Drilling Fluids

Remove cuttings
cool and clean bit
lubricate drill assembly
control formation pressure
maintain wellbore stability
prevent lost circulation

Uses

Types of Drilling Fluids

• Water-based muds
  – Most common and least costly
  – Bentonite, dispersants, and NaOH added

• Oil-based mud; lots of +’s and –’s (see handout)

• Air drilling (see handout) <1000 psi, 500-800 cfm
  - Dry air
  - Misting
  - Foam
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Drilling a Well

Whether drilling vertical or horizontal, making hole depends on:

- Dip of beds
- Hardness and rock composition
- Bit design
- Drilling parameters
- Faulting
- Fracturing
Terminology of a directionally drilled well (slant-hole)
Typical build rates for horizontal wells

- **Short laterals ~ few hundred ft.**
  - Short radius
    - 1°–3° per ft

- **Intermediate laterals ~ few thousand ft.**
  - Medium radius
    - 8°–20° per 100 ft

- **Long laterals ~ several thousand ft.**
  - Long radius
    - 2°–6° per 100 ft
History of deviated/horizontal drilling

Bit deflection using *whipstocks*
- Limited control
- Missed targets

Positive-displacement motor *PDM*
- Improved directional control
- Inefficient

Steerable drilling motor
- Rotary and *sliding* modes controlled at surface
- Improved directional control
- Tortuosity from *slide* drilling limits horizontal reach

Rotary steerable system
- Continuous rotation
- Excellent directional control
- Improved borehole quality
- Increased rate of penetration
- Very efficient (but costly)
Bit deflection using whipstocks

- Limited control
- Limited applications
- Early but still utilized technology
PDM or positive displacement (mud) motor

Figure 1: A turbine converts hydraulic power in the drilling fluid into rotary mechanical energy.
These directional drilling assemblies use down-hole hydraulic motors (mud motors) which utilize circulated drilling mud pumped from the surface. The tool is positioned and then held stationary while hole is made by sliding the drill string downward and forward.

Steerable (non-rotating) drilling assemblies
Pushing a bit  
Pointing a bit  
Steerable drilling methods
PDC bit on a modern rotary steerable drill system RSD)
Steering section: assembly

Continuously orients the tilted bit shaft to control the drilling direction and the dogleg severity of the borehole.
MWD & LWD

• measure while drilling
• Log while drilling

Control system: electronics and sensor package take measurements to control steering assembly.
Alternatively, some systems use hydraulic power from the mud system to power the bit (mud motor).
What?

*Horizontal wells.*

Schlumberger Power Drive Rotary Steerable Assembly

Mud + Motor + MWD + LWD = **COSTLY horizontal wells.**
Grand Directions, LLC
Short Radius Drilling Tool

Reduce the cost of horizontal wells.

Rotary steerable assembly
Rotary steerable systems in 4 ¾”, 6 ¾”, 9” & 11” from Schlumberger
Major drilling tool suppliers

• Schlumberger
• Baker-Hughes
• Halliburton