Geophysical Research Abstracts
Vol. 18, EGU2016-9785, 2016
EGU General Assembly 2016


# Sensitivity of seafloor bathymetry to climate-driven fluctuations in mid-ocean ridge magma supply

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Abyssal hills are the most common topographic feature on the surface of the solid Earth, yet the detailed mechanisms through which they are formed remain a matter of debate. Classical seafloor observations suggest hills acquire their shape at mid-ocean ridges through a combination of normal faulting and volcanic accretion. However, recent studies have proposed that the fabric of the seafloor reflects rapid fluctuations in ridge magma supply caused by oscillations in sea level modulating the partial melting process beneath the ridge [Crowley et al., 2015, Science]. In order to move this debate forward, we propose a modeling framework relating the magma supply of a mid-ocean ridge to the morphology of the seafloor it produces, i.e. the spacing and amplitude of abyssal hills.

We specifically assess whether fluctuations in melt supply of a given periodicity can be recorded in seafloor bathymetry through (1) static compensation of crustal thickness oscillations, (2) volcanic extrusion, and (3) fault growth modulated by dike injection. We find that topography-building processes are generally insensitive to fluctuations in melt supply on time scales shorter than ∼50-100 kyr. Further, we show that the characteristic wavelengths found in seafloor bathymetry across all spreading rates are best explained by simple tectono-magmatic interaction models, and require no periodic (climatic) forcing. Finally, we explore different spreading regimes where a smaller amplitude sea-level signal super-imposed on the dominant faulting signal could be most easily resolved.