The Laschamp geomagnetic dipole low expressed as a cosmogenic 10Be atmospheric overproduction at _˜41 000 yrs BP

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Résumé

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Authigenic 10Be/9Be ratio measurements were performed at high resolution along a Portuguese margin deep-sea core (37∘48 N; 10∘09 W) spanning the 20-50 ka BP time interval, in order to reconstruct variations in atmospheric cosmogenic 10Be production rates and derive the related geomagnetic dipole moment modulation. A complementary approach consisting in 230Thxs-normalized 10Be deposition rate determination on some selected samples confirmed the reliability of the authigenic 10Be/9Be record. This study constitutes the first successful comparison of the two widely used normalization techniques of 10Be concentrations. For both methods, the presented results evidence a factor of _˜2 cosmogenic nuclide overproduction linked to a minimum dipole moment associated to the Laschamp excursion. The later is stratigraphically constrained beneath the Heinrich Event 4. It is dated at 41.2±1.6 ka BP on the basis of direct correlation between the series of rapid paleoclimatic events recorded in the Portuguese margin sediments and in Greenland ice sheet. This age is further confirmed by calibrated radiocarbon dating carried out on the same sediments. The remarkable agreement between the authigenic 10Be/9Be and the Greenland Ice cores 10Be deposition rate records attest of their global significance. This new authigenic 10Be/9Be record has been combined with that previously obtained at the same site to produce a stacked record that is calibrated using absolute values of Virtual Dipole Moment determined on lava flows. This provides a reconstruction of the dipole geomagnetic moment variations over the 20-50 ka BP interval, independent from paleomagnetically-constrained methods, which documents the Laschamp dipole low but fails to express any dipole low related to the Mono Lake excursion. This high resolution record responds to the necessity to supplement the knowledge of the atmospheric Δ14C variations in the interval 30-45 ka BP during which the 14C calibration curve suffers from a lack of accurate data, and during which a discrepancy of about 5500 yr between the 14C and U-Th ages is due to the Laschamp geomagnetic dipole low. Such new high resolution datasets from records spread over different latitudes will be required to make significant advances in understanding the causes of atmospheric Δ14C variations. This study is funded through the "MAG-ORB" project ANR- 09-BLAN-0053-01.