A 3-D Petroleum System Model for the San Joaquin Basin, California

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Acalibrated model, constructed using PetroMod software, depicts the geometry and three-dimensional (3-D) evolution of petroleum systems in the San Joaquin Basin, California. Input for the calculation included a omprehensive, 3-D structural-stratigraphic model of the basin, and regional maps of heat-flow and lithofacies variations. Stable carbon isotope and biomarker data identify four principal oil types that correlate to four different source rocks: the Miocene Antelope Shale, and the Eocene Kreyenhagen, Oligocene Tumey, and the Cretaceous Moreno formations. The two principal source rocks in the model, the Antelope and Kreyenhagen formations, were modeled using Type IIS and Type II kerogen kinetics, respectively.

The modeling and geochemical evidence indicate that maximum burial of the source rocks occurred in latest Pliocene to Pleistocene time. Except on the west flank of the basin, where steep dips in outcrop and seismic data indicate substantial uplift and erosion, only a minor amount of section was eroded. The Antelope and Kreyenhagen petroleum systems generated at least 15 billion barrels of recoverable oil and 19 trillion ft_3 of recoverable gas in the PetroMod calculation. Most petroleum migration occurred during the Late Cenozoic in distinct stratigraphic intervals along eastwest pathways from "kitchen" areas beneath the west-side fold belt to updip sandstone reservoirs on the stable northeastern basin shelf.

PetroRisk was used to assess the relative importance of different input parameters in controlling the predicted volumes and compositions of accumulated petroleum. Tornado diagrams show that the key variables include kerogen kinetics and initial hydrogen index prior to thermal maturation. Lithology was also a key variable controlling petroleum expulsion from the Antelope siliceous shales. Satisfactory model runs for our model required about 3 hours of computation time using parallel processing on a Linuxbased Beowulf cluster.