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Origin and age of the directions recorded during the Laschamp event in the Chaîne des Puys (France).

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We sampled new lava flows and revisited several sites which recorded the Laschamp event in the Chaîne des Puys. This study combines thermal and alternating field demagnetization of 272 samples from 21 units including 12 new localities and 12 K-Ar datings of main units. No new site with intermediate or reverse polarity was found. Ten sites have a full normal polarity with a mean far-sided pole (82.4˚N, 204.4˚E) and a dispersion of 11.9˚. The seven sites studied at Olby, Louchadière and Royat display intermediate directions close to those of the previous studies, but with relatively large scatter and not strictly at the same locations. Magnetic mineralogy is characterized by primary titanomagnetite with a Curie temperature of 130 ± 60˚C ($0.6 < x < 0.8$), by variable amounts of titanomaghemite and by a high temperature phase due to almost pure magnetite with Curie temperatures of 540 ± 25˚C. We confirmed that flows with reverse polarity are affected by self-reversals but we found that this is also the case for flows with normal polarity. A direct consequence is that self-reversals cannot be taken as responsible for the reverse directions at Laschamp. Low temperature oxidation persisting after cooling is likely responsible for producing a CRM with normal polarity which overlaps the initial magnetization and thus generates the apparent scatter of the transitional directions. The overall coherency and consistency of the results indicates that this process was limited. Thus, despite complex magnetization processes, the geomagnetic origin of the volcanic records of the Laschamp in the Chaîne des Puys is not questioned. The compilation of all volcanic pole positions (VGPs) published so far shows significant scatter but they remain consistent with each other. Interestingly, they do not coincide with the longitudinal loops seen in the sedimentary records and thus

retain different information. New K-Ar datings allowed us to establish a first detailed chronology for the successive polarities accompanying the Laschamp event. The 37 ka old reverse directions of the Olby flow are chronologically consistent with the average date of 41.9 ka for the normal polarity flows preceding the event. The Royat flow which is marginally intermediate suggests that the end of the event was not younger than 33.3 ka in the Chaîne des Puys.