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0.1 High-resolution climatic record of the high-latitude Atlantic (Site 1302/03, IODP Exp 303): Pleistocene occurrence of rapidly-deposited detrital layers

Romero, O.E.(1,2) and D. A. Hodell(3)

1 Department of Geosciences, University Bremen, POBox 33 04 40, 28334 Bremen, Germany (oromero@uni-bremen.de)

2 Instituto Andaluz de Ciencias de la Tierra, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva, 18002 Granada, Spain

3 Department of Geological Sciences, University of Florida, 241 Williamson Hall, PO Box 112120, Gainesville, FL 32611, USA

North Atlantic deep-sea sediments provide records of abrupt climate variability at sub-orbital time scales. In particular, the region off Newfoundland supplies the most detailed marine record of Laurentidae Ice Sheet (LIS) instability in the form of rapidly-deposited detrital carbonate layers intercalated with hemipelagic sediments. Site 1302/03, well-positioned to monitor LIS instability at 50˚10'N, 45˚38'W, shows the occurrence of numerous carbonate-rich detrital layers within and prior to the last glacial interval. These layers, recognizable visually as well as with gamma ray attenuation density and magnetic susceptibility, have now been characterized by analysis of X-ray fluorescence (XRF) and diatom assemblages. XRF-measurements were made from the Site 1302/03 composite section every 1-cm, representing between 70 and 100 yr, whereas diatom samples were counted every 10 cm, representing 700-1000 yr (mean sedimentation rate at 1302/03 estimated to be $\sim$13.5 cm/k.y.) Sediment bulk density variations are consistent with our Ca measurements, $i.e.$, low density values correspond to high Ca values, suggesting that carbonate-dominated sedimentation characterized these layers. At Site 1302/03, at least eight distinct Ca peaks, which are coeval with Ti:Al minima, occurred during the last glacial period corresponding to Heinrich events. Similar detrital layers are identified and tentatively assigned to Ma-

rine Isotopes Stages (MIS) 6, 8, 10, 12, 14 and 16. We propose that XRF-measured Ca and Ti:Al, the latter indicative of the non-biogenic origin of buried sediments, provide an excellent proxy for the rapid, non-destructive recognition of detrital layers. Rough estimates of the accumulation time for these layers range from 300 to 2500 years, precluding deposition by single catastrophic events. Additionally, variations in the diatom thanatocoenosis deliver information on paleoclimatologic and paleoceanographic conditions. Coeval with the layers' occurrence, strong decreases in diatom production occurred, interpreted as mirroring either low siliceous productivity or strong dissolution events of opaline microfossils due to meltwater pulses.

Both our downcore XRF record and the diatom signal not only provides a guide to the glacial-interglacial cycles but also offer a centennial-to-millennial scale reconstruction of LIS instability through recognition of Heinrich-like detrital events (according to the present stratigraphic framework, possibly back to MIS 17). The occurrence, timing and pacing of these older detrital carbonate layers might help to constrain the origin and cause of Heinrich events in the North Atlantic. Our results also suggest that centennial-to-millennial scale of both climate changes and variability of surface water conditions have been the rule rather than the exception over the past 900 k.y., during both glacial and interglacial intervals.