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Dynamics of the Earth Magnetic Field during the period of high variability covering the Laschamp and Mono Lake excursions.

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We report on a synthesis of new paleomagnetic data (direction and intensity), conducted together with new K/Ar and 40Ar/39Ar dating over the past few years on 37 lava flows from the Chaîne des Puys (Massif Central, France). New flows emplaced during the Laschamp excursion have been identified and their K/Ar and 40Ar/39Ar dating improves again the precision of the age of this excursion, now established at 41.3 $\pm$ 0.6 ka (2sigma). Also, transitional flows corresponding to the Mono Lake excursion have been identified for the first time in this region, widening the geographical expression of this excursion.

Absolute intensities obtained from 22 flows out of the 35 studied flows indicate that the intensity of the earth magnetic field is highly reduced, not only during the Laschamp but also during the Mono Lake excursion (to about 10% of the present-day field value). These two well identified and well dated minima, therefore now constitute very precise and accurate tie-points for the chronostratigraphy of this time period.

In the 7000 years long interval separating the two excursions, the intensity of the earth magnetic field recovers to almost non-transitional values. This rules out the recent suggestion that a long intensity minimum (6000 years) between the two excursions would have resulted in the extinction of the Neandertal man-kind, via a strong decrease of the atmospheric ozone and an increase in UVB concentration.

Not only the amplitude but also the duration of the observed changes are remarkably consistent in the high resolution records obtained from marine sediments, lavas and cosmogenic isotopes from polar ice. They indicate that the duration of the Laschamp can be estimated at about 1500 years based on the intensity drop and to about 640 years based on the directional change. If an excursion is an aborted polarity state as previously suggested, this would imply a duration of only 320 years for a polarity reversal, far shorter than what is invoked in the literature.

The increase 36Cl production as observed in polar ice at the time of Mono Lake excursion, corresponds to very low dipolar intensity values confirmed by the new absolute intensities obtained from the lava flows. The duration of the Mono Lake, estimated from the change in intensity based on this 36Cl record is about 600-700 years, twice shorter than the Laschamp. This explains why this excursion is difficult to identify from most of the geological archives.

Finally, the decreasing rate of the intensity at the inception of the Laschamp excursion (between 44 and 41 ka) is about 18nT/year followed by an increase at about 10nT/year. The decreasing rate is significantly higher than that observed at the inception of an intensity decrease of the same amplitude but not associated with any excursion around 65 ka ago. Among other parameters to which we don't have access here, such a high decreasing rate could be the sign of a coming excursion. This high rate is the one observed for the earth magnetic field since 1840...