# GG450

April 27, 2010

Well Logging I

# Today's material comes from p. 501-541 in the text book.

Please read and understand all of this material!

### Drilling - Exploration and Scientific

Holes are drilled into the Earth for both commercial and scientific purposes.

Commercial holes are usually called *wells* and may be drilled to tap into water or oil/natural gas. Core samples are usually not taken in commercial holes, so geophysical logs are used for correlation between wells and for determining whether oil or gas are present.

Scientific holes are usually cored, but coring is often not continuous, so geophysical logs are used to "fill in" between cored sections.



#### Advantages of Logging

Provides objective and quantitative data for existing wells.Requires only one or two people.Test can be repeated.Non-destructive.Fast and economical.Much cheaper than coring.

**Disadvantages of Logging Methods** 

Equipment is expensive. Will not define all important contacts. Requires trained people for data collection and interpretation.

#### Down-hole logging methods

There are now two standard methods of well logging:

Wireline logging (Carried out after completing drilling) Logging While Drilling (LWD)

Both use similar tools and each has its advantages and disadvantages





# Wireline logging methods

In all wireline methods, a string of probes is lowered down into the well. Different properties are measured by the probe and plotted as a function of depth. Logging is usually done as the probe is coming back up the well. Probes are stacked together in strings to obtain as much information in as little time as possible. A string might be 30 m long.







# Standard Logs

- Nuclear Logs
- Sonic
- Electrical/magnetic
- Imaging
- Vertical seismic profile (VSP)
- Logging While Drilling (LWD)

- Nuclear Logs
  - Natural gamma ray
  - Density
  - Neutron
- Sonic
- Electrical/magnetic
- Imaging
- Vertical seismic profile (VSP)
- Logging While Drilling (LWD)









- Nuclear Logs
- Sonic
- Monop
- Dipole
- Electrical/magnetic
- Imaging
- Vertical seismic profile (VSP)
- Logging While Drilling (LWD)

# Dipole Sonic Imager (DSI)

The sonde provides borehole compressional, shear and Stoneley slownesses. (Slowness is the reciprocal of velocity and corresponds to the interval transit time measured by standard sonic tools.)

The DSI tool is a multireceiver tool with a linear array of eight receiver stations, a monopole transmitter and two dipole transmitters. The receiver array provides more spatial samples of the propagating wavefield for full waveform analysis. Frequency determines the wavelength that drives the depth of investigation of the measurement. Low frequency penetrates deeper into the formation and helps read beyond altered zones.























- Nuclear Logs
- Sonic
- Electrical/magnetic
- Resistivity Magnetic susceptibility
- Imaging
- Vertical seismic profile (VSP)
- Logging While Drilling (LWD)

















<ul> <li>Sonic</li> <li>Electrical/magnetic</li> <li>Imaging <ul> <li>Electrical</li> </ul> </li> <li>Vertical seismic profile (VSP)</li> <li>Logging While Drilling (LWD)</li> </ul>	<ul> <li>Sonic</li> <li>Electrical/magnetic</li> <li><i>Imaging</i> <ul> <li><i>Electrical</i></li> </ul> </li> <li>Vertical seismic profile (VSP)</li> <li>Logging While Drilling (LWD)</li> </ul>	•	Nuclear Logs
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Logging While Drilling (LWD)	Logging While Drilling (LWD)		Vertical seismic profile (VSP)
			Logging While Drilling (LWD)







#### Nuclear Logs

- Sonic
- Electrical/magnetic
- Imaging
- Vertical Seismic Profile (VSP)
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#### Array Seismic Imager

The ASI consists of an array of seismic sensors 6-48). Each sensor package contains orthogonal geophones. This tool is used in Vertical Seismic Profiling, where a seismic source at the top is recorded by the sensors in the hole, providing excellent estimates of interval velocities.







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