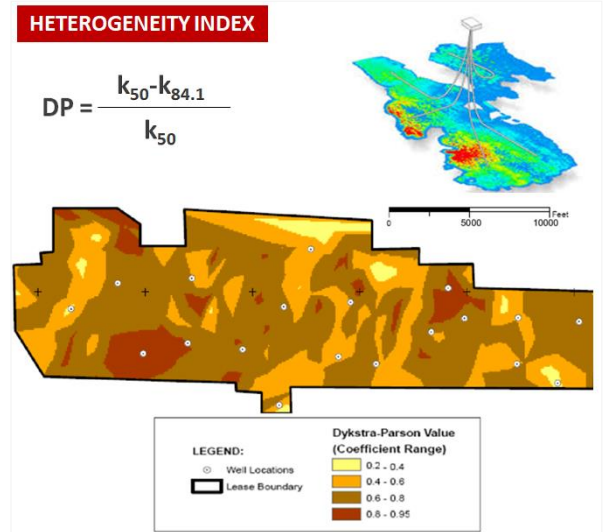




# GEOLOGICAL SCREENING FOR THERMAL EOR

## RESERVOIR HETEROGENEITIES

Conventional screening methods are supported in worldwide statistics for EOR projects data bases executed for different NOC'S and IOC'S. These specific criteria are mostly related to **average** petrophysical properties, fluids properties and reservoir condition. The literature tends to idealize the reservoir properties, for this reason many scientists has introduced the term **Geological Screening**, in order to consider the **reservoir heterogeneities** as a key variable in the decision for implementation any scheme or method for thermal EOR projects. The estimation of different heterogeneity indexes have been developed by several scientist and engineers, one of the most used is the Dykstra Parson Coefficient (considering permeability variations) which can be projected in 2D and 3D maps to get a real perspective for the homogeneous (0) and heterogeneous zones (1) within the reservoir in order to select the appropriate pattern for thermal EOR (SAGD, HASD, Steam Flooding).



## GEOLOGICAL SCREENING

		Lateral Heterogeneity		
		Low	Moderate	High
Vertical Heterogeneity	Low	Wave-dominated delta Barrier core Barrier shore face Sand-rich strand plain (9)	Delta-front mouth bars Proximal delta front (accretionary) Tidal deposits Mud-rich strand plain (7) / [3]	Meander belts* Fluvially dominated delta* Back Barrier* (0)
	Moderate	Eolian Wave modified delta (distal) (9) / [2]	Shelf barriers Alluvial fans Fan delta Lacustrine delta Distal delta front (83) / [9]	Braided stream Tide- dominated delta (52)
	High	Basin-flooring turbidites (19)	Coarse-grained meander belt Braid delta (2)	Back barrier** Fluvially dominated delta** Fine-grained meander belt** Submarine fans** (4)

\* Single Units \*\* Stacked System

The geological screening process is a key stage in the EOR project planning, it must be considered as a complementary phase for the conventional screening techniques. The geological characteristics such as depositional environments, geology age, lithology, type of structure and diagenesis process have strong influence in the Vertical and Lateral heterogeneities within the reservoir. According to this perspective by reviewing technical data bases in technical literature it has been documented 200 steam flooding projects in sandstone reservoirs, then these information was plotted in the **Tyler and Finley (1991) heterogeneity matrix**. Of the 200 steam flooding projects described, 185 and 15 were reported by the operators as successful and failed respectively. Another important aspect in thermal EOR is the presence of an active aquifer that may lead to steam segregation and important heat losses. Following up the previous matrix, it is a powerful tool based on field experience from which it can be validate the impact of reservoir

heterogeneity in project success. Others methods suggested by Henson, Todd and Corbett (2002) when the dimensions of sand bodies or genetic units (length, thickness, and width) and current or proposed well length and spacing are known, horizontal and vertical heterogeneities indexes can be estimated through simple equations. In this approach, the lateral heterogeneity index (LHI) is estimated for different "genetic unit mean lengths" (GUML) and completed well intervals, while the vertical heterogeneity index (VHI) is estimated for different "genetic unit mean thicknesses" (GUMT). Consequently, for SAGD projects for example The lower the heterogeneity indexes (negative values), the higher the probability that a SAGD well pair will be in the same sand body (sand channel). Low indexes provide good opportunities for developing stable steam chambers and thus SAGD projects (environments of low to moderate lateral and vertical heterogeneities).

$$LHI = -\log \frac{GUML}{Well\ Spacing} \quad VHI = -\log \frac{GUMT}{Gross\ Pay\ Thickness}$$

The main idea of screening techniques is to support the asset team and the decision maker with enough information to select the suitable EOR scheme or rank projects against other investment opportunities at the early stage of evaluation, thus, **considering geological screening can complement the risk management strategies of a particular oil company or investor.**