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Time-series analysis of rock magnetic data from sediments spanning the last 40.000 years in the Western Mediterranean: strong paleoenvironmental cyclicities during the last glaciation

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Time-series analysis of high-resolution rock magnetic data from deep-sea marine sediments (piston core GP03, Alboran Sea, Westernmost Mediterranean), spanning the last 40.000 years, has been performed to reveal paleoenvironmental cyclicities and climate variability in this region during the uppermost Pleistocene and Holocene. We have applied both the classical Fast Fourier Transform (FFT), after regularizing our data by linear interpolation, and the Lomb-Scargle periodogram, which is well suited to analyze non-regular time series, as is the case. In addition to the usual Lomb-Scargle periodogram, we have also tested a modification of the periodogram that takes into account the experimental errors of the analyzed parameters. Also, in addition to the power spectrum and its peak spectral frequencies/periods, we have computed the Achieved Confidence Level (or false positive rate) of the different spectral peaks by a Monte Carlo evaluation of the permutation test, restricting our further analysis to those spectral peaks with Achieved Confidence Levels greater than 95%. The obtained results through these different approaches show a high degree of coherency, proving the reliability not only of the methods, but also of the modifications introduced and of the obtained results. Our results highlight the presence of characteristic cyclicities with periods in the range of 1600-4500 years during the last glaciation, especially between 25 and 38 ka. The most intense spectral peak has a period around 2 ka, which is consistent with the characteristic periods of Dansgaard-Oeschger (D-O) climate fluctuations. This strong 2 ka signal is clearly arising from the observed match between high magnetic susceptibility and saturation remanent magnetization values with D-O warm phases (interstadials). These relative maxima in magnetic mineral abundance are correlated with high S-ratio values, pointing to an increase in magnetite *vs*. hematite abundance in the sediments. Conversely, cold D-O phases (stadials) seem to be related to low susceptibility, low saturation remanence and lower S-ratio, indicating a decrease in the contribution of low coercivity phases (like magnetite) and an increase in the relative importance of high coercivity phases like hematite. We suggest this is connected with variations in the relative importance of riverine *vs*. aeolian terrigenous input. In contrast, Holocene rock magnetic data do not show this 2 ka peak, but instead cyclicities with

periods around 2800, 3800 and 5500 years are recognized. To our knowledge, this is the first report of such a remarkable relationship between marine sedimentary rock magnetic data and paleoclimatic cyclicities in the frequency range of the Dansgaard-Oeschger or stadial-interstadial events in the Western Mediterranean over the last glaciation, pointing to the interest of further rock magnetic studies.