Refining the Quaternary Geomagnetic Instability Time Scale: The Laschamp Excursion Dated from a Speleothem Record

Ioan Lascu
Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ, United Kingdom, il261@cam.ac.uk

Short-lived events such as geomagnetic excursions are global events that are used for dating purposes across scientific disciplines. A critical ingredient for characterizing such geomagnetic instabilities are tightly constrained age models that enable high-resolution magnetostratigraphies. The focus of this study is a speleothem geomagnetic record of the Laschamp excursion, which was the first geomagnetic excursion recognized and described in the paleomagnetic record, and remains the most studied event of its kind. The geological significance of the Laschamp lies chiefly in the fact that it constitutes a global geochronologic marker about 40,000 years ago. The Laschamp excursion occurred around the time of the demise of *Homo neanderthalensis*, in conjunction with high-amplitude, rapid climatic oscillations leading into the Last Glacial Maximum, and coeval with a major supervolcano eruption in the Mediterranean. Thus, precise determination of the timing and duration of the Laschamp would help in elucidating major scientific questions situated at the intersection of geology, paleoclimatology, and anthropology. A geomagnetic record from a stalagmite collected in Crevice Cave, Missouri has been dated using a combination of high-precision ^{230}Th ages and annual layer counting using confocal microscopy. The maximum duration for the Laschamp excursion spans the interval 42,250–39,700 years BP, with an age of 41,100 ± 350 years BP for the main phase of the excursion, during which the virtual geomagnetic pole was situated at the southernmost latitude in the record. This chronology provides the first robust bracketing for the Laschamp excursion, and improves on previous age determinations based on ^{40}Ar/^{39}Ar dating of lava flows, and orbitally-tuned sedimentary and ice-core records. A rigorous documentation of timing, duration, and frequency of excursions can be invaluable for constraining the chronology of certain periods of the Quaternary. Well-constrained age models are critical for characterizing geomagnetic instabilities, and are key in developing high-resolution geomagnetic time series. One such effort is the development of the Quaternary Geomagnetic Instability Time Scale (GITS). Geomagnetic excursions are concentrated within two ~200 ka time periods (722–528 ka BP and 211–17 ka BP) within the Brunhes polarity chron, each containing half a dozen excursions, which are in the dating range of the ^{234}U/^{230}Th method. The younger Brunhes excursions would particularly benefit from precise pinpointing by taking advantage of this method, which under ideal circumstances yields 2σ uncertainties as low as ± 0.1 ka at 130 ka BP, and ± 0.3 ka at 200 ka BP.