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Oligocene and Miocene Vegetation and climate development on the Atlantic Coastal Plain (IODP Expedition 313)

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The major aims of IODP Expedition 313 are estimating amplitudes, rates and mechanisms of sea-level change and the evaluation of sequence stratigraphic facies models that predict depositional environments, sediment compositions, and stratal geometries in response to sea-level change. Cores from three Sites (313-M0027, M0028, and M0029; 45 to 67 km off the coast of New Jersey) from the New Jersey shallow shelf (water depth approximately 35 m) were retrieved during May to July 2009, using an ECORD "mission-specific" jack-up platform. The recovery rate for the three sites exceeded 80%; in total, more than 1300 m core length were achieved. The oldest sediments were recovered from Hole M0027A, and dated as late Eocene/early Oligocene according to biostratigraphy, sequence-stratigraphy, and Sr-isotopy-based age estimates.

We have investigated the palynology of sediment cores from Sites M0027 and M0029. The cores examined span ca. 33 to 13 million years before present together with additional samples from younger sediments. The palynological results were complemented with pollen-based quantitative climate reconstructions using bioclimatic analysis, a mutual climate range NLR approach.

Until the Pleistocene, the hinterland vegetation of the New Jersey shelf was characterized by oak-hickory forests in the lowlands and conifers in the highlands. The Oligocene witnessed several downward expansions of conifer forest, which were probably related to cooling events. The pollen-based climate data show a temperature increase during the Rupelian and at the Chattian-Aquitanian transition, with mean annual temperatures surpassing 15 °C. For the Miocene, mean annual temperatures varied around ∼13.5 °C. Generally, the Miocene ecosystem and climate conditions were similar to those of the Oligocene in the hinterland of the New Jersey shelf. We conjecture that the Miocene uplift of the Appalachian Mountains led to the proliferation of mountainous taxa and thus to an increase of related pollen taxa in the palynological record. This explains the comparatively low annual temperatures reconstructed for this time interval. The vegetation changed after the Miocene, with increasing conifers, and understorey and swamp taxa. A Miocene to Pleistocene expansion of grasslands is not evident for the hinterland of the New Jersey shelf.

The pollen-based annual temperature curve shows general agreement with global oxygen isotope data; however, there seems to be a shift to younger ages in the dataset from the New Jersey shallow shelf; thus for some time intervals, regional terrestrial temperature may have been decoupled from marine conditions. Transport-caused bias of the pollen assemblages was identified via the analysis of the terrestrial/marine palynomorph ratio and these were considered when interpreting palaeo-vegetation and climate from the pollen data.