

are favorable sites for generation and accumulation of organic biomass.

The prolonged exposure to the freshwater diagenesis in regressive phases of depositional megacycles results in destruction of organic matter in tidal-flat and lagoonal environments. The transgressive phase of depositional megacycles provides for short-lived exposures to the freshwater diagenesis. Consequently, tidal-flat and restricted lagoonal deposits of transgressive phase can be considered as petroleum source rocks.

Bitumens and hydrocarbons, which evolve from the thermal degradation of kerogens, migrate to the nearest available microporosities such as recrystallized patches of limestones, calcite cements, and dolomitic mosaics. Thus, early and late diagenesis helps to bring about a continuous segregation of bitumens and hydrocarbons from kerogens in carbonate source rocks. Tectonic fracturing can provide avenues for secondary migration from source to reservoir facies.

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Recent Activities in United States Tar Sand

The known tar sand resources of the United States consist of about 550 occurrences located in 22 states. Total oil-in-place in 39 of these occurrences, which have been submitted to some reservoir evaluation, is estimated between 23.7 billion and 32.7 billion bbl. At least 90% of this resource is located in Utah, where six deposits each contain from 1 to 16 billion bbl of oil. Other significant deposits occur in Texas, New Mexico, California, and Kentucky.

Current efforts to develop the United States tar sand resource include: reservoir characterization and evaluation work by industry, states, and the U.S. Department of Energy (D.O.E.); oil recovery and related research by industry, academia, and D.O.E.; and a few field minitests and pilots by industry and D.O.E.

The future supply role of the United States tar sand resource is necessarily vague because of the relatively small magnitude of the known resource, when compared to other potential synthetic fuels such as coal or oil shale, the lack of demonstrated applicable oil recovery technologies, and a resultant lack of recoverable reserve estimates.

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Hydrocarbon Prospects of Bering Sea Shelf South of St. Lawrence Island, Alaska

Hydrocarbon prospects of the Bering Sea shelf are encouraging because of the presence of numerous, large sediment-filled basins, a variety of structural and stratigraphic traps, and potential reservoir beds. The large shelf area south of St. Lawrence Island is underlain by at least 13 sediment-filled basins. One of these basins, Bristol Bay basin, extends offshore from the Alaska Peninsula and contains more than 3 km of section. Nearby on the northwest is St. George basin, a graben approximately 300 km long and 50 km wide that includes a section about 10 km thick. The northwestern

region of the shelf near Siberia is underlain by the large Navarin basin province (40,000 sq km), which comprises three subshelf basins that contain sections as much as 15 km thick.

Structural traps for hydrocarbons occur as folds associated with growth faults flanking the basins, strata draped over basement blocks, regional dip divergence in the upper sedimentary basin sequence, and thinning of beds against the basement flanks of the basins. Diapirlike folds as well as large anticlinal structures occur in the Navarin basin province.

Rocks dredged from the Beringian continental slope include volcanic sandstone of Late Jurassic age, mudstone of Late Cretaceous age, and less consolidated deposits of early Tertiary age. Pyrolytic analyses of these rocks indicate that none are good source beds for petroleum; however, the samples are generally sandy units that may not be representative of finer grained possible source beds that may be present along the margin or within the subshelf basins. Tertiary samples are generally porous—probably because of abundant diatom frustules. The permeability of these rocks is variable. Tertiary outcrops can be traced as seismic reflectors to the subshelf basins, where, if the beds remain diatomaceous, potential reservoir beds may be present.

SOURCE ROCK & RESERVOIR CHARACTERISTICS
BERING SHELF DREDGE SAMPLES

Sample number	Lith.	Age	Org Carb. (Wt.%)	Pyrol. HC (Wt.%)	Vitr Refl. (%)	Por. (%) perm.(md)
36-77-88						
DRI-20	Vol. Ss.	Late Jur.	—	—	0.38	—
DRI-26	Vol. Ss.	Late Jur.	—	—	1.14	—
TT-1-021						
O01	Mudst.	Late Cret.	0.62	0.11	0.40	—
LS-78-88						
5-5	Ss.	Late Jur.	0.27	0.02	0.63	—
2-3	Mudst.	E. Tert.	0.33	0.02	0.41	—
16-9	Mudst.	M. Eo.	0.83	0.04	0.31	—
2-4	Mudst.	L. Olig.	—	—	—	68.3/5.46
2-11	Siltst.	L. Olig.	—	—	—	48.1/1.25
3-10	Tuff	L. Olig.	—	—	—	50.7/19.0
7-3	Mudst.	M. Mio.	—	—	—	57.4/1.67

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Development of Conceptual Model to Characterize Uncertainty in Coal Resource Estimates

Published coal reserve estimates for the United States have traditionally differed by wide margins, e.g., Electric Power Research Institute estimating 135 billion tons and U.S. Geological Survey estimating 212 billion tons. These differences in reserve estimates possibly result from mechanically following the USGS/USBM resource classification system, without appreciation of lateral variability in seam thickness and seam discontinuity. Variability and discontinuity are dependent in part upon depositional history. For example, coals accumulated on an ancient alluvial plain or in a back barrier setting are more variable and, thus, more difficult to characterize as to resources than are those that accumulated on a delta plain.

A statistical model for characterizing uncertainty in