

SPD3-13 P & T wire line survey

01 to 02 Jan 2006

Quick look results

First quick look conclusions

This SPD3-13 wire line survey has been achieved in very good conditions

- Good program execution & following
- Good quality data recorded on both gages
- Long shut in period before survey
- Steady production on surrounding wells before & during survey

Provisional quick look results are:

- Last recorded static pressure 4813 psia (331.8 bara) @ 2871 mWL
- Extrapolated bottom hole static pressure BHSIP* 4844 psia (334.0 bara) @ -2900 mSL
- No liquid interface at bottom hole
- Suspected cross flow between K4 & K2

**Reminder*

- Initial reservoir static pressure (2002) 5294 psia (365.0 bara) @ -2900 mSL

Warning

- ✓ this BHSIP* must not be confused with a Reservoir Static Pressure

Argumentation

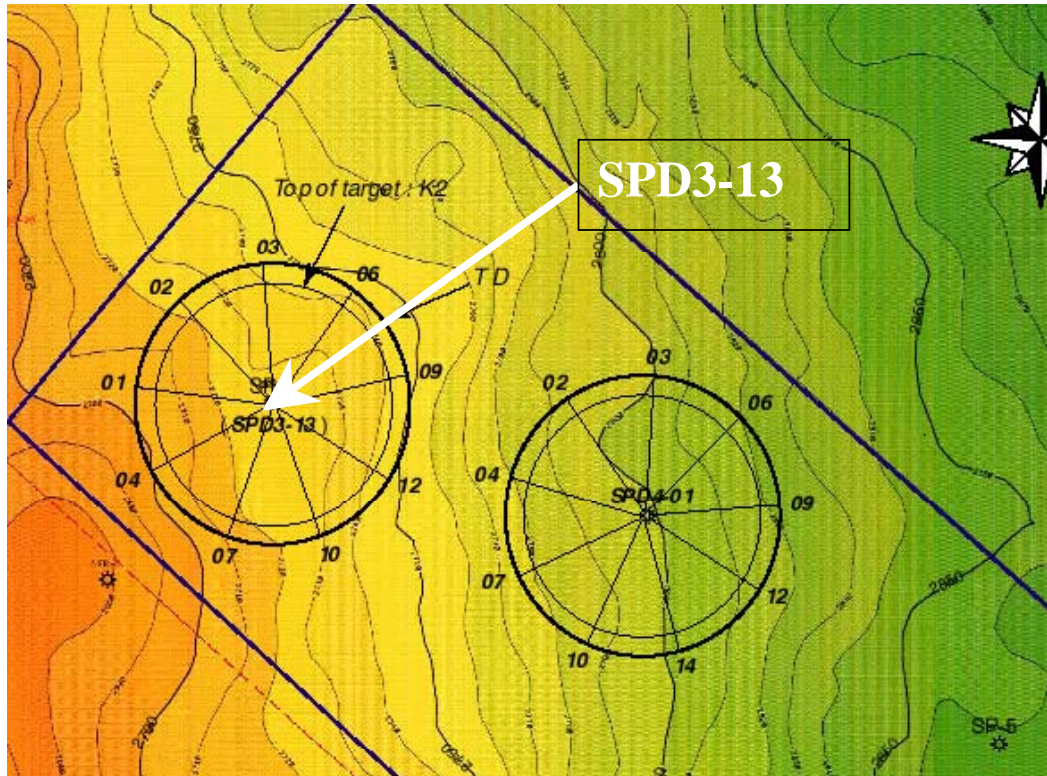
- All wells on SPD3 & SPD4 are perforated on K4, K3 & K2 reservoirs.
- In such cases, vertical pressure distribution has no chance to be achieved. Even with an academic 2 reservoirs case with equivalent kh & skin there is no way to determine from BHSIP respective static reservoir pressures (and so dP between the two layers and cross flow direction), without extra information The system handles much more variables than equations to be solved as it.

Sequence of Events

| Date | Time | Operation |
|----------|-------|------------------------------|
| 12/12/05 | 20:30 | Shut in SPD3-13 |
| 12/20/05 | 16:00 | Opening SPD3-13 |
| 12/22/05 | 21:00 | Shut in SPD3-13 |
| 01/02/06 | 17:00 | RIH (run in hole) |
| | 18:40 | At bottom, recording step #1 |
| | 19:12 | Step #4 (2h recording) |
| 01/03/06 | 01:20 | At surface |
| | | End of operations |

Well data

Well Position



Trajectory

Vertical well: TD 3090 mRT / -3055.9 mSL

Depth conversion

Rotary Table elevation 32.8 m
 Tubing Hanger to RT 19.8 m
 Xmass Tree Swab Valve to TH 2.9 m

Wire Line depth reference (mWL)

Reservoirs

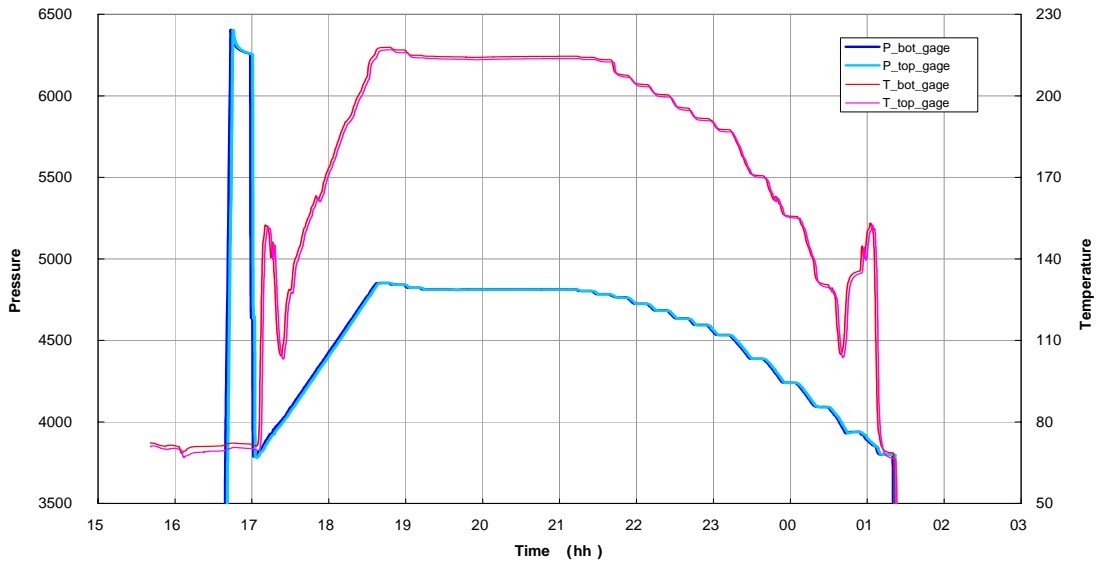
| Res | TVD | Sea Level |
|-----|--------|-----------|
| K1 | 2644.8 | -2612.0 |
| K2 | 2748.8 | -2716.0 |
| K3 | 2800.8 | -2768.0 |
| K4 | 2931.8 | -2899.0 |

Perforations

| Res | Top | Bottom | Top | Bottom |
|-----|--------|--------|---------|---------|
| K2 | 2760.4 | 2777.9 | -2726.4 | -2743.9 |
| K2 | 2780.4 | 2788.9 | -2746.4 | -2754.9 |
| K3 | 2805.9 | 2829.9 | -2771.8 | -2795.8 |
| K3 | 2837.4 | 2844.9 | -2803.3 | -2810.8 |
| K3 | 2854.9 | 2865.9 | -2820.8 | -2831.8 |
| K4 | 2922.9 | 2958.9 | -2888.8 | -2924.8 |
| K4 | 2923.9 | 3041.9 | -2889.8 | -3007.8 |

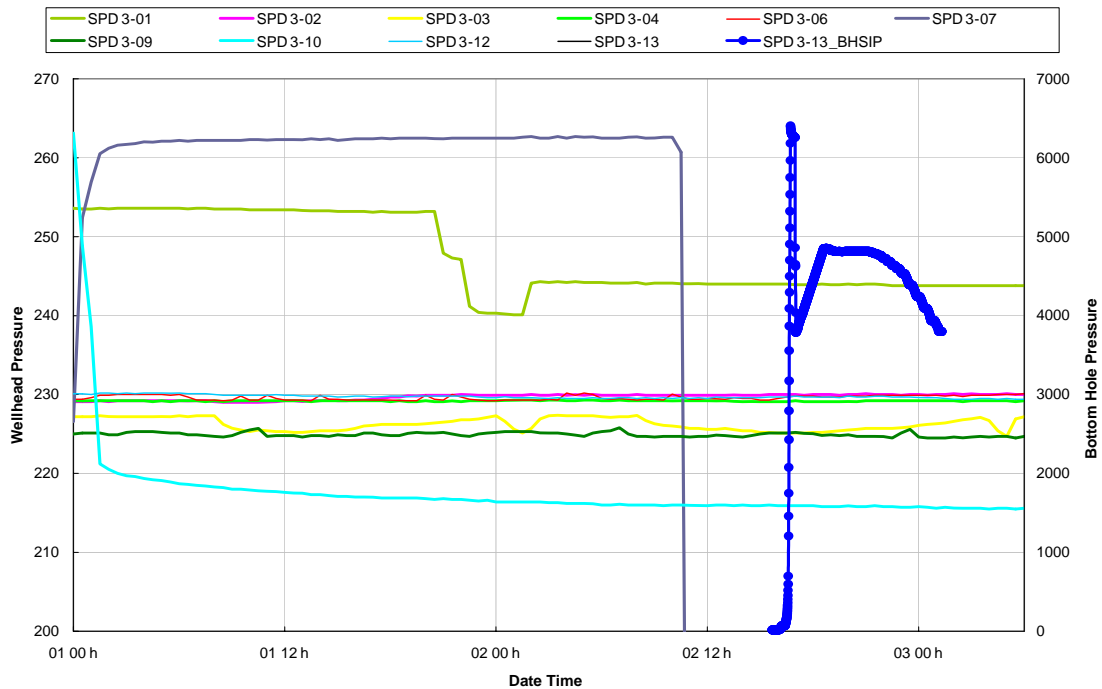
P & T data

Both gages readings are valid.



Production context

Except for SPD3-07 closing & SPD3-10 opening, global production context during survey was steady for all other wells, preventing thus from any significant interference effect.



SOUTH PARS Phases 2&3

P & T Steps

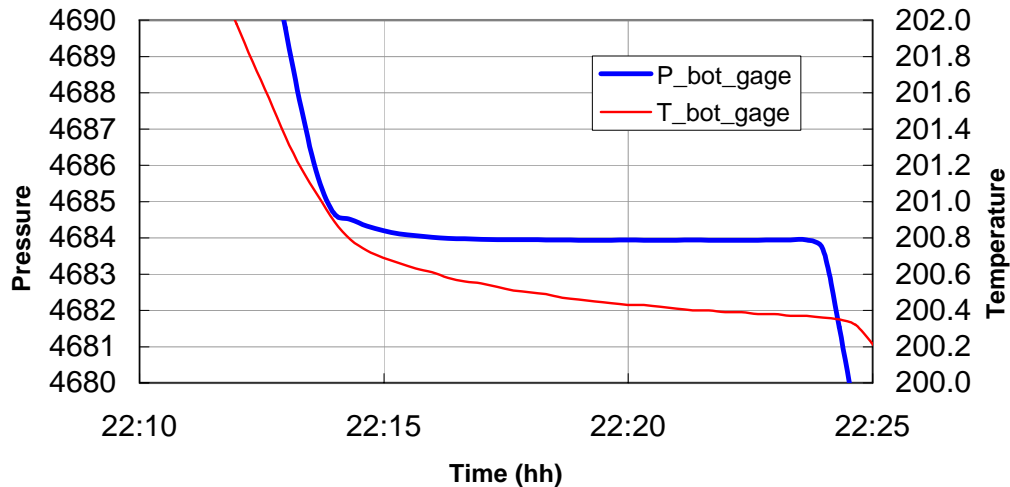
17 pressure step have been recorded during log up

P & T selected values are the last stabilized ones recorded at each step

| Step Num | Wireline depth mWL | Date Time dd hh:mm | Step duration hh:mm | TV depth mSL | Pressure psia | Temp. degF | dP/dZ gradient psi/m | Fluid |
|----------|--------------------|--------------------|---------------------|--------------|---------------|------------|----------------------|-------|
| 17 | 0.0 | 03 01:18 | | 16.0 | 3798.0 | 68.6 | | gas |
| 16 | 397.7 | 03 00:53 | 00:10 | -381.6 | 3939.1 | 135.5 | 0.355 | gas |
| 15 | 813.8 | 03 00:28 | 00:10 | -797.3 | 4091.9 | 130.5 | 0.368 | gas |
| 14 | 1230.1 | 03 00:03 | 00:10 | -1213.5 | 4240.0 | 155.6 | 0.356 | gas |
| 13 | 1646.1 | 02 23:38 | 00:10 | -1629.4 | 4387.2 | 170.5 | 0.354 | gas |
| 12 | 2062.4 | 02 23:12 | 00:10 | -2045.5 | 4533.4 | 187.5 | 0.351 | gas |
| 11 | 2236.8 | 02 22:54 | 00:10 | -2219.8 | 4594.9 | 191.6 | 0.353 | gas |
| 10 | 2350.4 | 02 22:39 | 00:10 | -2333.4 | 4634.0 | 195.5 | 0.345 | gas |
| 9 | 2494.4 | 02 22:23 | 00:10 | -2477.3 | 4683.9 | 200.4 | 0.347 | gas |
| 8 | 2610.4 | 02 22:07 | 00:10 | -2593.3 | 4724.1 | 204.1 | 0.346 | gas |
| 7 | 2726.4 | 02 21:51 | 00:10 | -2709.3 | 4764.1 | 207.6 | 0.345 | gas |
| 6 | 2784.4 | 02 21:38 | 00:10 | -2767.2 | 4783.3 | 213.3 | 0.331 | gas |
| 5 | 2842.4 | 02 21:24 | 00:10 | -2825.2 | 4803.1 | 214.2 | 0.341 | gas |
| 4 | 2871.4 | 02 21:12 | 02:00 | -2854.2 | 4812.9 | 214.5 | 0.339 | gas |
| 3 | 2900.4 | 02 19:11 | 00:10 | -2883.2 | 4822.5 | 214.9 | 0.332 | gas |
| 2 | 2958.4 | 02 18:58 | 00:10 | -2941.2 | 4842.0 | 216.9 | 0.335 | gas |
| 1 | 2986.4 | 02 18:47 | 00:10 | -2969.2 | 4851.8 | 217.8 | 0.350 | gas |

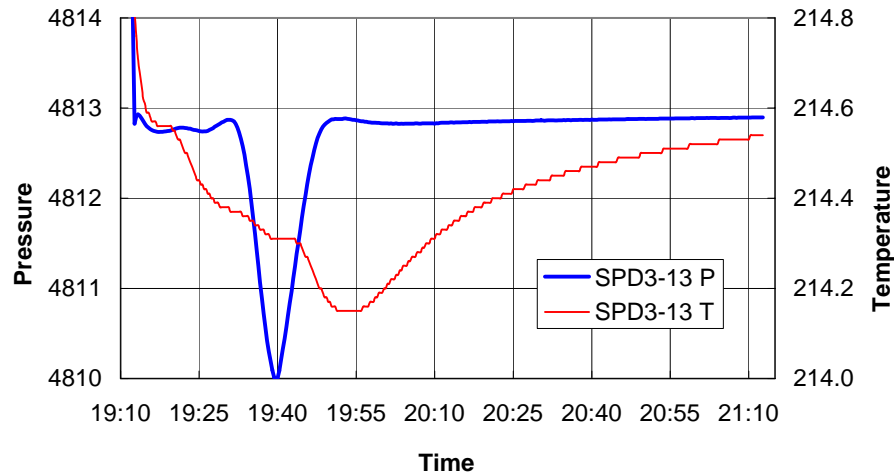
Nota : TVD=True Vertical Depth , mSL= meter referred to sea level

Good stabilization on every steps (Example: step #9)



Long Duration Pressure Step (#4 @ 2871 mWL)

A 2 hours recording step mid-perforation was design in order to obtain reliable Bottom Hole Shut-In Pressure.



Trend analysis

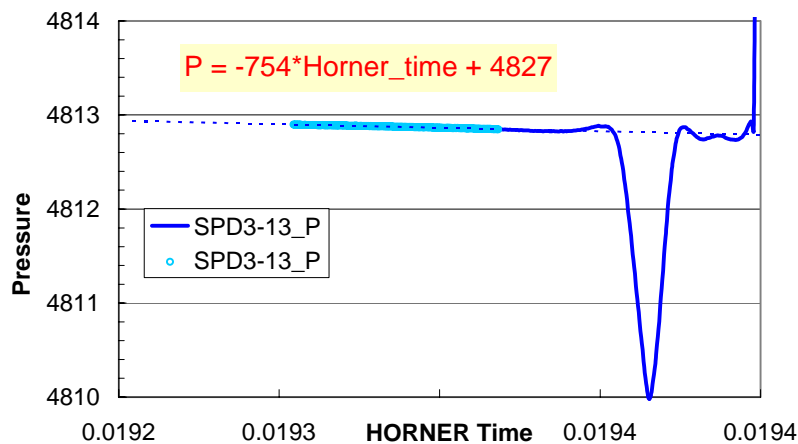
An 3 psi anomaly is observed during 20' in the first part of the step survey. Same figure is observed on temperature curve with a shift on minimum value.

This pressure signal could be the signature of a liquid slug passing around the gages and re circulated into reservoirs, but the temperature signal shift requires complementary analysis. With a liquid slug circulation hypothesis, and as SPD3-13 was closed since 10 days, this liquid slug (oil and/or water) could not have originated from tubing condensates dropping down after shut in. So this could be interpreted as an indication of cross flow (intra reservoirs flow after well shut-in due to differential reservoir pressure on K2, K3 & K4).

Pressure extrapolation

A limited but clear +0.015 psi/h slope is observed.

If we attribute this trend to the sole SPD3-13 build up, a standard Horner interpretation gives an 14 psi extrapolation dP correction leading to: BHSIP* = 4827 psia @2871 mWL



Quick look conclusions

- 2 hours are a minimum for a good validation of the Bottom Hole Shut In Pressure: general trend validation & pressure extrapolation calculation

Gradients

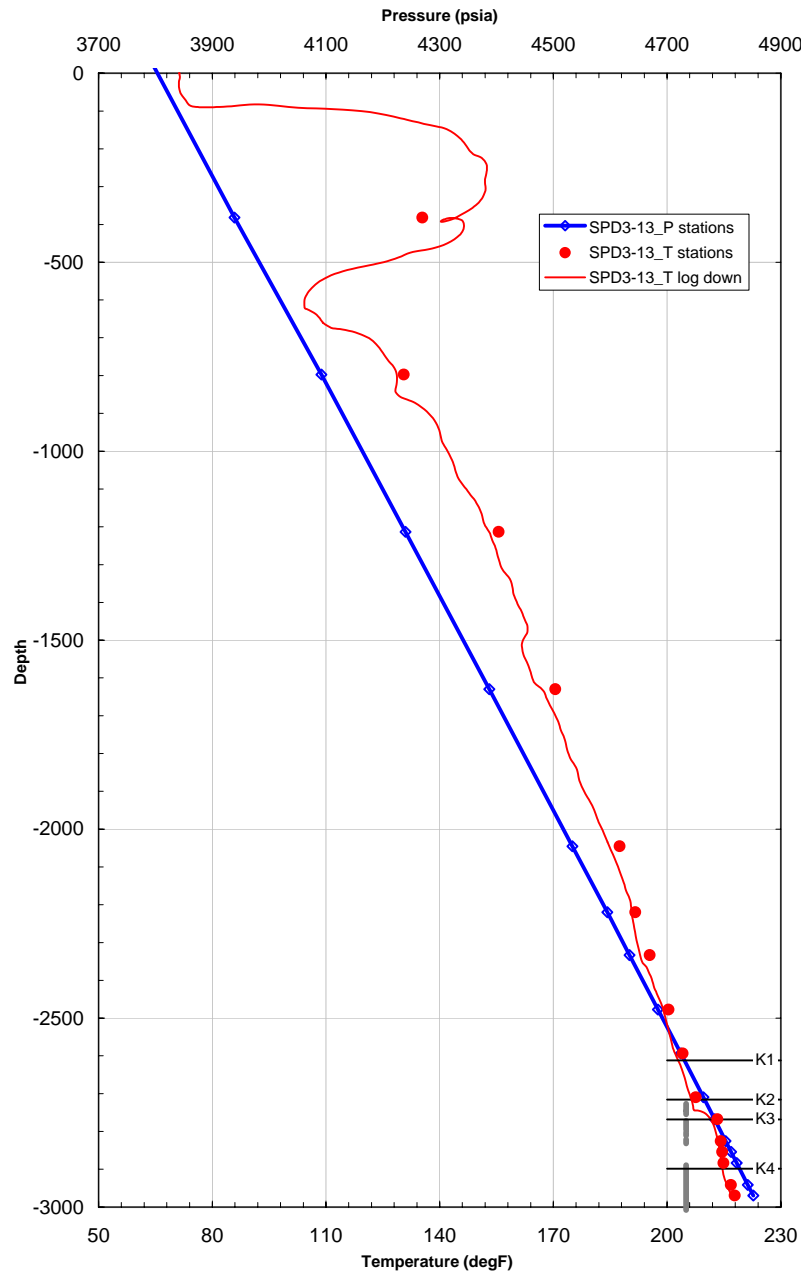
Following picture present stations results and a pseudo log down calculated using the pressure profile versus depth

Temperature gradient:

An strong “anomaly” is observed on both log down & up, from -90 to -620mSL . This effect could have different origins such as a change of fluid in casing annulus and/or to a geological effect (aquifer formation)

Pressure gradient

Step gradient shows a very regular pressure gas gradient from wellhead to bottom hole



Quick look conclusions

These pressure & temperature gradients could be used to match a thermodynamic static well model in order to extrapolate Wellhead Shut In Pressure data to to Bottom Hole Shut In Pressure data

Gradients zoom over Reservoirs

Pressure gradient

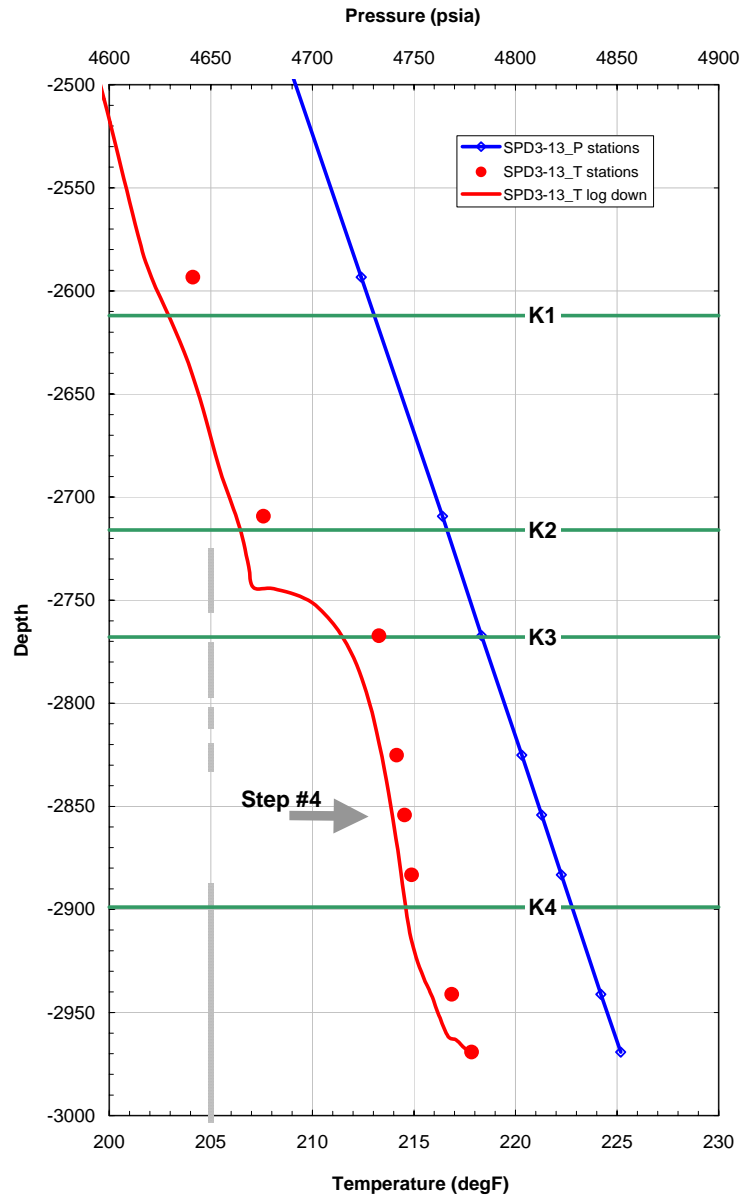
- Strict gas gradient: no liquid interface at bottom hole

Warning : this conclusion is only available for this long shut-in period (10 days)

Temperature gradient

A significant break is observed on the “pseudo” log within K2 reservoir. The same figure could also be observed on the step temperature gradient.

The shape of this “thermo log” curve could indicate a significant cross flow from K4 to K2



Quick look conclusions

Present wire line “logging” procedure carefully applied could give very interesting information on dynamic reservoir behavior (much more justified for shorter shut in periods)