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HOW FAST DOES GAS MIGRATE ?

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ABSTRACT

After generation, petroleum migrates through fine grained water-wet rocks into more permeable carrier beds and is trapped beneath seals. However, these seals are rarely perfect and considerable leakage is both expected and observed. The mechanics of this process are well established but little is known of the absolute rates, or of how oil and gas are able to pass freely through highly overpressured sediments in which the water is retained. The apparent difference in flow rates between petroleum and water is too great to account for by the additional buoyancy of the petroleum or conventional relative permeability arguments. Part of the problem may be caused by the state of water in mudrocks, in which most of it bound to clays and thus immobile. By assuming Poiseuille flow of oil and gas through the pore network of shales, it can be shown that modeled flow rates for oil are about two orders of magnitude faster than for water. Calculated gas flow rates through typical mudstones are in the region of 2-5 km/Ma, equivalent to gas fluxes of 0.4-1.0 m^3 STP gas/m^2/year (15-35 ft^3).

In order to test these ideas, measurements of gas fluxes for three seepage sites on the European continental shelf are compared with predicted flux rates from depth. In addition, data are presented from the central Malay Basin in which a dynamic seal system is in the process of bleeding off gas while retaining water in the highly overpressured zone beneath.

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