Combined exercise (From P. Glover Petrophysics book)

You are provided with a set of logs from a reservoir sequence in the UKCS of the North Sea and a neutron-porosity crossplot.

- The drilling mud was saline water-based and contained no KCl or barite.
- The depth scale is in meters.

Answer the following questions marking the logs with construction lines where appropriate and showing full working for numerical questions.

(a) Identify the main lithologies throughout the log, marking explicitly any fining-up or coarsening-up sequences. Shade the depth scale with the standard colour or pattern for each lithology. (***Hint:*** *You may find carrying out parts (b) and (c) below first help you in this process.*)

(b) Shade the difference between the caliper log and the bit size for:
- Intervals where Caliper<BS and there is mudcake.
- Intervals where Caliper>BS and there is caving.

(c) Shade the intervals of (i) negative separation, and (ii) positive separation on the neutron-density log (track 2).

(d) Comment briefly upon the likely cause of the shape of the gamma ray log in the interval 2635 m and 2645 m.

(e) Why is a similar effect noted on the density log, but not on the neutron or resistivity logs?

(f) Calculate the mud-cake thickness at 2590 m.

(g) Calculate the shale volume (V_{sh}) at 2550 m from the gamma ray log.

(h) Calculate the shale volume (V_{sh}) at 2550 m from the neutron/density separation.

(i) Given that the section between 2560 m and 2609 m is 100% saturated with water (r_f=1.0 g/cm$_3$), calculate the porosity at 2590 m.

(j) Repeat the porosity assessment at 2590 m by plotting the appropriate point on the neutron-density crossplot, supplied.

(k) Given that at 2590 m the Archie 'm' exponent equals 1.86, calculate the resistivity of the water occupying the pores in the rock using the porosity calculated in part (j).

(l) Given that the water resistivity, R_w, in the interval 2505 m to 2531 m can be assumed to be the same as that calculated in part (k), and that the Archie exponents are m=1.86 and n=2, use the combined Archie equation to calculate the mean fractional water saturation, S_w, and mean fractional oil saturation, S_o, in the interval.

6	BS (inches)	16	
6	Caliper (inches)	16	Depth m
0	GR (API)	150	

1.95	Density (g/cc)	2.95
45	Neutron Porosity (%)	-15

1	Resistivity, Ild (ohm.m)	1000

2450

2500

2550

2600

2650