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Defining the Lower–Middle Pleistocene Subseries boundary

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The Lower–Middle Pleistocene transition (1.4–0.4 Ma) represents a fundamental transformation in the Earth's climate state in which glacial–interglacial oscillations shift towards a quasi-100 kyr frequency and increase progressively in amplitude [1]. The Matuyama–Brunhes Chron boundary (MBB), conveniently occurring at its approximate mid-point, will serve as the primary marker for the Lower–Middle Pleistocene Subseries boundary [2,3]. This paleomagnetic reversal boundary has strong chronostratigraphic utility in marine and nonmarine sediments and ice cores (through ^{10}Be flux), but like other paleomagnetic signals, may be affected by post-depositional remanent magnetization lock-in depth and by chemical weathering and secondary overprinting. In marine sediments and ice cores, the polarity reversal is dated by reference to an oxygen isotope chronology, but lags and leads in different ocean basins create additional uncertainty. This notwithstanding, the most reliable astrochronologically-tuned marine records give an age of around 773–772 ka for the midpoint of the reversal. The duration of the transition is estimated to vary between 2.9 and 6.2 kyr but a record of less than 100 years has also been reported [1].

The MBB falls within Marine Isotope Stage (MIS) 19, an interglacial of distinctive structure, occasionally beginning with a Younger-Dryas-type event followed by a rapid rise to lighter isotopic values (Termination IX), an early or late peak within these elevated values of MIS 19c, and several oscillations towards the end of the interglacial (MIS 19b,a) that may reflect a bipolar seesaw mechanism caused by ice sheet growth and subsequent instability [4]. MIS 19 should serve as an important secondary marker in recognizing the Lower–Middle Pleistocene boundary, so its precise relationship to the MBB needs to be understood. Presently, most marine records place the MBB in the upper part of MIS 19, or even near the MIS 19–18 transition, but in some records the MBB is recorded in its lower part [1].

Three candidate sections for the global boundary stratotype section and point (GSSP) for the Lower–Middle Pleistocene Subseries boundary are under consideration: the Valle di Manche (Calabria [5]) and Montalbano Jonico (Basilicata [6]), both in southern Italy, and the Chiba section in Japan [7]. Formal GSSP proposals will be submitted at the end of 2016 or early in 2017. A critical appraisal of these sections is therefore timely. In particular, the MBB (or its ^{10}Be flux proxy) as the primary marker, its relationship with MIS 19, possible leads and lags in the marine isotope signal, the timing of both land-based and sea-surface warming in relation to Termination IX, and the timing of sedimentary features that might reflect sea-level rise (i.e. increased accommodation space) at the start of MIS 19, all warrant careful attention for a full understanding of the boundary.

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