Petroleum Geology of Chukchi Sea

Kirk W. Sherwood

Minerals Management Service, Centerpoint Financial Center, 3801 Centerpoint Drive,Suite 500, Anchorage, Alaska 99503-5823; e-mail kirk.sherwood@mms.gov

The Chukchi Sea continental shelf shares many geologic attributes with the oil-producing area of the Alaska North Slope and these similarities help drive the perception of high oil and gas potential for the Chukchi shelf. The Chukchi shelf has a petroleum endowment of 32.3 Bboe and contains 28% of the total (117 Bboe) for the greater "Arctic Alaska" petroleum province (North Slope, 71.3 Bboe [Houseknecht, pers. comm., 2006; AK DOG, 2004]; Beaufort Sea, 13.4 Bboe [MMS, 2006]).

Most of the oil & gas resources of the Chukchi shelf are linked to two separate rift systems of Paleozoic and Mesozoic ages. Basins related to these rift systems are dissected on the north by younger transtensional faults and overprinted on the south by a foredeep and foreland fold belt.

Hanna trough is a rift basin of probable Devonian to Jurassic age with up to 38,000 feet of Ellesmerian strata and that trends south to join the Arctic Alaska basin of the North Slope. The Paleozoic rift faults of Hanna trough were reactivated as transtensional faults in Paleocene-Eocene time coeval to foreland folding and extend to the seafloor in most areas. These faults may have disrupted pre-existing accumulations and form a risk to petroleum prospects in the Chukchi Sea.

The North Chukchi rift basin (>40,000 ft of strata) of the northern Chukchi shelf apparently originated in Jurassic time as part of the Beaufort rift system that eventually created the Canada basin. Rift-shoulder sags and grabens ring North Chukchi basin but transition to a stable shelf on the south that deepens southward into a nascent Colville foredeep.

Triassic oil source rocks were sampled at the Klondike 1 well on the west side of Hanna trough and these rocks extend eastward and down-dip into a probable oil generation "kitchen" in the deeper parts of Hanna trough. The thermal maturation of the Triassic oil source rocks in Hanna trough probably culminated by 95 Ma with filling of the western end of the superposed Colville foredeep.

The complex structural history of Chukchi shelf has created many structural and stratigraphic-wedge traps that are favorably positioned to capture oil & gas migrating west out of a generation center in Hanna trough. MMS seismic mapping has identified over 800 untested prospects, with a small fraction having closure areas that surpass the productive areas, 150,000 and 200,000 acres respectively, of the Prudhoe Bay (13,700 Mmbo) and Kuparuk (2,900 Mmbo) oil fields. The large potential traps combined with favorable petroleum geology indicate that the Chukchi Sea has the potential to become a major area of future petroleum supply. Despite the remoteness and high costs of operating in the Chukchi Sea, at oil prices of $60/bbl, 14.5 Bboe or nearly half the Chukchi oil and gas could be economic to develop (MMS 2006).

References: AK DOG, 2004, Annual Report, http://www.dog.dnr.state.ak.us/oil/products/publications/annual/report.htm; MMS, 2006, Offshore Oil and Gas Assessment, http://www.mms.gov/alaska/re/reports/2006Asmt/index.HTM