Glacial-Interglacial circulation changes inferred from sediment $^{231}Pa/^{230}Th$ in the North Atlantic

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Comparison of sediment $^{231}Pa/^{230}Th$ profiles obtained at five sites from the western and eastern North Atlantic between 1710m and 4550m water depth provides new insights into the evolution of the mode of deep water formation during the last deglaciation and the changes in the rate of the Atlantic meridional overturning circulation during the last 20,000 years. $^{231}Pa/^{230}Th$ measured in upper Holocene sediments indicates slow deep water renewal rates above ~2500m and faster rates below, consistent with our understanding of modern circulation. In contrast, during the Last Glacial Maximum (LGM), the formation of Glacial North Atlantic Intermediate Water (GNAIW) drove a rapid overturning circulation to a depth of at least ~3000m depth, while deep water renewal rates were significantly slower than today below ~4000m. At the onset of Heinrich event 1 (H1), the rate of the overturning circulation declined at all depths. GNAIW shoaled above 3000m while its rate of formation significantly decreased but did not totally stop. During the Bølling-Allerød (BA) that followed, the rate of meridional overturning further decreased above 2000m but increased below. Our results suggest for the first time that ocean circulation during that period was quite distinct from the modern circulation mode, with comparatively higher renewal rates above 3,000m and lower renewal rates below, in a pattern similar to the LGM but less accentuated. The rate of the meridional overturning during the Younger Dryas (YD) was very similar to that of the BA down to 2,000 m but slightly slower below.

The coherence of these results and the absence of a clear signal that could suggest a control by particle flux or composition further support the interpretation of $^{231}Pa/^{230}Th$ in Atlantic sediments as a paleocirculation proxy, and provide new insight into the depth of water column integration for the $^{231}Pa/^{230}Th$ sediment signal. We will further address this issue in light recent results obtained from a simple 2D model.

Low-T thermochronology provides new insights in the Mesozoic to present tectonic evolution of NW Africa

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To constrain upward and downward vertical movements in NW Africa we have sampled for low-T thermochronology a 500km long transect from the Mediterranean coast to the Anti Atlas of Morocco. The analysis of this large data set has provided major surprises requiring a reconsideration of generally accepted ideas.

The data we have produced document an Early to Middle Jurassic stage of subsidence and of Late Jurassic to Early Cretaceous exhumation affecting a large elongated region stretching from the Moroccan Meseta to the Anti Atlas. These domains are typically considered as stable during the same time span. Late Jurassic to Early Cretaceous exhumation caused the erosion of a large amount of terrigenous sediments transported offshore and deposited in the otherwise monotonous and fine-grained succession of the Moroccan Atlantic passive continental margin.

Alpine deformations began in the Late Cretaceous and continue until present. They were initially associated with the development of large scale, WNW-ESE trending folds and then with localization of shortening and exhumation in the Atlas system.