

**AAPG Annual Convention
Salt Lake City, Utah
May 11-14, 2003**

A Case for Cores: The Reservoir Geology of ERT (Penn Sand) Field, Potter Co., Texas

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The ERT (Penn Sand) Oil Field was discovered in 1991 by Horizon Oil and Gas. It is situated in the northern Palo Duro basin. Seven total wells were drilled by 1994 with a 71% success ratio (5/7). At this time the field was only partially developed and only a southern limit to production was evident. In 1995 Tide West Oil Company acquired the field based on an estimated EUR of 1MMBO from producing wells and another 460 MBO recoverable via two proved undeveloped locations. The Penn Sand log signatures indicated a low-contrast shaley sand ranging from 70 to 100 feet thick and broken by 1 to 3 foot thick beds with little or no porosity. Because of the internal tight beds, the reservoir was interpreted to be highly heterogeneous and therefore not valued as a suitable candidate for secondary waterflood recovery. Tide West continued to develop the field in 1995 drilling eight wells with an 88% success ratio (7/8). The analysis of whole core taken from two of these wells indicated the reservoir is a ripple laminated, very fine to fine grain, shaley sandstone turbidite. Lithology is lithic arkose to feldspathic litharenite. The cores revealed that the "tight beds" interpreted from the logs were actually irregularly shaped regions of cemented sandstone in which nearly all the porosity was occluded by diagenetic cementation. The contact between cemented and non-cemented sand was about three sand grains wide or less than one millimeter. The contacts cut across sedimentary structures and bed boundaries and ranged from sub-parallel to bedding to vertical within the four inch dimension of the core face. Some cemented intervals may be continuous at the inter-well scale, but most are not. Porosity distribution was bi-modal, clustering from 11 to 16% for uncemented zones and 3 to 6% for the cemented intervals. The pore system is very fine (pore throats 5-10 microns) yet homogeneous. Because the transition between porosity regimes was less than one millimeter, the open-hole logs understated porosity significantly in zones less than 1.5 feet or the approximate resolution of the tool. Schlumberger's Formation MicroImager tool (FMI) successfully resolved the complex contacts between cemented and uncemented sandstone porosity. The dominance of a single sedimentary process indicates the potential for a certain lateral continuity and isotropy. The reservoir is highly heterogeneous on a small scale, but very likely laterally and vertically continuous on the inter-well scale. Because of the core studies, Tide West ultimately concluded a waterflood was feasible. Estimated secondary recovery potential was 3 MMBO, with a 1996 present value of nearly 20 MM\$.