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Seismic paleoceanography and the stratigraphic signature of rapid climate changes

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The term ”seismic paleoceanography” was introduced in 2004 by R. Schneider, a former Chair of Images, during the EC-funded « Promess » project, for highlighting the importance of seismic data in paleoceanographic reconstructions during this particular project. The interest of seismic stratigraphy prior to drilling operations, such as those of the IODP, has long been recognized, and became a pre-requisite for the submission of scientific proposals. However, this kind of expedition generally relies on relatively low resolution, multi-channel seismic data where only the impact of major climate changes can be visualized. In contrast, a large proportion of the Images community, more familiar with the Marion Dufresne, mainly considers seismic data as a support for selecting the best coring sites.

The large amount of shallow cores, borehole and seismic (at various frequencies) data available in the Gulf of Lions allows us to illustrate the importance of very high- and ultra high- resolution seismic data for tracking the signature of rapid climate changes. The flooding events associated to “Bond Cycles” (bundles of several Dansgaard-Oeschger cycles) during MIS 3- MIS 2, are an example of the interesting feedbacks between seismic interpretation and high-resolution paleoceanography. These events where first identified in the Gulf of Lions through the multi-proxy analysis of cores retrieved at site PRGL1-4 (Sierro et al., 2009). In return, the re-examination of seismic data allows us to identify a series of corresponding seismic bounding surfaces (characterized by toplap and onlap terminations) along the continental slope. In terms of seismic amplitudes, the seismic surface associated to the transition between Heinrich Stadial 4 and Interstadial 8 appears as the most pronounced event during the entire MIS3-MIS2, suggesting that the magnitude of the associated sea-level change was the most important of this interval. Even more subtle events, such as the Melt Water Pulse 19 ka, have a distinct seismic stratigraphic signature, in the form of a mappable transgressive parasequence. Once identified at a specific location, such distinct seismic signatures might become important guides in the selection of coring sites along margins that have not yet been cored extensively.

Sierro, F. J. et al. (2009). Phase relationship between sea level and abrupt climate change." Quaternary Science Reviews 28(25-26): 2867-2881.