Application of Shallow Water Well Data to Understanding Fracture Controlled Flow Systems in the Western Canada Sedimentary Basin

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Regional permeability trends are difficult to assess in the deep basin given the relative wide spacing of data points. The updip edge of petroleum hosting Paleozoic carbonates, which crop out in southwestern Manitoba, provides an analogue for studying reservoir heterogeneity of similar carbonates in the deep basin. Near surface Ordovician to Devonian carbonates form a major regional groundwater aquifer, the Carbonate Aquifer, with close to 80,000 water wells. Pump test data from these wells provide an ability to assess transmissivity on a regional scale. Results indicate that the Carbonate aquifer in southern Manitoba is a heterogeneous and anisotropic aquifer, wherein groundwater flow follows preferred-flow path networks. Specific capacity tests show that aquifer transmissivity can vary up to four orders of magnitude within one km. Geostatistical analysis reveals a strong anisotropy in the transmissivity field, with better spatial continuity in NE-SW and NW-SE directions. We show that preferential flow paths are coincident with the dominant orientations of fractures observed in bedrock exposures. Similar relationships between transmissivity and fracture patterns are observed in the Paskapoo Formation of southwester Alberta. On a regional scale theses near surface fracture systems appear to be related to the in situ stress field for the basin. Weyburn EOR results and a regional studies of oil mixing are consistent with regional fracture trends, similar to those observed in the near surface, are influencing fluid movement in the deep basin. Suggest that deeper strata may similarly have preferential fracture networks controlling fluid flow.