Introduction
Wettability and importance for EOR

Workshop
Wettability characterization and alteration for heterogeneous carbonate reservoir rocks
Ingebrit Fjelde, NORCE, Norway
18 March 2019
Spontaneous imbibition Reservoir temperature

FW/SW mixture improved spontaneous imbibition of water, but SW only minor additional production.

Spontaneous imbibition of SW Reservoir Chalk

Effect of sulphate in FW

FW with sulphate concentration as in real FW gave higher spontaneous imbibition than FW without sulphate

Fjelde and Asen. Effect of Initial Sulfate in Reservoir Chalks on the Spontaneous Imbibition of Sea Water. 18th European Symposium IOR, Dresden, Germany, April 2015.
Spontaneous imbibition Limestones

Fjelde, 1998. Limestone example 1

FR = Formation water, SR = Surfactant as wettability modifier

Fjelde, 2006. Limestone example 2

Wettability modifier (WM)

FR = Formation water, SR = Surfactant as wettability modifier
130°C and 340bar

**Spontaneous imbibition Carbonated water vs FW**

- Different initial wettability
- CW spontaneous imbibition
  - FW $\rightarrow$ CW after $\approx$ 80 days
- Additional production

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Fjelde, Åsen and Zuta. Improvement of Spontaneous Imbibition in Carbonate Rocks by CO2-saturated Brine. 16th European Symposium IOR, Cambridge, UK, April 2011.
Ekofisk – Water flooding (WF)

- First
  - Pressure depletion estimate 18 OOIP%
  - Based on experiments, concluded WF low potential
- Later
  - Pilots much higher recovery than estimated
  - Increased suspicion against laboratory results (Sylte et al., 1988; Sulak, 1991)
- Current recovery estimate 50 %OOIP
- If first conclusion final, income due to WF would have been lost
Thank you

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