Assessing Permeability in Bioturbated Media

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In the past, trace fossil research in hydrocarbon reservoir rocks was almost always confined to exploration geology, however, recent research is showing that ichnology has significant applications in production geology. Current research indicates that substrate controlled ichnofossil assemblages can enhance the permeability and vertical transmissivity of a relatively impermeable matrix. Permeability enhancement develops when burrows into a firm ground are filled with sediment from the overlying strata. If the lithology contrasts with the encapsulating firm ground substrate, anisotropic porosity and permeability is developed. The same concept can be applied to carbonate reservoirs where the burrows are subjected to different diagenetic phases. This again results in anisotropic permeability that can have dramatic effects on reserve calculations. If the burrows have enhanced permeability reserve calculations will be too low. Likewise if the burrows have lowered permeability the reserve calculations may be too high. Understanding the flow dynamics of the anisotropic permeability provides a potentially powerful reservoir development tool. The implications of such understanding are far reaching, particularly pertaining to calculations of reserves and deliverability. Permeability enhancement in bioturbated media has been recognized in five inter related scenarios: 1) Surface constrained textural heterogeneities; 2) Non-constrained textural heterogeneities; 3) Weakly defined textural heterogeneities; 4) Diagenetic textural heterogeneities; and 5) Cryptic bioturbation Specific examples will be drawn from the Ordovician Yeoman Formation in Saskatchewan, the Devonian Wabamun Formation in Alberta, the Triassic Sag River Formation in Alaska, the Jurassic Arab D in Saudi Arabia, and the Miocene Mirador Formation in Columbia.