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Dynamics of Cretaceous Epicontinental Seas

Acceleration of plate spreading and hot spot activity during the Cretaceous produced topographically elevated regions of the sea floor which episodically displaced global sea level upward as much as 300 m (980 ft), broadly flooding the world's cratons with shallow epicontinental seas. Episodes of relative plate quiescence accompanied destruction of these topographic features and sea level fall. Ten such eustatic rise-fall events, third-order cycles averaging 10 m.y. in duration, are defined from coincident transgressive-regressive strandline migrations and various types of sedimentary cyclothems on many of the world's cratons; epicontinental seas and their sedimentary record comprise the most sensitive tools for defining sea level fluctuations. Precise correlation of these eustatic fluctuations and determination of rates of sea level change are possible through a new technique of high-resolution event stratigraphy, integrated through graphic correlation with refined biostratigraphy and geochronology. The best documented record of Cretaceous eustasy, and the most refined system of geologic time and event correlation, is associated with the great Western Interior seaway of North America. This sea occupies a major foreland basin east of the North American Cordillera.

In this basin, strong evidence exists for near-simultaneous response of regional tectonic and volcanic activity, sedimentation patterns, eustatic fluctuation, strandline migration, climate history, and variations in paleobathymetry, temperature, and water chemistry in the Western Interior seaway, with episodes of active vs. passive spreading and subduction. The dynamics of basin history documented in the Western Interior seaway serve as a new model for epicontinental marine history worldwide. Basin analyses suggest that, coincident with active plate spreading and subduction along the Pacific margin of North America, active thrusting, plutonism, and vulcanism characterized the western Cordillera; the foreland basin was subsiding at rates greater than predicted by tectonic sedimentologic loading, basement block faulting was initiated in the tectonic hinge zone, and the basin reached its deepest phase as sea level rose and marine transgression overprinted regional tectonic and sedimentologic features. Major thermal and chemical fluctuations, including regional and global anoxic events, characterized the seaway at this time, producing extensive source rocks. Subsequent phases of relative plate quiescence were coincident with major reduction in Cordilleran tectonics, vulcanism, and basin subsidence, as well as with eustatic fall and epicontinental regression. Resultant filling of the seaway with sediments allowed extensive eastward progradation of clastic wedges across the basin axis and onto the stable eastern platform, forming the major Cretaceous hydrocarbon reservoirs. Most major coal deposits formed on delta and strand plains during relative eustatic stillstand at peak transgression and peak regression. The integrated study of basin dynamics in epicontinental seas, linked to eustatic history, allows the development of powerful exploration models for fossil fuels.

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