to recognize thirty-three palynological events and show the dominant role of sea-level variations in paleoenvironmental changes during the upper Coniacian-Campanian [Pearce et al., 2022]. The work by Ferry et al. [2022] contributes to demonstrate the tectonic control of the forced regression around the Aptian–Albian boundary recorded in the SE France basins, associated to the "Austrian" tectonic pulse. Duarte et al. [2022] present a sedimentological, organic, and isotopic study of the Upper Sinemurian of the S. Pedro de Moel section (Lusitanian Basin) that reveal the transgressive context of sedimentation and the impact of diagenetic transformations on $\delta^{13}C$ variations. Finally, the analysis of the organic fraction (Rock-Eval, Palynofacies…) in late Jurassic deposits of the Boulonnais (France) by Schnyder et al. [2022] highlights the importance of seawater warming for the occurrence of the Kimmeridgian Organic Rich Bands deposition in NW Europe.

Conflicts of interest

Authors have no conflict of interest to declare.

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