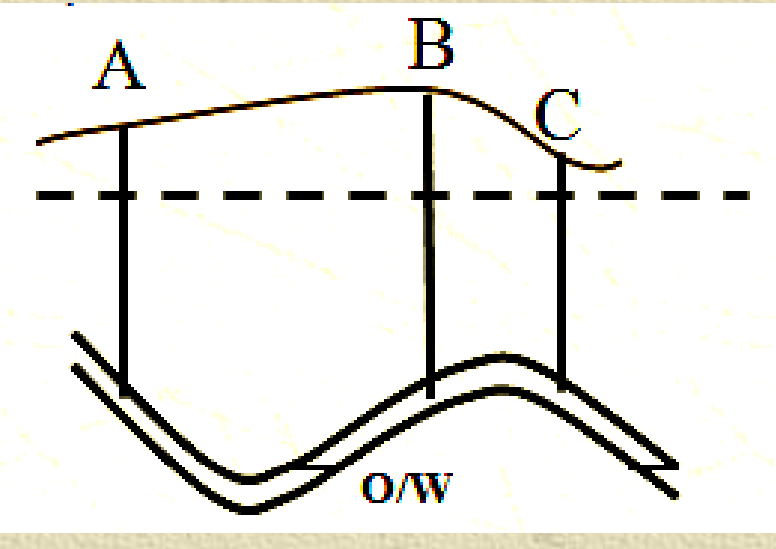
Exercise 5 Pressure Calculation and analysis

- Protect oil layer, safety production
- Design mud weight and reasonable casing programm
- Research petroleum generation, migration and accumulation

1. **There are three wells with same bottom elevation (-500m) drilled in an anticline reservoirs, of which A is a water well, B and C are oil wells. Their wellhead elevations are +150m, +250m and +100m, respectively. The elevation of contributing region is +50m and the oil/water interface is -700m. The specific gravities of oil and water are 0.85 and 1.0.**
   (1) Calculate the initial formation pressure of WellA, B and C.
   (2) Which is (are) gusher well(s)



$$P_H = \rho \cdot H/10$$

(1) $P_A = h_W \cdot Y_W/10$ =（500+50）* 1 /10 =55kg/cm^2 = 5.5MPa

$P_B = h_{OW} \cdot Y_W/10 - (h_{OW}-ho) \cdot Y_o$ = （700+50）* 1 /10 – (700-500)*0.80=5.9MPa

$P_c = h_{OW} \cdot Y_W/10 - (h_{OW}-ho) \cdot Y_o$ = （700+50）* 1 /10 – (700-500)*0.85=5.8MPa

A、B、C wells Pi 5.5MPa， 5.8MPa and 5.8MPa respectively

(2) $P_A = h_W \cdot Y_W/10$, hw=5.5*10*10/1.0=550m

Well A produce water, well head elevation +150m, then（500+150）—550>0，

Well A is not the flowing well

$P_B = h_O \cdot Y_O/10$, ho=5.8*10*10/0.85 =682.4m

$P_C = h_O \cdot Y_O/10$, ho=5.8*10*10/0.85 =682.4m

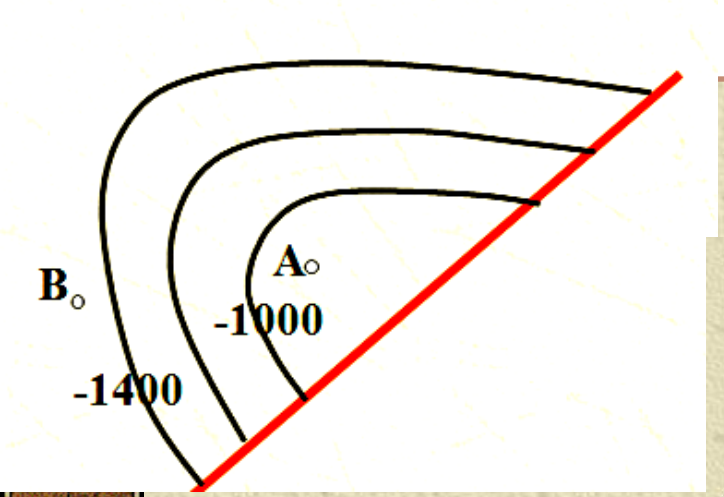
Well B produce oil, well head elevation +250m, then（500+250）—682.4>0;

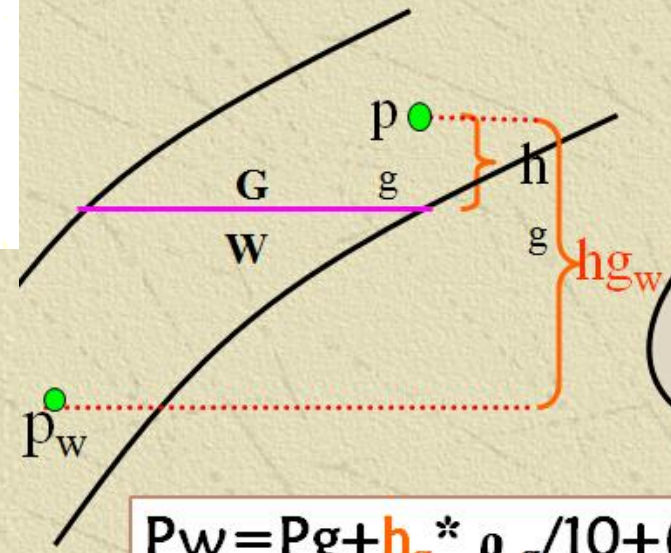
Well C produce oil, well head elevation +100m，then（500＋100）—682.4<0，

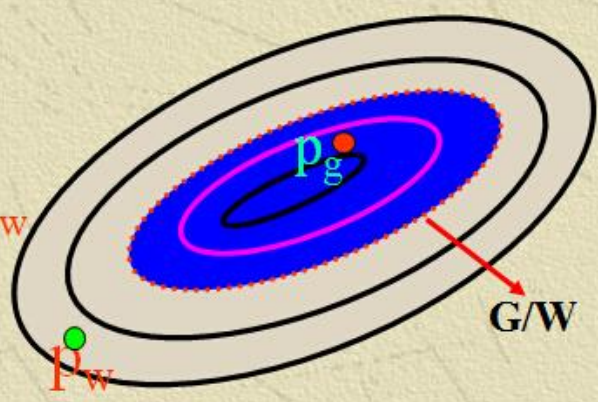
Well C is flowing well

2. There are two wells drilled in a block structure. Well A and B are gas well and water well respectively after testing. Their depth of the middle of production layers are -900m and -1,500m, their formation pressure are P_A=10.55MPa and P_B=16MPa. The specific gravities of oil and water are 0.78 and 1.0, respectively.

Predict the location of G/W interface







$$Pw = Pg + h_g * \rho_g/10 + (h_{gw} - h_g)\,\rho_w/10$$

$$h_g = [h_{gw}\,\rho_w - 10(P_w - P_g)]/(\rho_w - \rho_g)$$

$P_B = P_A + H_g\rho_g/10 + (1600-900-H_g)\rho_w/10$

$H_g = 250m$

G/W interface -900-250=-1150m

3. At the depth of 3,000m, $\triangle t_{sh}$=300us/m, $\triangle t_{shn}$=250us/m,

(1) Calculate formation pressure, pressure coefficient and $\triangle P$ at corresponding depth;

(2) If we want balanced drilling, how much specific gravity of mud should be prepared?

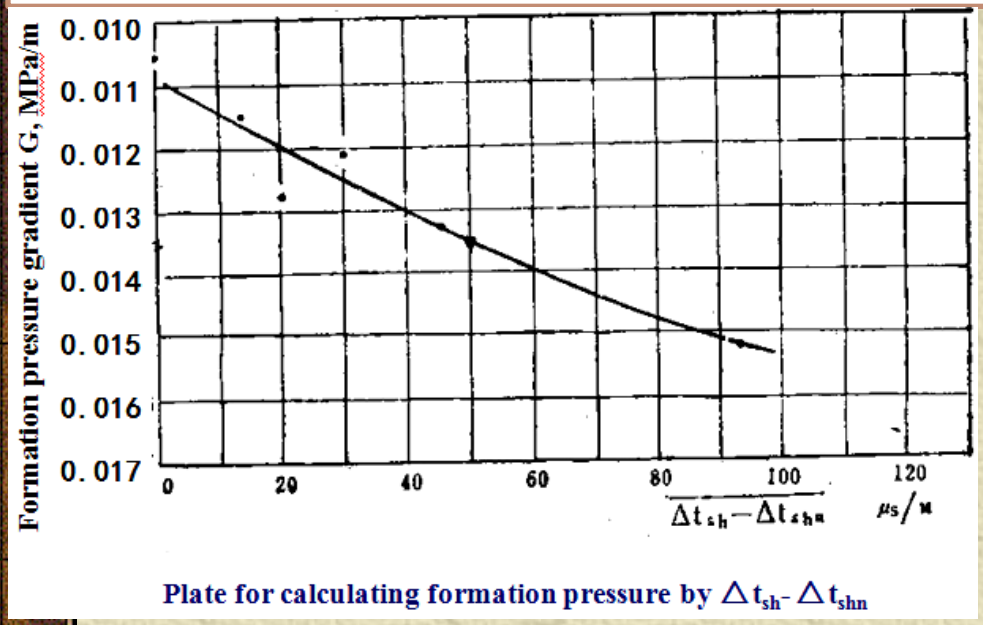
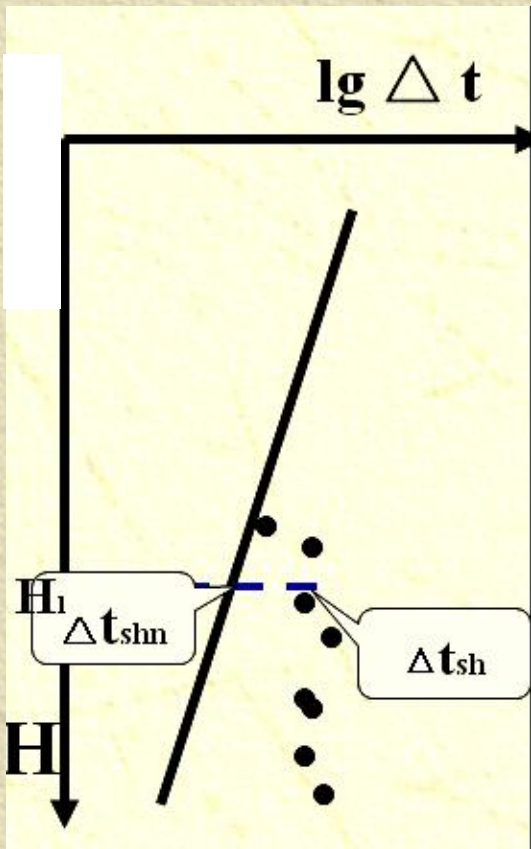


Plate for calculating formation pressure by $\triangle t_{sh}$- $\triangle t_{shn}$



△tsh—△tshn=50us/m， Pressure Gradient = 0.0135MPa/m

H= 3000m： P= 3000*0.0135=40.5MPa

pressure Coefficient： 40.5/30=1.35

△P= P—P静 = 40.5—30 =10.5 MPa

P_{mud}=1.1*P=1.1*40.5 = 44.55 MPa

$P_{mud}= \rho_{mud}\, h/10$

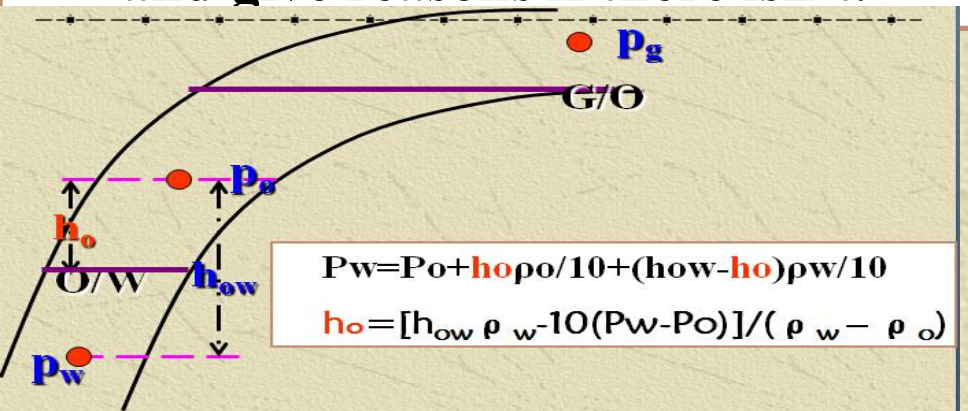
ρ_{mud} =1.485

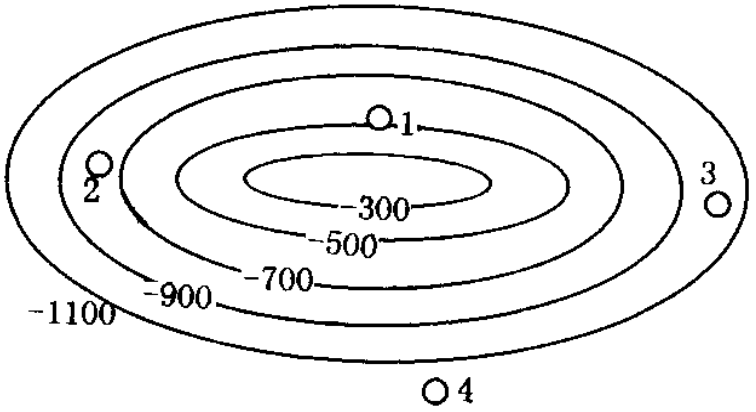
4. Four discovery boreholes on the uplift structure. Except for borehole 1 was discarded (due to drilling accident), others have completed the oil production testing successfully. The top of oil pay zone in borehole 2 and 3 are respectively buried at -800 m and -1000 m, with 13.6MPa and 15.2MPa

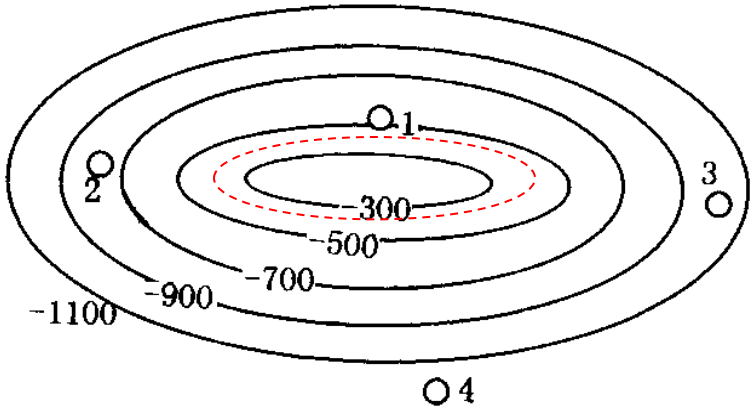
(Pressure gradient is 0.008 MPa/m) of fluid pressure. The saturation pressure of oil pay zone is 10.4 MPa. The borehole 4 that drilled into the edge water zone of the oil filed indicated the fluid pressure is 17 MPa at -1200 m. Density of oil and formation water are 0.8 g/cm3 and 1.0 g/cm3, respectively.

(1) Height of water-oil contact/interface?

(2) Judge whether there is a gas cap, draw the scope of gas cap if there is and give reasons if there isn't.







(1) $P_W = P_O + h_O\ \rho_O/10 + (h_{OW}-h_O)\ \rho_O/10$

$h_{03}=[h_{OW}\ \rho_W-10(P_W-P_O)]/(\rho_W-\rho_O)=-1100m$

$h_{02}=300m$

∴ O/W interface is at -1100m

(2)800m Well 2, P2=13.6MPa

The saturation pressure 10.4MPa,

Pressure gradient is 0.008 MPa/m (0.08atm/m)

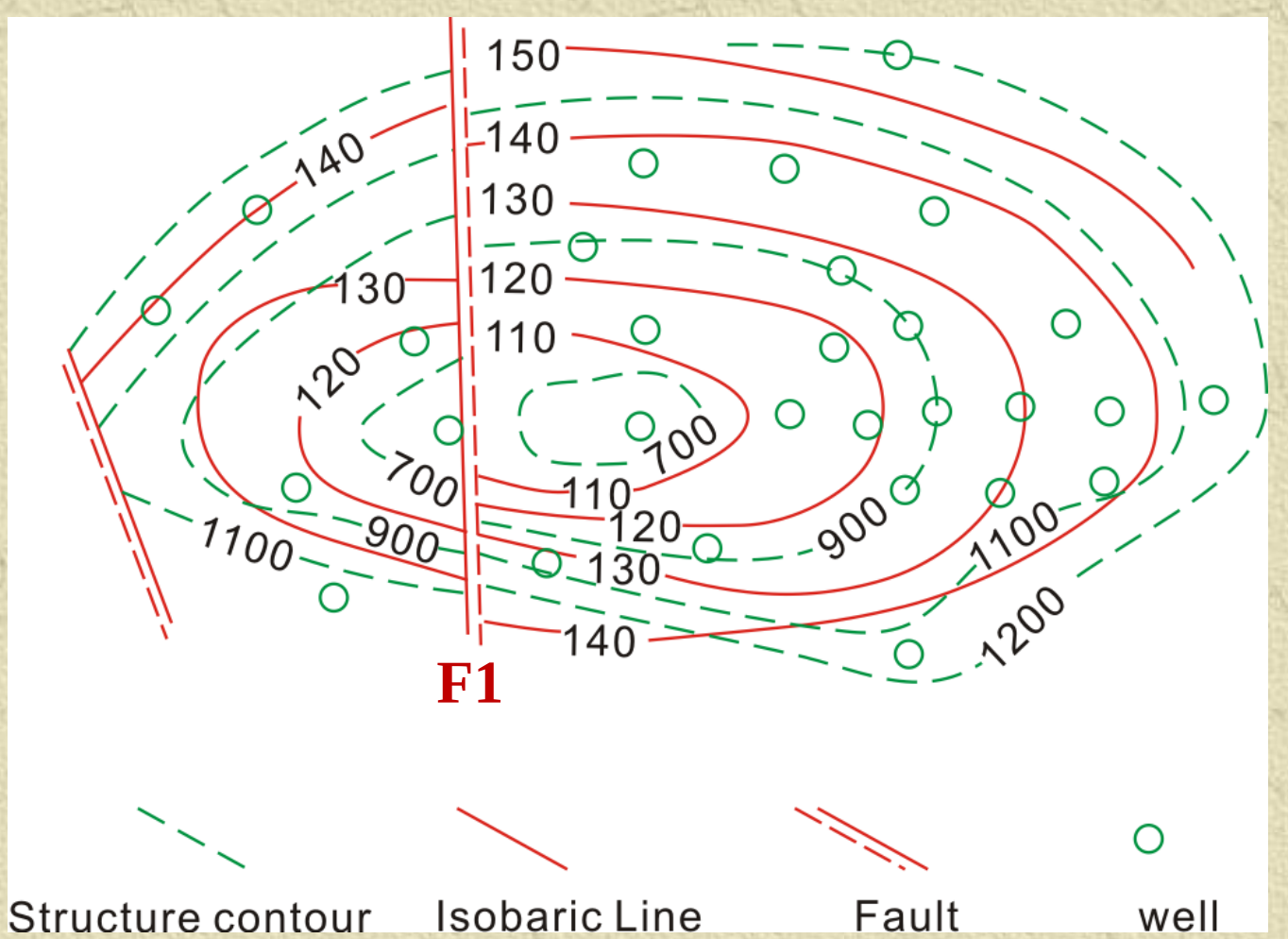
136-104=32atm 32/0.08=400m

∴ there is a gas cap, G/Ointerface is at -400m,

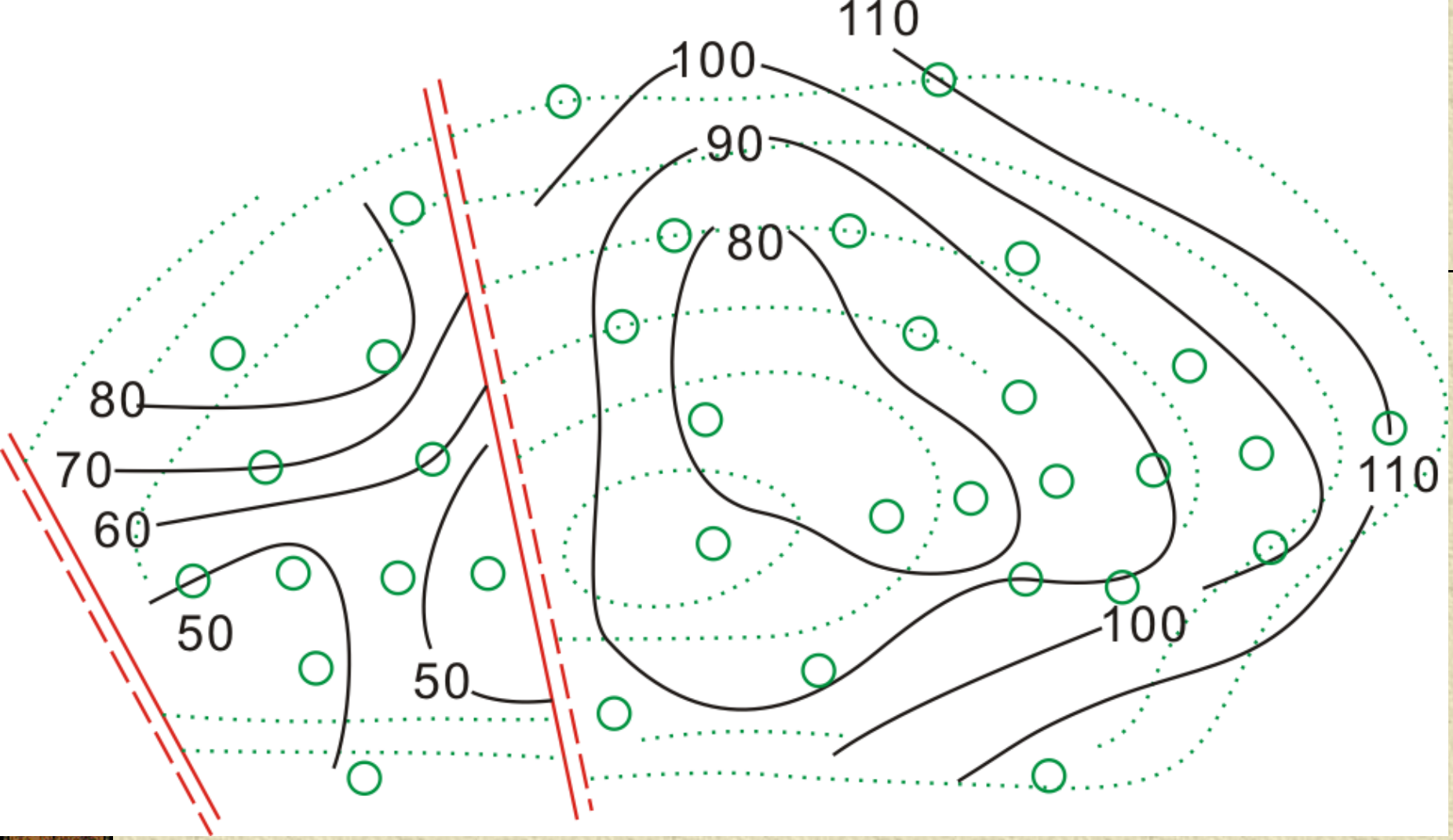
When the depth is less than -400m,

the reservoir pressure is less than saturation pressure

5. The figure is initial pressure isobaric map, try to identify the fault sealing (F1) and explain the reason.



Initial pressure isobaric map



Reservoir static pressure isobaric map