Resistivity Well Logging in Petroleum Industry

In petroleum industry resistivity well-logging is one important method to detect the resistivity of the formation. This method can be described as follows. After a well has been drilled, one puts a log-tool into the well. The log-tool is an insulation rod whose lateral surface is covered by metal as electrodes. While it works, some of the electrodes discharge currents of fixed intensity into the formation then the potentials in some other electrodes are measured. Raising the log-tool along the well-bore one gets the potential distribution on the electrodes of various positions. By this information one infers the resistivity of the geological formation. Combining this information with the porosity of the formation obtained by some other well-logging techniques, one can calculate the oil storage.

In petroleum geophysics, the underground formation is usually supposed to be regularly stratified and be symmetric with respect to the well-axis. A cross section through the well-axis of the typical formation model is shown in Figure 1, where Ω_1 is the well-bore filled by mud, Ω_2, Ω_3 are called enclosing rock, Ω_4 is the object layer and Ω_5 is called invasion zone since the mud filtrate penetrates into this area. Usually the resistivity in $\Omega_1, \Omega_2, \Omega_3$ is suppose to be known constants and the resistivity in Ω_4 be unknown constant, the resistivity in Ω_5 be unknown and variable of the position. A log-tool is designed with 3 discharging electrodes, and 20 measuring electrodes shown as Figure 2. How do we determine the resistivity in Ω_4, Ω_5 by the measuring data?

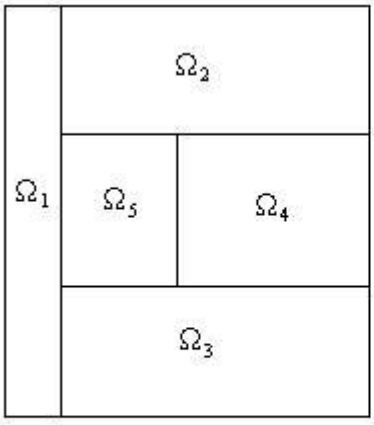

Figure 1

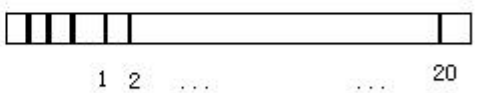

Figure 2