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Magnetostratigraphy around the Gauss-Matuyama boundary in the Villarroya basin (N Spain); Implications for the "LAD" of Hipparion in western Europe

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The Villarroya Basin contains an exceptional and well-known macromammal fossil record (including abundant Hipparion remains), some micromammal-rich levels and long and well-exposed sections (up to 100 m) suitable for magnetostratigraphy. We have studied and correlated two long magnetostratigraphic profiles (more than 250 samples) implementing previous and controversial preliminary data.

Paleomagnetic components have been successfully isolated by means of stepwise thermal cleaning (30-50˚C steps). The ChRM directions (obtained in different lithologies and carried by soft and hard magnetic minerals) exhibit normal and reverse polarity of the magnetic field and are overall antiparallel. Samples with unambiguous polarity have been used to define the local magnetic sequence, which shows up to ten different zones. The main and longer profile (VIL-1) displays a net boundary between normal (lower) and reverse polarity (upper part) around meter 24 and it is interpreted as the Gauss-Matuyama boundary. The classical fossil locality is located 10 meters above this reversal within a short normal polarity zone. A new fossiliferous level (Vi-1) 3 meters immediately below this R-N boundary indicates an upper MN16 / lower MN17 age,. The uppermost fossiliferous level in the basin (Vi-2) is situated 1.5 meters above the stratigraphic interval of the classical Villarroya macromammal site and characterizes the uppermost part of the MN16 zone and the lower part of the MN17 zone.

The interpretation of the local sequence of magnetozones and the new micropaleontological data, suggests that the Villarroya Basin was filled with sediments throughout (at least) two million years and spans temporally from the normal zone between Kaena and Mammoth events (3.22 Ma.) until the long reverse lapse below Jaramillo ($\approx$ 1.07 Ma.). The classical fossil locality with Hipparion remains is located in the Reunion I zone (2.19-2.44 Ma.) over the Gauss/Matuyama boundary. This seemingly young age for Hipparion horses implies that the European LAD and associated biostratigraphic interpretation should be considered with caution.