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# Detrital carbonate (Heinrich-type) Layers during Glacial Stages of the Bruhnes Chromozone at IODP Site 1302/03 (North Atlantic, off Newfoundland)

O. E. Romero

Department of Geosciences, University Bremen, POBox 33 04 40, 28334 Bremen, Germany,

oromero@uni-bremen.de / Phone: +49 421 21865537

The region off Newfoundland in the NW Atlantic has provided the most detailed marine record of Laurentidae Ice Sheet (LIS) instability in the form of rapidly-deposited detrital layers intercalated in background hemipelagic sediments. Site 1302/03, drilled at 50˚10.0'N, 45˚38.3'W during IODP Exp 303, is well positioned to monitor LIS instability and serves as an important reference location for detrital (Heinrich-type) layers and their correlation to Greenland ice cores over. Although Heinrich events are well-documented for the past glacial period, less is known about whether similar events occurred during older glacial periods. Using the Avaatech XRF core scanner at the University of Bremen, we measured a full suite of elements between Al and Ba ($e.g.$, Al, Si, p, S, K, Ca, Ti, Mn, Fe, Sr, Ba) at 1-cm resolution in the upper 90 m of the spliced composite section of Site 1302/03, corresponding to the last 800 k.y., ensuring a high-resolution record (mean sedimentation rates estimated to be $\sim$13 cm/k.y.). We found that the Ca/Sr and Ti/Al ratios are excellent proxies for detrital carbonate layers. Because the Sr/Ca partition coefficient is much greater for biogenic carbonate, detrital carbonate events are uniquely identified by peaks of Ca/Sr. At Site 1302/03, at least 8 distinct Ca/Sr and Ti/Al peaks occurred during the last glacial period corresponding to Heinrich Events. These 8 layers were originally described by Heinrich (1988) as "cemented marls" an each is also marked by an increase in sediment bulk density measured by gamma ray attenuation. Similar detrital carbonate layers, identified by peaks of Ca/Sr, Ti/Al and density, are tentatively identified during Marine Isotopes (MIS) 6, 8, 10, 12, and 14. On the basis of the density data alone, detrital carbonate events occur prior to MIS 15 at Site 1302/03 and are thus not only limited to periods of large

ice volumes associated with the “100-k world” in the latest Pliocene. We conclude that Ca/Sr and Ti/Al ratios provide an excellent proxy for the rapid, non-destructive recognition of detrital carbonate layers in North Atlantic sediments. Detailed geochemical analysis is needed to verify the source areas of these older detrital carbonate layers. The occurrence, timing and pacing of these older detrital carbonate layers may provide some important constraints on the origin and cause of the Heinrich events in the North Atlantic.