*Petromall Ltd*

# Near-surface manifestations of micro-seepage

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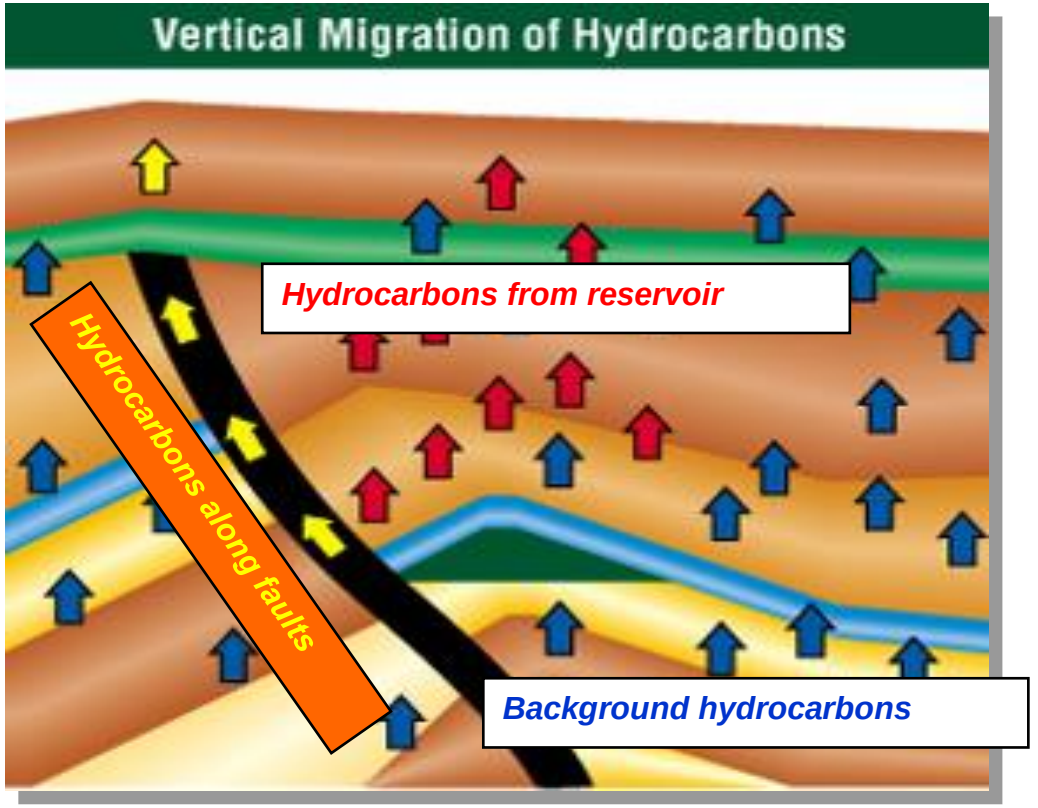
# Vertical Migration




*Macroseepage:*
*Detectable in visible amounts*
*Pathway follows discontinuities*
*Offset from source/reservoir*

*VS*

*Microseepage:*
*Detectable in analytical amounts*
*Pathway is nearly vertical*
*Overlie source/reservoir*

# Vertical Migration - Microseepage

Four possible mechanisms:

1) Diffusion - gradient movement of dissolved gases

2) Aqueous transport - movement in ascending water

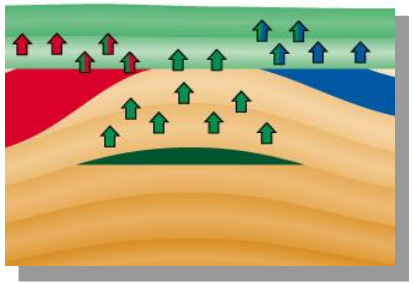
3) Continuous gas phase flow

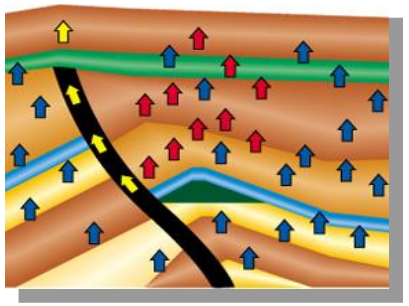
Favoured mechanism:

4) Microbuoyancy - transport in buoyant microbubbles

- Direct surface projection of reservoirs
- Migration in the absence of faults
- Rapid changes in surface anomalies as production starts

***"Vertical Migration Mechanisms"***





*Klusman, R.W., and M.A. Saeed, 1996, Comparison of light hydrocarbon microseepage mechanisms, in* ***D. Schumacher and M.A. Abrams, eds., Hydrocarbon migration and its near-surface expression: AAPG Memoir 66****, pp. 157-168.*

*Brown, A., 2000, Evaluation of possible gas microseepage mechanisms, AAPG Bulletin, pp. 1775-1789.*

# Summary of the basic reactions & processes

1. Hydrocarbons, chiefly methane through pentane, migrate upwards from source rocks and reservoirs to the surface
2. When upward-migrating light hydrocarbons reach near-surface oxidizing conditions, aerobic hydrocarbon-oxidizing bacteria consume methane (and other light hydrocarbons) and decrease oxygen in pore waters.
3. With this development of anaerobic conditions, the activity of sulphate-reducing bacteria results in sulphate ion reduction and oxidation of organic carbon to produce reduced sulphur species and bicarbonate ion.
4. Highly reactive reduced sulphur species can then combine with iron to form iron sulphides and oxides. Iron sulphide can be in the form of pyrite, marcasite, magnetite, pyrrhotite, greigite, or maghemite.
5. As a result of bacterial sulphate reduction, sulphate ion concentration is decreased. In addition, bicarbonate is added to pore waters, raising pH and thus promoting precipitation of isotopically light, pore-filling carbonate cements.

# Airborne Multi-Measurements

There are several choices:

1. Observation of changes in rock colours, for example, whitening of red beds.
2. Geophysical measurements, detecting ‘unusual’ minerals:
    a. Magnetic
    b. Electrical
    c. Gamma Ray
3. Impact on vegetation:
    a. Reflectivity
    b. ‘Health/Stress’
    c. => Links to agricultural expertise and experience