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Elephant hunting in Nevada

SPEAKER

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The central Nevada thrust belt provides an opportunity to explore for giant oil and gas fields. Thick, thermally mature, organic-rich, lacustrine oil shales deposited in the Mississippian Antler basin flood plains are the source beds for the fifty million barrels of oil already produced in Nevada. Karsted unconformities, stromatoporoid reefs, impact breccias, and sandstones make Nevada's Devonian reservoir rocks most favorable for giant accumulations. Late Cretaceous thrusting created the compressional features of the prolific Canadian foothills, Utah/Wyoming thrust belt and the central Nevada thrust belt.

Typically, oil seeps are associated with oilbearing thrust belts worldwide. However, a blanket of Tertiary volcanics sealed in many of Nevada's oil seeps and concealed Nevada's thrust belt. Some of these seeps, including Grant Canyon, Blackburn, Trap Spring, and Eagle Springs oil fields, built up enough oil to become commercial. So far, all of Nevada's crude has been produced from these commercial oil seeps. Little effort has been expended to identify the source of these commercial oil seeps because of the lack of an accurate geologic map and model. In contrast to other states, the State of Nevada has never surveyed its mineral potential. The cursory geologic mapping by the federal government is not adequate for exploration purposes. Old depositional and deformational models, based on insufficient data, have been entrenched into the literature, thus impeding exploration.

An old model championed by the United States Geological Survey is the theory that the Mississippian Antler Basin siliciclastics were deposited as flysch turbidites into a deep foreland basin between the Antler highlands in central Nevada and the Utah hingeline in central Utah. However, new field data indicates regressive sequences containing vascular plant roots (Stigmaria) penetrating bedding planes and lacustrine palynomorph assemblages. This new data dispels the old model and supports a new depositional environment model. The new model shows that the richest and most oilprone Mississippian source rocks are lacustrine oil shales. Lacustrine oil shales make oil exploration in the Antler Basin very attractive. Cumulative thicknesses of these world-class lacustrine oil source rocks are measured in thousands of feet in outcrops and wells. They are thick enough and rich enough to generate trillions of barrels of oil.

Until the early 1980s the typical exploration practice in Nevada was to drill just the Tertiary valley fill in synclines. Therefore, most of the eight hundred wells drilled in Nevada penetrate only syncline Tertiary valley fill. Few wells have penetrated any Paleozoic section. However, two significant fields were found by drilling "too deep" and penetrating Devonian rocks below the Tertiary unconformity. Oil flows from Devonian reservoirs in the Blackburn and Grant Canyon oil fields. One well in Grant Canyon flowed 4,000 barrels a day for ten years. It has now produced more than 15,000,000 barrels of oil since its discovery in 1983. The Grant Canyon reservoir consists of 200 to 400 feet of karst breccia at the top of the Middle Devonian Simonson Formation. This karst interval is found in wells and measured sections throughout the eastern Great Basin. In addition to the karst interval, stromatoporoid reefs, impact breccia, quartz sandstones, and other intervals provide world-class reservoir rocks within the eastern Great Basin Devonian sequences.An isopach of all the Devonian sequences reveals a structurally compressed basin – the Sunnyside Basin – and can be used to predict the spacial distribution of potential Devonian reservoir rocks. The Simonson karst breccia interval alone has the capacity to store billions of barrels of oil in certain structures.A careful analysis of logs from the few wells that penetrated other significant portions of Paleozoic rocks shows that, contrary to preconceived notions, many intervals contain similar reservoir rocks.

Another deeply entrenched notion that discouraged exploration investment is that the north-south structural grain of the eastern Great Basin was caused by Tertiary extension, which could have compromised seals on older, compressional structures. However, new mapping is revealing many uncharted compressional features and a lack of extensional features. The new maps demonstrate that the region underwent much more compression than previously thought. Furthermore, some of these features show no evidence of being broken by major Tertiary extensional faults. Several unbroken compressional structures in the Timpahute Range, 50 miles south of the prolific Grant Canyon field, are exposed.

Another example of an intact compressional feature is the Golden Gate fault fold 40 miles south southeast of the prolific Grant Canyon field and ten miles north of the Timpahute Range. The Golden Gate fault fold is ten miles long and five miles wide and has more than five thousand feet of closure. It may have trapped billions of barrels of oil before it was breached by headward erosion of the Colorado River. New mapping reveals that no Tertiary extensional faults compromise the structure. Similar structures, along strike that have escaped erosion, likely contain billions of barrels of oil and trillions of cubic feet of gas. Oil seeping from these giant fields is probably the source for the commercial oil seep fields in Nevada. However, old opinion and theories based on little or poor geologic mapping have obscured the true understanding of Nevada geology for at least five decades. As a result, past oil exploration efforts in Nevada based on old tectonic and depositional models have been disappointing.

BIOGRAPHY

Alan K. Chamberlain received his B.A. and M.S. from Brigham Young University and his Ph.D. from Colorado School of Mines. His dissertation Structural Geology and Devonian Stratigraphy of the Timpahute Range, Nevada, provides a new exploration model that could lead to significant discoveries in this frontier region. After he worked for Exxon, Gulf, Marathon, and Placid, he became president of Cedar Strat Corp. in 1984.

Cedar Strat was organized at the request of several major oil companies to fill a need for exploration data for Great Basin exploration. Alan conceived the idea of using a scintillation counter to create a surface gamma-ray log of measured sections while working for Gulf Oil after having worked for Exxon Minerals USA in uranium exploration. It was not until Placid hired him away from Marathon to head up their Great Basin program that he had the freedom to test the idea. At Placid, Alan had the unique opportunity to visit many of Shell Oil Company's staked measured sections by helicopter with former Shell geologists. They had been involved in measuring the sections in the 1950s and 1960s. Using the Shell measured sections he learned the Paleozoic stratigraphy of the Great Basin. As he re-measured many of the sections, he applied his new technique of surface gamma-ray logs. He earned the Best Poster of the Session Award at the 1983 National American Association of Petroleum Geologists when he presented his work on surface gamma-ray logs in the Wyoming thrust belt and in the Great Basin. His abstract and subsequent paper attracted the attention of national and international oil companies that have applied his surface gamma ray log technique worldwide. Development of this successful technique resulted in the formation of Cedar Strat Corp in 1984. A presentation to the American Association of Petroleum Geologists of the results of Alan's new, sequence stratigraphic model of the Mississippian Antler Basin including lacustrine source rocks secured him the Levorson Award in the late 1980s.