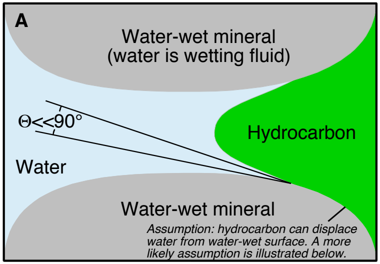
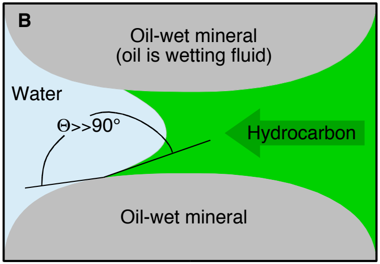
# Fluids, pores throats, wetting, and interfacial tension




The usual (compared to B) water-wet case: Cos(Θ) is near 1; resistance is maximally positive; work must be done to push hydrocarbon through pore.




The unusual (oil-wet) case: Cos(Θ) is near –1; resistance is maximally negative; hydrocarbon advances through pore. If this were common, we would not spend so much time worrying about migration (and not have as many seals).

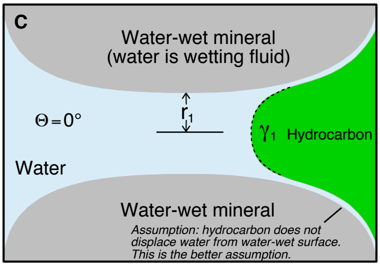
**Resistance pressure** (the pore's resistance to movement of the fluid that we envision moving) (a.k.a. "capillary pressure", bearing in mind that it is a pressure to be overcome, not a pressure exerted by the capillary (the pore throat))

$$\text{Resistance pressure} = \frac{2\,\gamma\,\text{Cos}(\Theta)}{r}$$

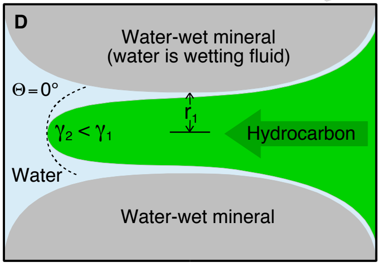
- $\gamma$: Interfacial tension (see note at bottom)
- $\Theta$: Contact angle, measured through the fluid that we do not envision moving (almost always water)
- $r$: Radius of pore throat

*Two different assumptions about fluid-surface interaction**

Migration

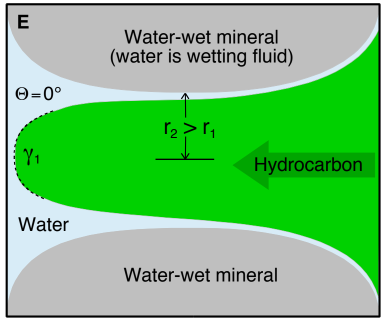



No migration of hydrocarbon with pressure presently exerted on hydrocarbon to overcome resistance pressure. See D and E.




Lesser interfacial tension of hydrocarbon (greater flexibility of hydrocarbon's interface with water) allows migration of hydrocarbon (with same pressure exerted on hydrocarbon to overcome resistance pressure).

or




Larger pore throat allows migration of hydrocarbon (with same pressure exerted on hydrocarbon to overcome resistance pressure).

*For an example of the "two different assumptions about fluid-surface interaction", see Figures 1 and 3 of Downey (1984, Evaluating seals for hydrocarbon accumulations: American Association of Petroleum Geologists Bulletin v.68, 1752-1763). The assumption inherent in the upper panels may be an artifact of portrayals of water and air in a vertical glass capillary, rather than oil and water in pores of rocks.*

To think about interfacial tension, imagine an un-inflated child's balloon and a finger of a very heavily constructed rubber glove. The fluids inside and out are the same (air, at atmospheric pressure inside and out), but the finger of the glove is stronger and returns to its original shape, whereas the un-inflated child's glove has little strength, and its shape is whatever gravity makes it. The finger of the rubber glove is the analog of the interface with greater tension.

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