

WEEK #8 – TRUE POLAR WANDER

Topics/Concepts

Fossil bulge, Gold's beetles

Principal-axis rotation, minimum energy state

“Inertial interchange” true polar wander

Positive gravity anomalies migrate towards the equator, negative towards the poles

Reorientation is a competition between the applied load and the fossil bulge

Equations

Degree of reorientation  $\theta_R$                        $\sin 2\theta_R = \frac{Q}{n} \sin 2\theta_L^f$                        $\theta_L^i = \theta_L^f + \theta_R$

$n=1$  for planets;  $n=1-4$  for satellites, depending on longitude of load

Dimensionless load  $Q$                        $Q = \frac{GM}{R^2} \frac{3\sqrt{5}G_{20}^L}{R\omega^2(k_2^f - k_2)}$

Zonal coefficients                       $G_{n0} = -\frac{2n+1}{2} \int_{-1}^1 g(\theta) P_n(\cos\theta) \sin\theta d\theta$

$$g(\theta) = \sum_{n=0}^{\infty} G_{n0} P_n(\cos\theta)$$

References

Nimmo & Matsuyama, Reorientation of icy satellites by impact basins, *Geophys. Res. Lett.* 34, L1920, 2007.

Matsuyama et al., Planetary reorientation, *Ann. Rev. Earth Planet. Sci.* 42, 605-634, 2014.