AAPG Annual Meeting
Denver, Colorado
June 3-6, 2001

W.A. King1, B.R. Mills1, Scott Gardiner2, A.A. Abdellah3 (1) Nexen Inc. (Formerly Canadian Occidental Petroleum Ltd.), Calgary, AB (2) Nexen Inc. (formerly Canadian Occidental Petroleum Ltd.), Calgary, AB (3) Yemen Ministry of Oil and Mineral Resources (MOMR), Yemen

The Masila Fields, Republic of Yemen

Masila Block 14 is operated by Canadian Occidental Petroleum Yemen on behalf of its partners Occidental Peninsula, Inc. and Consolidated Contractors International, Ltd., and is located in the Hadhramaut region, in east-central Republic of Yemen. Oil was first discovered on the Block in late 1990 with Commerciality declared in late 1991. Oil production at Masila began in July 1993. There are now 14 known fields containing 56 pools within the Masila Block. Total proved ultimate recoverable oil reserves are approaching 900 million STB. Proven, probable and possible reserve estimates are in excess of one billion barrels of recoverable oil.

The Masila fields are in the Jurassic- to Lower Cretaceous-aged, Saar Graben. Almost 90% of the Masila reserves are reservoired in the Lower Cretaceous Upper Qishn Clastics Member of the Qishn Formation. Oil is also found in at least seven other reservoirs consisting of Lower Cretaceous and Middle to Upper Jurassic age clastics and carbonates as well as fractured granitic basement.

This talk focuses on the main producing horizon; the Upper Qishn Clastics Member. The Upper Qishn represents an upward transgressive sequence from braided river deposits into tidally influenced shorelines, overlain by subtidal and shelf deposits. The Qishn reservoir sandstones have both high porosity (18-21%), and high permeability (<10 Darcies). They are relatively homogenous and continuous in the lower section and are more heterogeneous in the middle-upper section. The uppermost marine sandstones are more mature and very homogeneous. The major field accumulations are tilted, normal, fault block structures located over basement paleohighs, and are dependent upon juxtaposition against overlying Qishn carbonates. The carbonate-dominated pre-Qishn section, including the source rock, is not present on the paleo-highs, and is thickest in the basement lows. The main identified source rock is the Madbi Shale, a Type II marine source which is mature in 'kitchens' adjacent to the structural highs. Secondary oil migration occurred upward along fault planes to the overlying traps.

Seismic acquisition in the Masila block has been difficult and expensive because of the remote location, rugged topography and rocky desert terrain. The land surface is incised by deep, wadis or canyons. To date, four 3D seismic programs totalling 162 mi2 (414 km2), and 1,415 miles (2,264 km) of 2D data have been acquired. Processing and interpretation problems are significant due to a low velocity surface layer, scattered seismic energy, poor signal to noise ratio from numerous canyon walls, and to "fault shadow" velocity anomalies overlying many of the the tilted fault block culminations.

The biggest production challenge in these fields is water handling. Much water is produced along with the oil, due to a combination of medium gravity (15-33 API^{o}) moderate viscosity oil, high reservoir permeability and a strong regional acquifer. The Upper Qishn oil is undersaturated in gas (average GOR is 3 to 7 SCF/bbl) requiring electric submersible pumps to provide sufficient artificial lift for the large volumes of produced fluid.

At end of December 1999, the daily production rate collectively for all fields was 210,000 STB/D, with 680,000 BWPD and 6.5 MMCF/D solution gas. Cumulative oil production is over 400 million STB. Initial average well oil production rates vary by producing zone, but fall in a range of 1500 to 15,000 STB/D, with many wells producing from more than one reservoir zone with minor commingling.

Oil and water are produced in the fields, transported via pipeline to the Central Processing Facility (CPF), where most fluid separation occurs. Increasingly, separation of oil and water is being performed at individual fields using hydrocyclones before entering the CPF. Produced water is re-injected into the reservoirs. The clean oil is moved to the southern coast via an 85 mile long (140 km) 24" pipeline. Export oil is then loaded onto offshore tankers, via a Single Buoy Mooring system (SBM) located 1.25 miles (2 km) offshore, near Mukulla.