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Long distance sediment/sediment and sediment/ice correlations during glacial period using the changes in the earth magnetic field

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Many glacial marine records exhibiting Dansgaard-Oeschger type large amplitude short-term fluctuations have been peak-to-peak correlated to one another and/or to ice records. These correlations are based on the assumption that the fluctuations were synchronous in the different oceans and between marine and ice sequences. Of course this assumption prevents from quantifying any lead/lag relationship which may exist between them. Tephrochronology provides important tie points between the different archives but remains mainly valid on regional scale.

In this context, the pattern of short-term variations of the earth magnetic field, both in intensity and in direction is an invaluable tool. When the earth magnetic field paleointensity measured in sedimentary sequences reflects the dipolar component of the field, the observed variations are synchronous at the surface of the earth, allowing long-distance sediment/sediment correlations. Moreover, the earth magnetic field acts as a shield for the production in the high atmosphere of cosmogenic isotopes measured in ice, allowing sediment/ice correlations. Because the earth magnetic field is generated inside the core of the earth, independently from climate changes, and because it is recorded continuously, it is a unique tool allowing to transfer the different climatic records on the same horizontal scale and to quantify the leads and lags between climatic events recorded in different archives and different regions.

As a first step, we shall show how the global paleointensity stack (GLOPIS-75) we constructed for the last glacial period nicely correlates with the Greenland ice cosmogenic record and within which age uncertainties. We shall also discuss the accuracy of two important tie points present in the continuous paleointensity curve and corresponding to the Mono Lake and Laschamp geomagnetic excursions. These excursions were recognized in lava flows that we studied in detail using both paleomagnetism and K/Ar-40Ar/39Ar dating. We shall present a synthesis of the previously published data and of the newly obtained ones. Finally, we'll give examples of how this tool can be used for long-distance correlation of marine sedimentary records and how this is important for temporal comparisons of climatic records.