MMS Arctic Technology Workshop

Arctic Offshore Drilling Basics

Anchorage, AK

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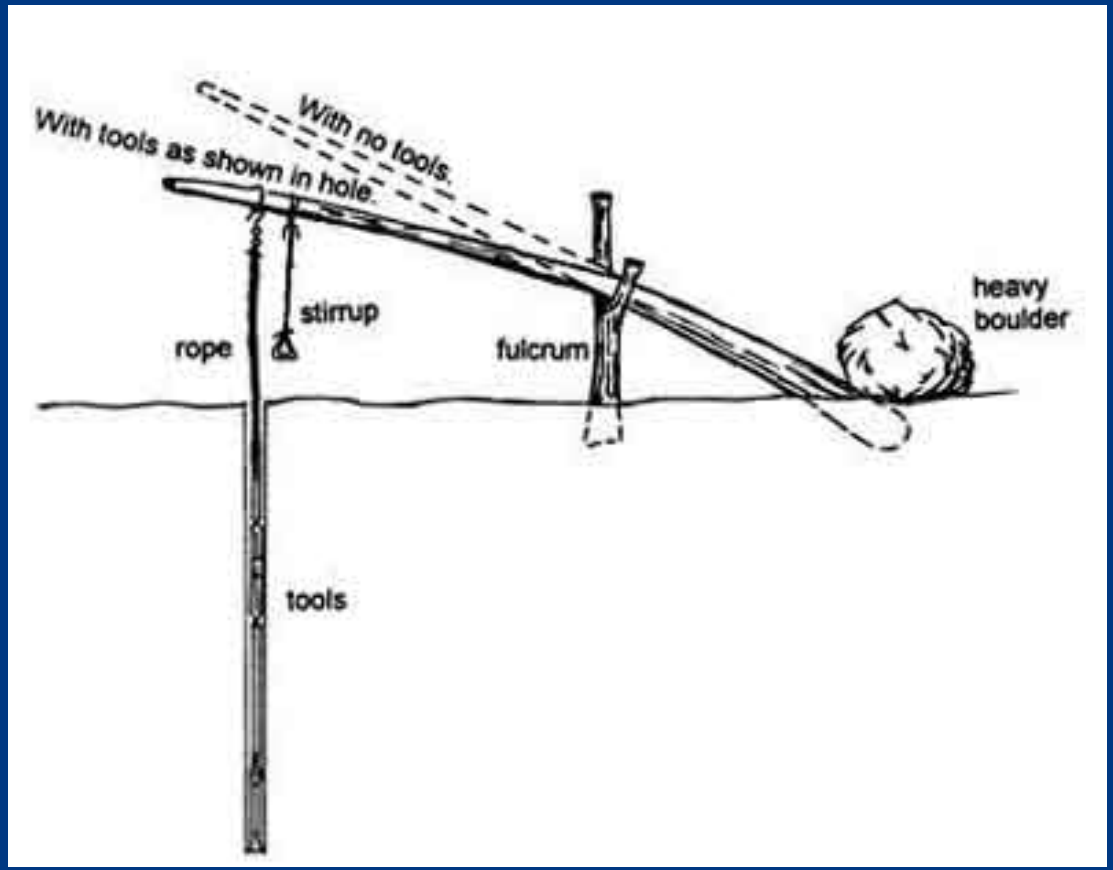
Shell E&P

Historic Drilling Methods

Spring Pole

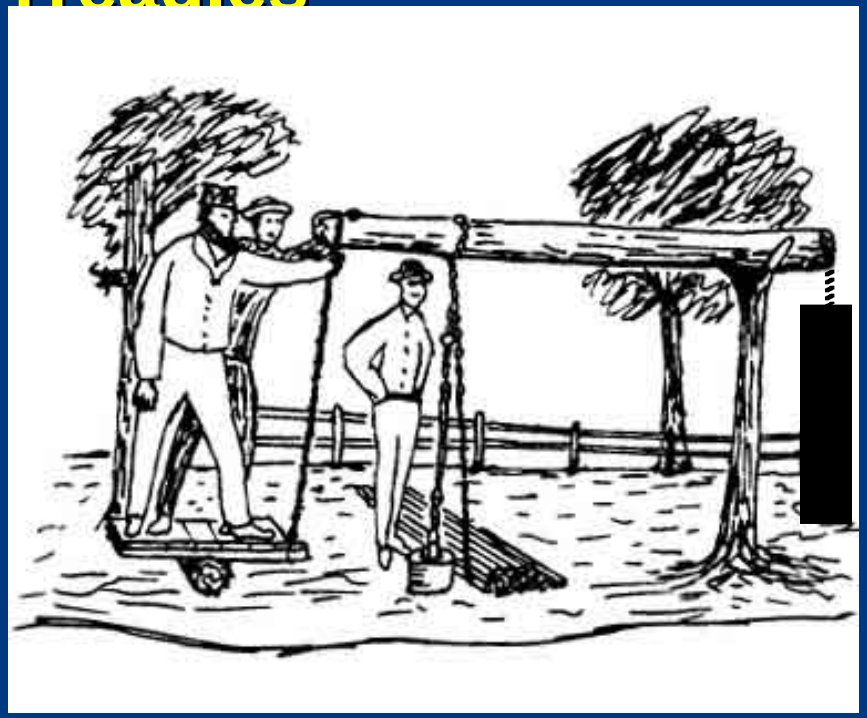


- Used in China over 3,000 years ago with bamboo poles
- All “human” powered
- Shallow wells only

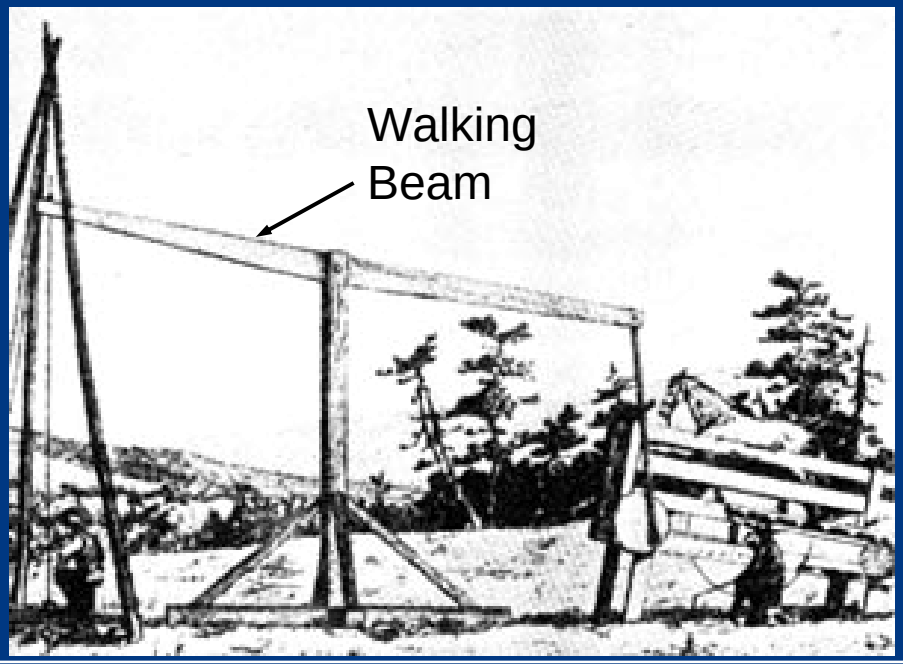
The first well drilled (not dug) in the US was inside the city limits of Charleston, WV, 1806-1808 by the Ruffner brothers to a depth of 58 ft using a spring pole. The well flowed brine used to make salt.

Historic Drilling Methods

See-saws and Treadles

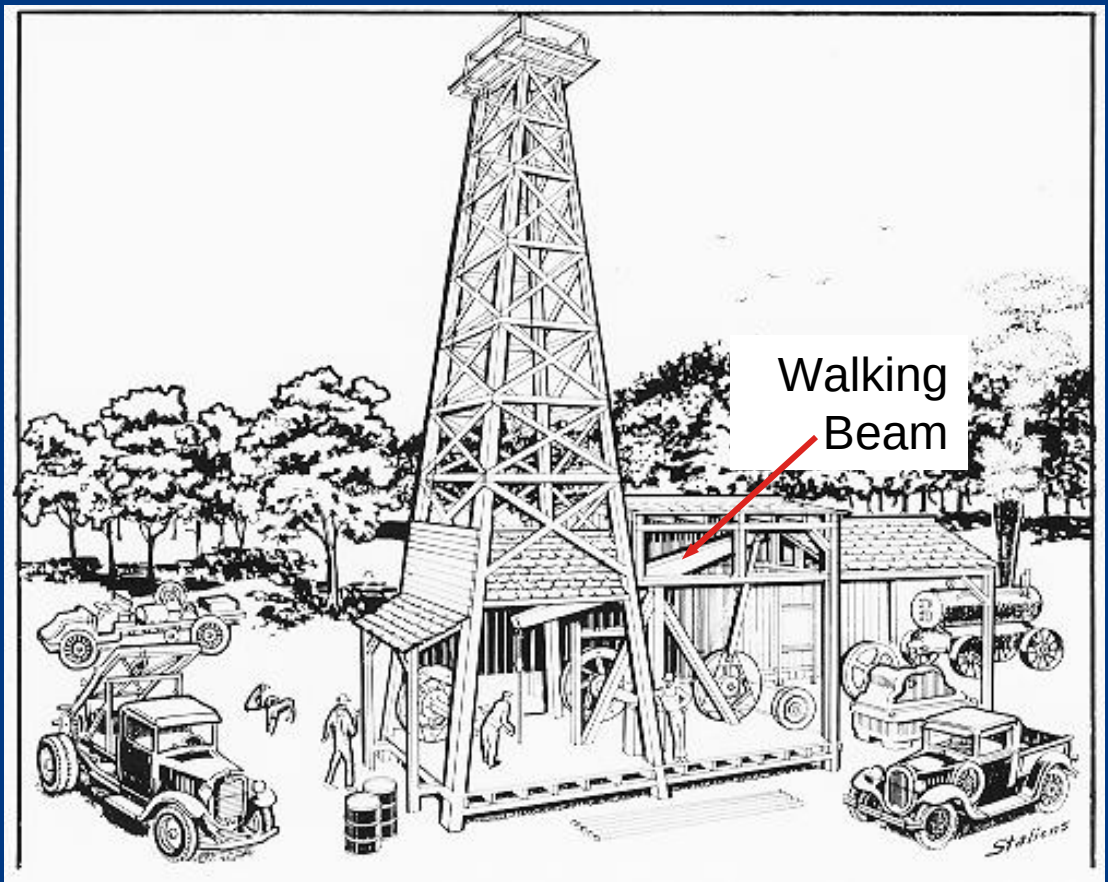


- A variant of the spring pole
- Also used in China
- Human or horse powered
- Employs a “walking beam”



Historic Drilling Methods

Cable Tool Rigs



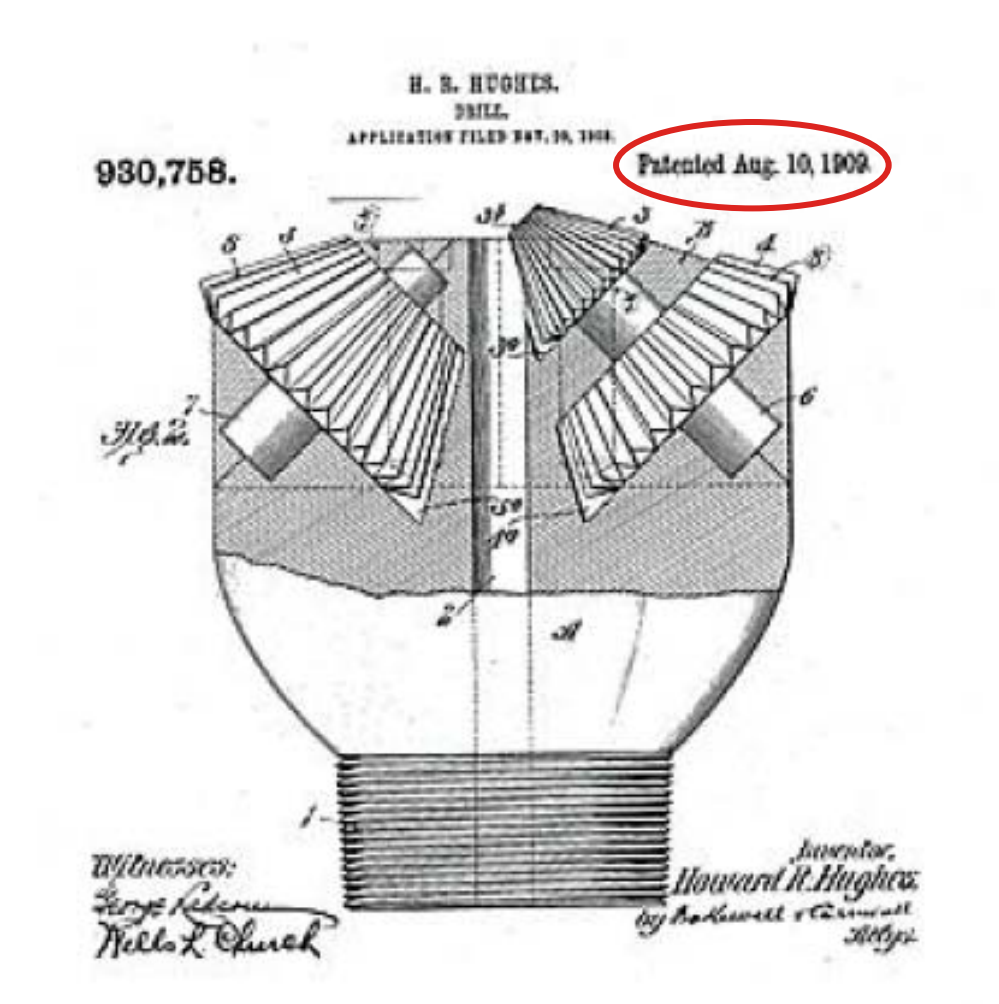
- Also a variant of the spring pole with improvements
- Also used in China in 600 BC
- Horse, mule or steam engine powered
- Also employs a “walking

Historical Drilling Methods

- All were variants of the spring pole
- Known as “percussion” drilling
- Little or no fluid in the well
- Little or no casing
- No blowout preventer

Spindletop - 1901

Rotary Drilling

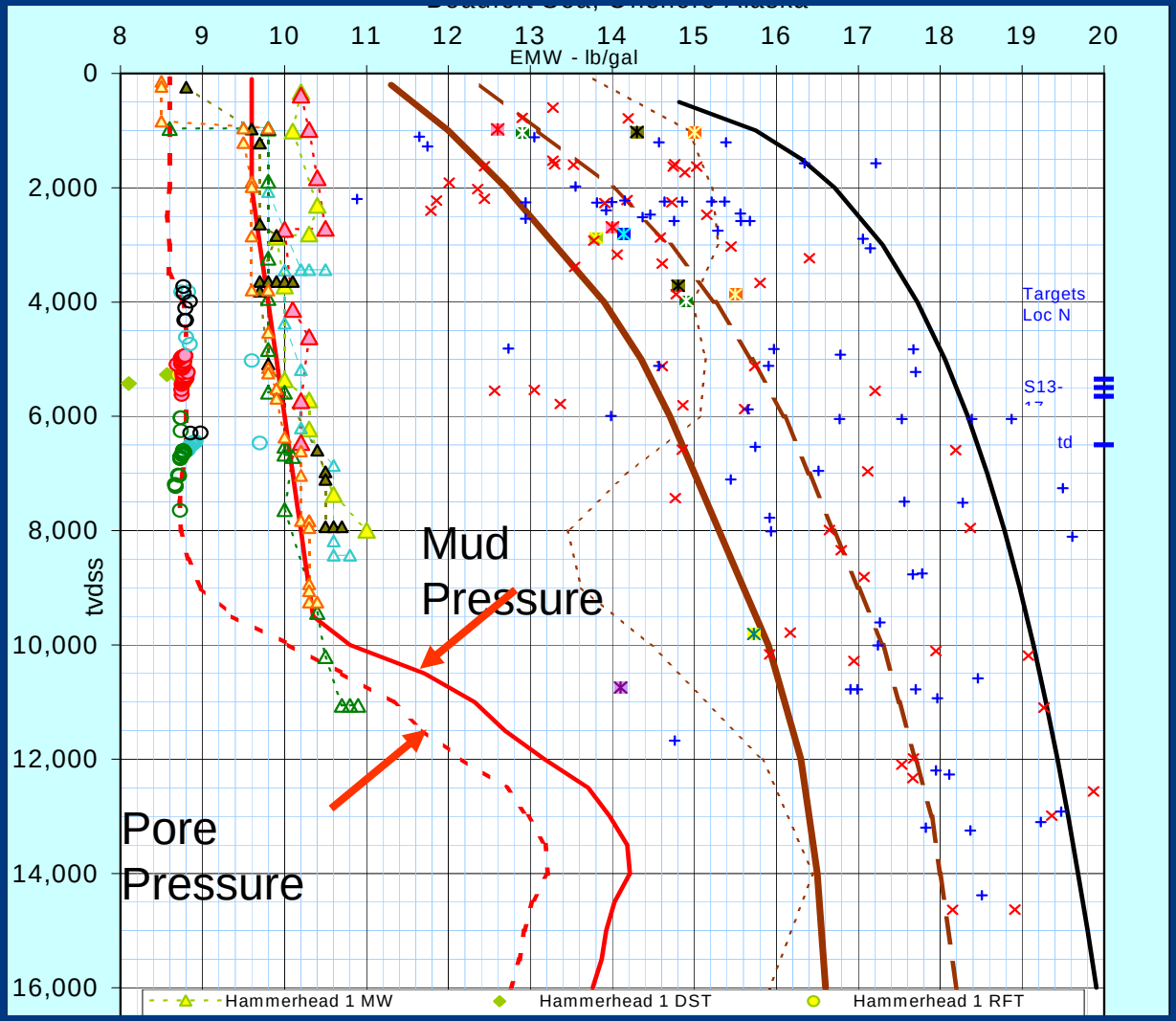


- Original rotary bit was invented by Granville Humason, a Louisiana oilfield worker, who was inspired by the workings of a coffee grinder
- Howard Hughes, Sr. bought the Humason design for $150 and patented it in 1909
- The rotary drill bit has revolutionized drilling

Now, a drilling fluid could be pumped down the drillpipe, through the bit, and up the annulus to:

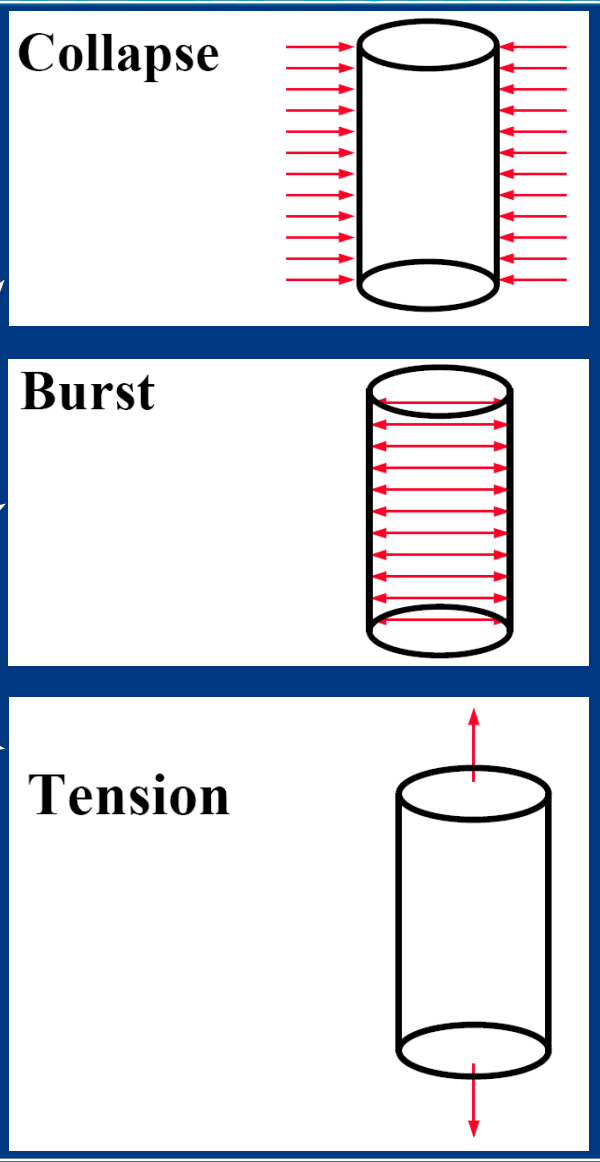
- ✓ Clean out cuttings
- ✓ Cool the bit
- ✓ Stabilize the hole
- ✓ **Apply pressure inside the well to keep it from flowing**

BHP, psi = Mud Density, lb/gal x depth, ft x 0.052


8
9
10
11
12
13
14
15
16
17
18
19
20
EMW - lb/gal
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
tvdss
Mud
Pressure
Pore
Pressure
Targets
Loc N
S13-
td
Hammerhead 1 MW
Hammerhead 1 DST
Hammerhead 1 RFT

Casing Design

- Each hole section must be cased with pipe to prevent caving and hold pressure
- Each pipe is cemented on the outside to keep it in place and protected
- **Each pipe must be designed by engineers to resist the forces acting on it**



Blowout Preventer (BOP) Development

Wooden Caisson (no barrier)

First Ram BOP (1922)

Early Manual Ram BOP (1940)

Subsea Blowout Preventer

Offshore Drilling History

Alaska Exploration

Offshore California, 1896

Offshore Gulf of Mexico, Kerr-McGee, 1947

Gulf, Caddo Lake, Louisiana, 1911

Offshore Drilling History

Alaska Exploration

Drilling Barge, 1920's

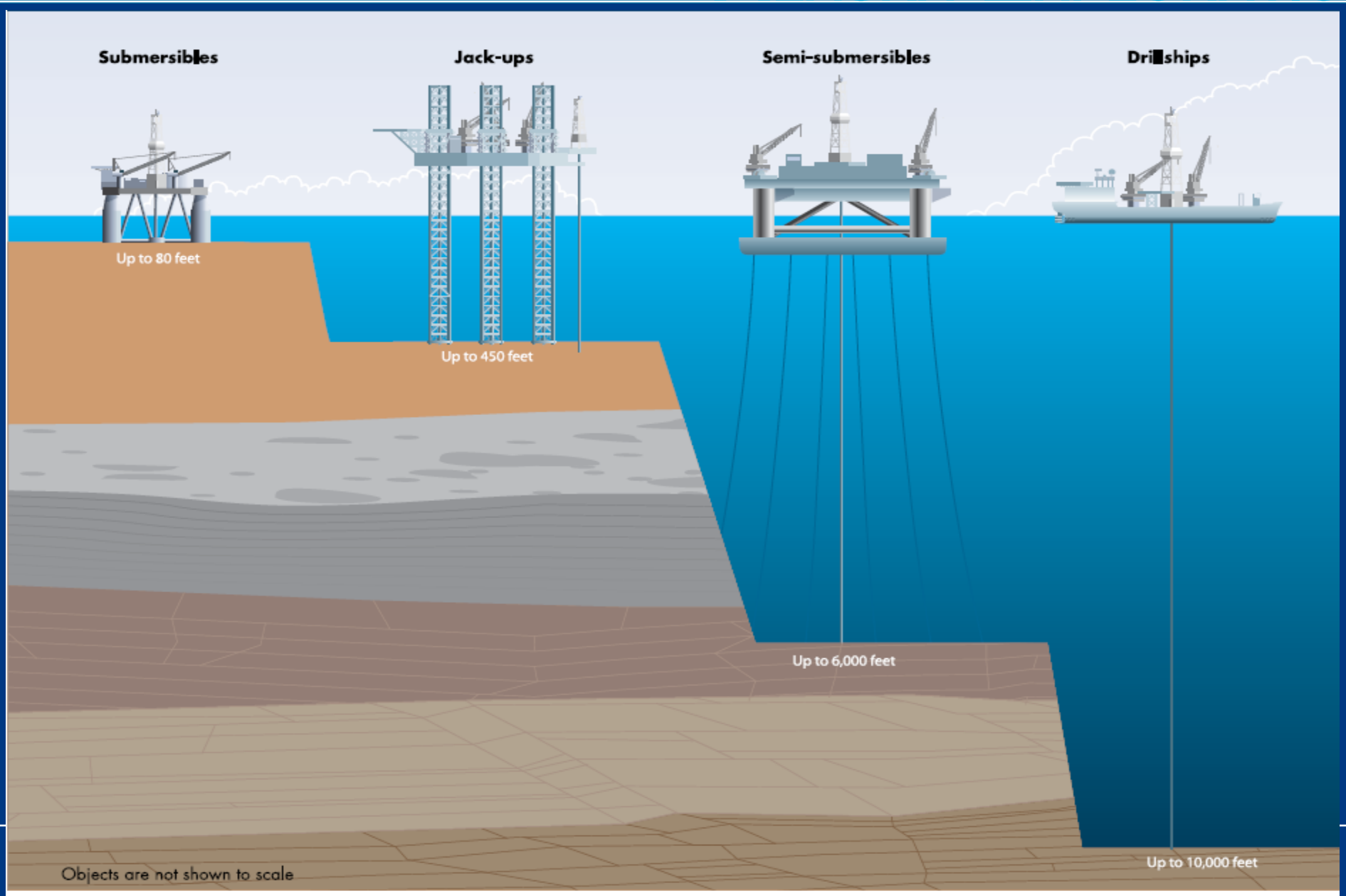
Submersible Rig, 1954

Jackup Rig, 1955

Drillship, 1956

Semi-submersible,

Drilling Rig Types



The way we drill today:

BACKUP SLIDE

Composition of Drilling Fluids

ALASKA EXPLORATION

Additive	Function	Also Found in:
Seawater	Base Fluid	Naturally occurring
NaCl (salt)	Clay inhibition & density control	Table salt, food flavoring and preservative
Duovis (poly-saccharide biopolymer)	Primary viscosifier	Salad dressings and sauces
Polypac UL (poly-anionic cellulose)	Fluid loss control agent	Ice cream, powdered instant drinks, jellies, sauces, cheese products
Polyplus RD (PHPA = partially hydrolyzed poly-acrylamide)	Clay inhibition	Food thickening agent
Barite (barium sulphate)	Weighting agent	Naturally occurring mineral
NaOH (caustic)	pH control agent	Used in food processing of fruits, vegetables, chocolate, pretzels
Bentonite Clay	Secondary viscosifier & fluid loss control agent	Shampoos, facial creams and lipstick