

## Timing of Petroleum System Events Controls Accumulations on the North Slope, Alaska

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The Alaska North Slope is estimated to contain most of the undiscovered oil and gas in the circum-Arctic. Results from a calibrated 3D basin and petroleum system model for this region demonstrate the importance of the relative timing of trap formation and expulsion from the source rock. Petroleum system event charts for four examples from the model in the foothills of the Brooks Range, Prudhoe Bay, Mukluk, and the Barrow Peninsula show how the relative timing of these events impacts risk.

The event chart for a location in the foothills of the Brooks Range shows significant risk for accumulation in stratigraphic traps because they formed at about the same time as expulsion from the Triassic Shublik Formation source rock. Risk is also high for accumulations in structural traps formed after expulsion, because they can be filled only by remigration from older stratigraphic traps.

At Prudhoe Bay, trap formation preceded expulsion, resulting in a major accumulation. Biomarkers show that Prudhoe Bay field contains mixed oil from the Triassic Shublik Formation and Cretaceous Hue-gamma ray zone (Hue-GRZ) with lesser input from the Jurassic Kingak Shale. These results are consistent with the 3D model, where the Shublik and Kingak source rocks started to expel petroleum during the Cretaceous, while the Hue-GRZ contributed later.

Debate persists over the reasons for failure of the Mukluk wildcat well. At the time of drilling, the Mukluk structure was estimated to contain 1.5 billion bbl of recoverable oil in a structural-stratigraphic trap, although subsurface imaging was uncertain due to difficulty in assessing seismic velocities through permafrost. Drill cuttings showed extensive oil stain in the target formation. The 3D model shows that petroleum accumulated, but spilled from the structure to the southeast through the Kuparuk C-D interval toward the Kuparuk River field during Tertiary tilting.

Preliminary 3D simulations predicted a large petroleum accumulation on the Barrow Peninsula, although only a few small gas fields are known (S. Barrow, E. Barrow, Sikulik) near the Avak structure, which resulted from a middle-late Turonian meteor impact. Our revised 3D model accounts for the effects of the meteor impact on temperature and permeability of the target rocks. The model predicts a large accumulation prior to impact, but predicted present-day accumulations occur only to the west, south, and east of the Avak structure, in agreement with known accumulations.