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Implications for regional and eustatic sea level since Late Cretaceous from North America dynamic models

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Sea level undergoes eustatic fluctuations and continental interiors experience epeirogenic motions as a result of mantle flow, changing dynamic topography and the motion of plates with respect to dynamic topography. We implement an inverse methodology to solve mantle convection, where past mantle structure is recovered through the backward integration of the convection equations using scaled seismic tomography; the method incorporates temperature- and pressure-dependant viscosity with imposed plate motions. Dynamic topography on a mesh fixed to the plate is continuously tracked over the changing mantle. Observations of flooding, sediment thickness and tectonic subsidence are used to constrain dynamic models, iteratively updating mantle structure to match these observations.

Here we present implications of North America dynamic model for regional and eustatic sea level from Late Cretaceous to present. Because of the subduction of Farallon plate under North America, a wide dynamic topography low develops in the continental interior during Late Cretaceous. Our model suggests that Cretaceous flooding was not an unusual event, in which North America regionally subsided, but rather North America moved over a relatively fixed mantle downwelling, and the flooding event was recorded due to elevated eustatic sea level. In a fixed North American frame of reference, a dynamic topography low moved eastward from Late Cretaceous to present, causing subsequent uplift of the interior of the continent. At present, the dynamic topography low is located below the east coast of North America. Dynamic models, along with hypsometric and paleo shoreline analysis, suggest that this region is experiencing dynamic subsidence at least since the Eocene, synchronous with an overall

eustatic sea level fall. Land subsidence is absent as a result of the eustatic change being larger than the dynamic subsidence. The proposed dynamic subsidence accounts for the difference between eustatic sea level and regional sea level calculated for the New Jersey coastal plain, suggesting that this region should not be used as a stable reference frame for eustatic sea level calculations.