# The impact of the Oligocene sea level lowstand on petroleum systems worldwide

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The Eocene (ca. 55.5 M a) saw a thermal maximum with global average temperatures 8°C warmer than today followed by a remarkable transition to the Oligocene (ca. 35–33 Ma). These are the most profound oceanographic and climatic changes recorded in the past 50 Ma with global cooling of ca. 30°C and eustatic sea level lowering from 55 m to 155 m. Accompanying these phenomena was a global increase in $\delta^{18}O$ of 1.0 ‰–1.5 ‰ throughout the Atlantic, Pacific, Indian, and Southern oceans and dramatic drop in the calcite compensation depth. Many scientists attribute this change to the formation of polar ice sheets but there is controversy regarding the causal mechanisms.

The world's sedimentary basins record major unconformities and sequence boundaries associated with this transition. Some ascribe part of the drop in sea level to global spreading-rate changes and suggest large areas of the continental shelves were exposed subaerially exposed during tectono-eustatic lowstands triggering slope failure and submarine erosion. On the west coast of equatorial Africa, erosion of up to 500 m occurred with deep canyon incision and turbidite deposition on the slope. Some of the erosional processes are ascribed to oceanic bottom currents and renewed movement of polar waters by reorganization of ocean circulation, following the opening of the Drake Passage and the isolation of Antarctica.

We examine the Eocene–Oligocene transition in various basins worldwide and the impact on their petroleum systems and ask: (1) Did the Eocene thermal maximum and sea level highstand lead to generation of potential source rocks? (2) Did regressive sequences, related to the ensuing cooling and drop in eustatic sea level, lead to enhanced reservoir distribution and positive or negative effects on petroleum accumulations? (3) Could the Eocene–Oligocene transition be related to the post-Eocene cooling recorded by apatite fission track (AFT) thermochronology in the Scotian Basin?

AFT studies show the rocks in many Scotian Shelf wells attained peak temperature between 60 and 40 Ma and subsequently cooled 10 to 25° C. Explanations include significant post-Eocene erosion due to eustatic lowstand, regional tectonics, higher mean annual surface paleotemperatures, local circulation of hot fluids, and effects of salt. Is erosion via canyons or longshore currents sufficient to explain the thermal data? Could rapid unloading have led to overpressure and faulting in already pressurized and confined reservoirs on the margin? We will investigate the causes and impacts in this paper.

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