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Late Jurassic carbonate oceans and El Nino-type climate mode

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The Late Jurassic was a time with very high calcium carbonate accumulation rates in both pelagic and neritic environments (1). The rapid expansion of calcareous nannoplankton into pelagic environments resulted in the first widespread nannofossil limestone deposits in earth history. The Late Jurassic carbon isotope curve gradually decreases and reaches low values around +1 permil near the Jurassic-Cretaceous boundary. This indicates that the Late Jurassic was characterized by a mode of carbon cycling favouring high Ccarb/Corg burial ratios.

Investigation of Late Jurassic sedimentation pattern along a north-south transect through the Alpine Tethys reveals that the transition into the Late Jurassic carbonate sedimentation started during the middle Oxfordian. Along the northern Tethys carbonate ooze deposits flanked by coastal reefs began to drape the shelf. This onset of widespread carbonate sedimentation coincided with the end of radiolarian ooze deposition and with a progressive deepening of the Calcite Compensation Depth in wide parts of the deep alpine Tethys. This change is seen as a consequence of a decrease in equatorial upwelling intensity along the Tethys Seaway. Changes in Tethyan oceanography also coincided with a weakening of equatorial-polar temperature gradients. A new Oxfordian paleotemperature curve based on oxygen isotope data measured on northern Tethyan belemnites indicates stable Oxfordian temperatures in low-latitude environments contrasting with an earlier documented temperature increase of up to 12 degrees Celsius in Oxfordian middle-high latitudes (2). We propose that the progressive opening and deepening of the Hispanic corridor resulted in the establishment of a circum-equatorial current system with a stable thermocline and weakened equatorial upwelling. A stable oceanography and a peculiar climate with dry low latitudes and warm-humid high latitudes favoured the expansion of calcareous nannoplankton and the formation of the first widespread pelagic and deep-sea carbonates in earth history.

Weakening of equatorial upwelling, decreasing equatorial-polar temperature gradients coinciding with a stable carbon cycle are comparable with Pliocene oceanography and its El Nino-type climate.

[1] Budyko et al. (1985) History of Earth’s atmosphere;. [2] Dromart, G. et al. (2003) American Journal of Science, 303.