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Skewness Pole from Magnetic Anomaly C21n Implies Rapid Early Eocene True Polar Wander

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Skewness analysis of marine magnetic anomalies is the most misunderstood methodology in paleomagnetism. Such analysis has several advantages. First, marine magnetic anomalies innately average secular variation. Second, paleomagnetic poles determined by analysis of their skewness are not biased by overprints. Third, skewness analysis can determine high precision paleomagnetic poles. Specifically, skewness analysis of magnetic anomalies recording Late Cretaceous and early to mid-Cenozoic seafloor spreading between the Pacific and Farallon plates, because of their geometry with respect to the paleo-spin axis, results in high-precision paleomagnetic poles. These anomalies in many cases span ~140° of effective remanent inclination over a span of ~40° of latitude, reducing uncertainty by a factor of ~0.3 when mapping from direction space to pole space (Zheng et al. 2018).

Paleomagnetic poles have been previously determined from skewness analysis for six Pacific plate anomalies: C32n (74-71 Ma), C31n-C27r (60-63 Ma), C26r (62-59 Ma), C25r (59-58 Ma), C24r (57-54 Ma), C20r (46-43 Ma), and C12r (33-31 Ma). The younger group, C20r and C12r, together with independent paleo-spin axis estimates from the paleo-distribution of sediment accumulation rates from 12-46 Ma, define an approximately stationary paleo-spin axis location relative to the Pacific hotspots but offset from the current spin axis by 3°. The older group, 74-54 Ma, also shows that the Pacific hotspots remained approximately stationary relative to an additional paleo-spin axis location separated by 8° from the 12-46-Ma paleo-spin axis, implying an episode of reorientation of the entire solid earth – i.e., true polar wander (TPW) – of ~8° over at most 8 Ma between 54 and 46 Ma, or a rate of TPW of ~1°/Ma or more.

To constrain the timing and rate of reorientation, we analyze anomaly C21n (47-46 Ma), the youngest anomaly inside the 54-46-Ma interval. We incorporate 33 total-intensity ship- and 11 vector aero-magnetic track lines and find a well-constrained paleomagnetic pole near 77N, 23E in the fixed-Pacific plate reference frame.

Our new paleomagnetic pole is consistent with a prior, more uncertain, 48-Ma paleo-spin axis location from the paleo-distribution of sediment accumulation rates. When reconstructed into the Pacific hotspot reference frame, our new paleomagnetic pole lies close to the younger 46 to 12-Ma TPW stillstand location, indicating that true polar wander was completed by 47 Ma, if not earlier. Thus the ~8° shift occurred in, at most, 6.0 Ma at a rate of at least ~1.3°/Ma, and potentially even

faster. The lower bound of ~1.3°/Ma of TPW indicate that Early Eocene TPW is comparable to the rate of present-day TPW (~1.1°/Ma extrapolated from geodetic data (Argus and Gross, 2004)). This new pole bounds the Early Eocene TPW episode between approximately the old and young ends of the Early Eocene Climatic Optimum (EECO; 53.2-49.1 Ma (Westerhold et al. 2018)). Thus, there may be a link between Early Eocene TPW and important climate events, such as the frequency of hyperthermals and the onset of Eocene cooling. In addition, TPW was likely complete before the 47.4-Ma age of the bends in Pacific plate hotspot chains (Gaastra & Gordon, this meeting).