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Past hydrological and cold water coral growth variations at the SW Rockall Trough margin (NE Atlantic) during the Holocene

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The neodymium isotopic composition (εNd) and AMS radiocarbon have been analysed on precisely U-Th dated scleractinian cold-water corals (CWC; M. oculata, L. pertusa) from sediment cores, which were taken from coral mounds at 700 - 790 m at the SW Rockall Trough margin to constrain past variations of the mid-depth Sub-Polar Gyre (SPG) and estimate the occurrence of CWC over the Holocene. The coral εNd values present a large range from -12.2$\pm$0.3 to -16.7$\pm$0.4 implying past changes of the position of mid-SPG trough time. A westward contraction of the unradiogenic SPG water ($\approx$-15) are associated to a higher proportion of radiogenic ENAW and/or MSW ($\approx$-11) transported northward to the Rockall Trough by a boundary current along the European margin. The early Holocene climatic optimum (from 8 to 6 ka) is marked by a greater eastward extension of the SPG associated to a strong ISOW implying an active AMOC and a strong link between the dynamic of the SPG and the deep branch of the AMOC. The middle Holocene transition (from 7 to 5 ka) is marked by shift toward more radiogenic εNd values revealing a progressive westward contraction of the SPG. The first step of this transition occurred around 7 ka and is associated to the onset of the LSW formation and a decrease of the ISOW suggesting a re-routing of the NAC to the west South of Iceland permitting a greater intrusion of saline subtropical water in the subpolar Atlantic. During the late Holocene, εNd values record display millennial scale variability with eastward extension of the mid-SPG corresponding to warm periods over the northern Europe (such as MWP, RWP) and/or time intervals of Norwegian glaciers retreat in agreement with an intensification of the AMOC. In addition, a new compilation of U-Th ages of CWC from the SW Rockall Trough have permitted to constrain the environmental conditions driving variability in CWC growth during the Holocene. CWC abundance is marked by a pronounced increase in the mid-Holocene ($\sim$6 ka) and is modulated by millennial-scale variability throughout the late Holocene. Time intervals of decreased or no CWC occurrences closely match prominent increases in North Atlantic drift ice and storminess in Northern Europe suggesting an environmental control on CWC reef growth in the North Atlantic. Our results show that high detrital supply associated to IRD deposits and/or changes in the vertical density gradient are likely the controlling factors for CWC growth and subsequently mound formation.