Dinocyst species	Present-day ecology	Occurrence in core MD99-2339 (Figure 5) and paleo-ecological interpretation
Lingulodinium machaerophorum **(Opportunistic / temperate)**	Temperate to tropical euryhaline species, often found in stratified waters (fjords, bays, estuaries; e.g. Dale et al., 1999), and interpreted as a proxy for fluvial discharges to the ocean (Zaragosi et al., 2001; Gonzales et al., 2008; Mertens et al., 2009b; Holzwarth et al., 2010; Penaud et al., 2011b). Modern centres of distribution located along the Atlantic Eastern Boundary Current with a maximum representation observed at the Gibraltar Strait outlet (Marret and Zonneveld, 2003) and close to river mouths in general (Mertens et al., 2009b).	Observed all along the record with maximal percentages identified during GI 12, GI 8, GI 1 and the late Holocene. Interpreted as a strong signal for run-off and fluvial-related nutrients, as well as strong surface stratification in the Gulf of Cadiz during these intervals.
Operculodinium centrocarpum **(Opportunistic / temperate)**	Cosmopolitan, cold to temperate (low percentages in tropics), species that has often been linked to nutrient enriched waters and waters such as the North Atlantic Drift (Wall et al., 1977; Harland, 1983), through its distribution in the modern dinocyst database (Rochon et al., 1999), but also regarding its past temporal occurrences in North Atlantic sediments (Turon, 1984; Eynaud et al., 2004; Penaud et al., 2008).	Close pattern with *S. mirabilis* one. Potential witness of increased Atlantic surface water inflow into the Gulf of Cadiz. Interestingly, the couple *S. mirabilis* / *O. centrocarpum* succeeds to *Impagidinium* species twice during MIS 1 warmer intervals, with a clear bipartite structure evidenced during the BA as well as during the Holocene.
Impagidinium **spp (*I. patulum, I. aculeatum, I. paradoxum, I. sphaericum, I. strialatum*)** **(Warm group)**	Temperate to tropical full-oceanic species (except *I. pallidum*) typically characteristic of tropical/subtropical (20 to 35°N) oligotrophic environments (Wall et al., 1977; Turon, 1984; Marret and Zonneveld, 2003 ; Bouimetarhan et al., 2009) without large inter-seasonal fluctuations in SST/SSS (Vink et al., 2000). Highest abundances found in regions with SST above 20-25°C (winter-summer SST; summer SST above 15°C) and SSS around 35-36.	Strong increases during MIS 1 and especially at the start of GI 1 and during the early Holocene. Interpreted as an imprint for the installation of warm oligotrophic conditions in the Gulf of Cadiz through warm and nutrient-poor advection of subtropical North Atlantic Central Water through the Acores Current.
Spiniferites mirabilis **(Warm group)**	Characterizes temperate to tropical environments, and extends as far south as 10°N, with high abundances found today along the European margin in the Bay of Biscay (Rochon et al., 1999). Not observed from sites with summer SST below 12°C and found in fully marine environments characterized by SSS above 28.5 (Marret and Zonneveld, 2003).	Significant increases during MIS 3 GI, BA as well as highest values recorded during the Holocene.
Spiniferites delicatus / Spiniferites bentorii **(Warm group)**	A relatively high number of *Spiniferites* species, including *S. delicatus* and *S. membranaceus* (as well as *O. israelianum*) characterizes the equatorial zone, also often found at the vicinity of upwelling cells (Marret and Zonneveld, 2003). *S. delicatus* highest relative abundances are observed at sites with SST exceeding 25°C throughout the year, and forms a prominent part of associations in regions with SSS exceeding 31, also above 34 (Marret and Zonneveld, 2003).	Occurs especially during MIS 3, with significant drops related to all HS; alternating with *L. machaerophorum* higher percentages, and attesting of the warm/productive character of the subtropical study area during MIS 3 GI.
Operculodinium israelianum **(Warm group)**	Temperate to tropical (SST above 24°C) species characterizing fully marine sites as well as coastal waters (Wall et al., 1977; Harland, 1983), tolerating a broad range of nutrient concentrations (Marret and Zonneveld et al., 2003). Can be related to a typical signal of high salinity environments (Morzadec-Kerfourn et al., 1990; Marret and Zonneveld, 2003).	Typical signature found during the LGM, with however weak percentages, suggesting the relatively warm/saline character of the study area during MIS 2, especially between 16 and 24 ka BP.

Nematosphaeropsis labyrinthus **(Cold group)**	Cosmopolitan species able to tolerate a wide variety of environments (Marret and Zonneveld, 2003) including areas where up to 12 months of sea ice cover prevail (de Vernal et al., 2001). Also, considered as a typical open ocean species, predominantly found in cold to cool waters between 45 and 65°N in the North Atlantic Ocean (cf. Rochon et al., 1999), and recorded today with maximum abundances around the British Isles and in the NW Atlantic. Possibly related to enriched nutrient waters (Devillers and de Vernal, 2000).	Typical signature, being mainly related to cold GS, such as HS1 or the YD but also occurs during some GI recorded between HS4 and HS 5. This species would suggest cool / eutrophic conditions.
Spiniferites elongatus / Pentapharsodinium dalei **(Cold group)**	Both taxa have their highest relative abundances in temperate to cold regions and decreasing percentages of these species along the Northern Hemisphere subtropical front, constituting a 'physical' barrier for these taxa, typically reflecting today the transition from temperate to subtropical waters (Marret and Zonneveld, 2003)	MIS 3 to MIS 2 transition marks a strong shift from the earlier HS characterized by the cyst associations of *P. dalei*-*B. tepikiense* (HS5-HS4-HS3) to younger HS characterized by the association *S. elongatus* -*S. lazus* (HS 2 and HS1). Across HS4, strongest percentages of cysts of *P. dalei* attest to important coolings.
Spiniferites lazus **(Cold group)**	Restricted to fully marine, coastal regions, of western Europe (with low occurrences) and distributed within a broad range of temperature and nutrient concentrations, in areas with SSS exceeding 30. Arctic to temperate, inner to outer neritic species (Harland, 1983), not recorded from sites where SSS is reduced (e.g. Wall and Dale, 1973; McMinn, 1991; de Vernal et al., 1994; Nehring, 1994; Ellegaard, 2000; Persson et al., 2000).	MIS 3 to MIS 2 transition marks a strong shift from the earlier HS characterized by the cyst associations of *P. dalei*-*B. tepikiense* (HS5-HS4-HS3) to younger HS characterized by the association *S. elongatus* -*S. lazus* (HS 2 and HS1).
Bitectatodinium tepikiense **(Cold group)**	Characterizes strong thermal, seasonal contrasts with freezing winter SST and enhanced surface water stratification (Sanchez-Goni et al., 2000; Turon et al., 2003; Combourieu-Nebout et al., 2002; Penaud et al., 2011a, b).	Across HS5, HS 4 and then HS3, decreasing percentages of *B tepikiense*, in parallel with decreasing *L. machaerophorum*, may confirm a decreasing stratification trend through time over each HS.
***Brigantedinium* spp** **(Heterotrophic)**	Cosmopolitan species that can dominate cyst associations from coastal to oceanic sediments of the North Atlantic, the western equatorial Atlantic, as well as the coastal upwelling along the western African margin. Found within a broad range of temperatures, salinities and nutrient concentrations (Marret and Zonneveld, 2003). However, in this group distribution of the heterotrophic species seems largely controlled by their food requirements and authors suggest a relationship with high surface productivity (e.g. Lewis et al., 1990; Dale and Fjellsafi, 1994; Marret, 1994; Biebow, 1996; Targarona et al., 1999; Zonneveld et al., 2001).	Especially found with maximal percentages during the LGM, but also during HS4. Across the LGM, *Brigantedinium* has been previously related to the presence of a front within the Gulf of Cadiz at that time, probably similar to the modern Azores Front, which may have enhanced primary productivity through frontal upwelling cells (Rogerson et al. 2004, 2010; Penaud et al., 2011a). A strong seasonal pattern during HS4 would also be confirmed by the significant occurrence of *B. tepikiense* while cysts of *P. dalei* attest to extremely cold SST during this interval (cf. also Patton et al., 2011).
Selenopemphix nephroides / Selenopemphix quanta / Trinovantedinium applanatum **(Coastal Heterotrophics)**	Even if distributed within a broad range of temperature, salinity, or nutrient concentration, characterize estuarine to neritic environments (Harland, 1983), and often found in Western African upwelling and equatorial margin (Dodge and Harland, 1991; Wall et al., 1977). Highest occurrences of *S. nephroides*, temperate to tropical and fully marine species, characterize mesotrophic/eutrophic coastal environments (Marret and Zonneveld, 2003).	Grouped as "Coastal heterotrophic species" in this study. Especially found during GI/GS cycles of MIS 3, and strongly decrease after 30 ka BP, although slightly rising again during the Late Holocene. Contrary to *Brigantedinium*, these species (especially *S. nephroides*) are absent during HS in the Gulf of Cadiz.