The Triassic Sag River Sandstone, North Slope Alaska: An Example Of Shelf Sandstone Deposition Under The Influence Of Upwelling

By Dr Michael D. Wilson (QLD Branch, May 1999 Luncheon Meeting)

Abstract

The Upper Triassic Sag River Sandstone is a thin, marine sandstone unit of sheet-like geometry developed in a 160 km wide belt paralleling the coastal portion of the North Slope of Alaska. Though one of the minor reservoir units in the Prudhoe Bay Field, the Sag River Sandstone may be one of the largest shelf sandstone reservoirs in the world. In place oil and gas accumulations in the unit have been estimated to be as much as several billion barrels.

The body of the Sag River Sandstone consists of bioturbated, slightly argillaceous, glauconitic, coarse siltstones and very fine-grained sandstones. Thin, upper and lower transition zones consist of bioturbated and locally very glauconitic mudstones and argillaceous siltstones. Primary sedimentary structures are absent in all cores studied. Syndepositional phosphate nodules are common in zones near the base and top of the unit. Sponge spicules, preserved only as moulds within phosphate nodules, are estimated to have originally formed between 10 to 20% of the detrital fraction.

The body of the Sag River Sandstone represents a single progradational sequence. Grain size and sorting increase and matrix content decreases upwards from the base of the unit. A Cruziana burrow assemblage occurs at the base of the unit and a Skolithos assemblage occurs in the upper portion of the unit.

The Sag River Sandstone is the product of a depositional regime in which upwelling oceanic waters played a significant role. Upwelling of cold, deep ocean waters was probably associated with coastal aridity that severely limited fluvial sediment supply. This in turn promoted intense bioturbation and fostered the generation of significant amounts of sponge spicules, phosphate nodules, and glauconite. Moderate wave energies were required to maintain high levels of framework grain sorting and relatively low detrital matrix content. Upwelling appears to be a major control on the composition, texture, and bedding of shelf sandstones and has largely been ignored in the formulation of previous models for such deposits.

Sequence stratigraphic interpretations of the Sag River and underlying Shublik units, hinge on the relative water depths of the uppermost Shublik bioclastic carbonates and lowermost Sag River mudstones, and on whether an unconformity occurs between these units. Correlations within, and isopach data for, the upper Shublik Formation in Prudhoe Bay field suggest that little or no erosion has affected this unit. The relatively abrupt shift from Shublik limestones to Sag River mudstones is interpreted to be primarily the result of increased clastic influx. This increase may have been controlled by variations in climate in the source terrane and/or degree of upwelling offshore, and was not the result of erosion due to either tectonic uplift onshore or a relative sea level drop. Inability to study the nearshore/nonmarine equivalents of these units makes aspects of this interpretation difficult to verify.

Brief Biography

Dr Michael Wilson is a consulting petrographer and sedimentologist specialising in the areas of clastic diagenesis and reservoir quality prediction. While employed in research groups at Cities Service Oil and Exxon, and as an independent consultant, he has worked extensively in areas such as Alaska, the North Sea, and the western USA. He has taught and published on various aspects of clastic reservoir quality prediction and was formerly Dean of the Reservoir Geology School at Exxon Production Research and Chairman of the SEPM Continuing Education Committee.