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WAVREK, D.A., D.K. CURTISS, (EGI, University of Utah, Salt Lake City, Utah, U.S.A.); D. SHLYGIN, E.S. VOTSALEVSKY, (IGS, Academy of Sciences, Almaty, Kazakstan); J.L. SMALE, (Texaco, Houston, Texas, U.S.A.), and O. NAVROTSKIY, (Volgageolcom, Saratov, Russia)

Petroleum Systems of the Pricaspian basin: Kazakstan and Russia

This paper concentrates on defining the number and extent of petroleum systems within the Pricaspian basin, Kazakstan and Russia. Analysis of more than 400 potential source rocks and 225 crude oils concludes that a number of genetic oil families are present. The oil samples are representative of the production in the basin; all major fields in the post- and pre-salt stratigraphic complexes are included. The primary criteria for oil subset definition are based on the correlative source rock lithology; 58 percent of the samples are associated with clastic source rocks with the balance attributed to carbonate source rocks. The oils associated with carbonate source rocks account for the largest accumulations in the pre-salt reservoirs, although oils correlated to elastic source rocks are more commonly encountered in the post-salt reservoirs. The reason for the latter observation is related to producibility; post-salt reservoired oils are commonly determined to have been altered by biodegradation. The study documents that the carbonate sourced oils degrade to high sulfur (>1.5%) and low gravity (10-15°API) products, whereas elastic sourced oils degrade to producible low sulfur (<0.5%) and medium gravity (20-25°API) products. Furthermore, productive reservoirs in the post-salt complex usually contain a mixture of biodegraded oil plus a secondary charge of undegraded oil, whereas the non-productive "tar sands" did not receive the secondary hydrocarbon charge.

The source rock facies that charge the giant fields on the perimeter of the basin are restricted to the paleozoic pre-salt complex. Effective petroleum source rocks are identified from the Middle to Upper Devonian carbonates, Lower Carboniferous carbonates, Upper Carboniferous to Lower Permian clastic basin fill, and the Triassic post-salt sequences. Models for the source rock deposition are developed: clastic source rock facies in shelfal and distal condensed sections, the intersection of the oxygen minimum zone with the carbonate platform and ramp, and inter-dome depressions developed from salt withdrawal. The migration model for the post-salt oilfields relies on a combination of "salt windows" and local generation of oils in the inter-dome areas. Source rock potential in the post-salt complex is expected to increase in importance as exploration activity moves toward the basin center. Collectively, the results are used to demonstrate the existence of at least 4 effective petroleum systems.