

**AAPG Annual Meeting
March 10-13, 2002
Houston, Texas**

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Depositional Controls on Oil Family Composition Based on a Biomarker Calibrated Rock-to-oil Correlation Model from the Turpan-Hami Basin, NW China

The Turpan-Hami basin is a nonmarine, petroliferous, intermontane basin nestled within the Tian Shan orogenic belt of NW China. Based on a variety of molecular geochemical properties that reflect environmental conditions of the depositional source facies, oils produced throughout the basin form statistically distinct groups that span the various sub-basins of Turpan-Hami. Located in the northern sub-basin (Taibei Depression), Group 1 oils are isotopically heavy, freshwater, low algal, land plant-derived oils that characteristically contain high proportions of C₂₉ steranes, C₁₉ tricyclic terpanes, C₂₄ tetracyclic (17,21-secohopane series) terpanes, elevated pristane/phytane ratios, and are rich in the diterpanes 17-norphylocladane and norisopimarane. Also located in the Taibei Depression, Group 2 oils are isotopically heavy, freshwater, more algal-rich-derived oils that have high proportions of C₂₇ steranes, triaromatic dinosteroids, C₃₀ ethylcholestane, and high tetracyclic polyprenoid (TPP) ratios. Found only in the southern and western sub-basins (Tainan and Tokesun Depressions), Group 3 oils are isotopically lighter, anoxic, saline lacustrine, algal-derived oils that preserved high proportions of phylocladane, androstane, gammacerane, beta-carotane, and high C₃₅/C₃₄ homohopane and TPP ratios.

Field investigations of both outcrop and core intervals, combined with subsequent geochemical screening of proposed source rocks, identified three principle types of source rock facies. A rock-to-oil correlation model using a variety of biomarker parameters that reflect source rock depositional conditions that are indexed to rock samples from interpreted depositional environments positively correlate the oil groups to these main source rock facies: Group 1 oils-Lower/Middle Jurassic peatland/swamp facies, Group 2 oils-Lower/Middle Jurassic marginal lacustrine facies, and Group 3 oils-Upper Permian lacustrine facies. Mixtures between Groups 1 and 2 also exist.