IWANOHARA
Time Lapse Well Logging

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Purpose of Time lapse well logging

1. Detection of carbon dioxide (CO_2) breakthrough at the observation wells.
2. Estimation of CO_2 saturation.

Observation wells with monitoring logs

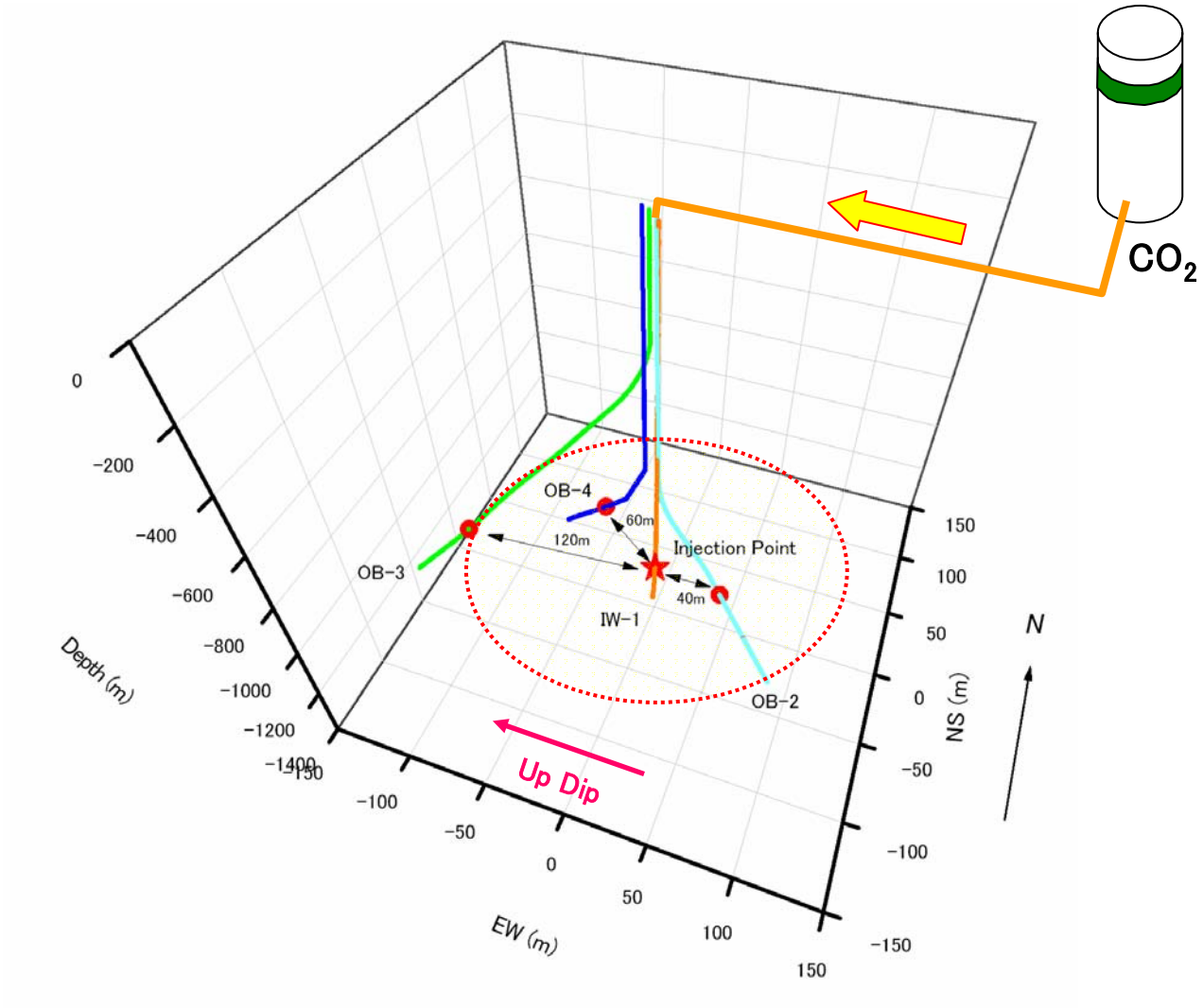
Induction Log (Resistivity)

Neutron Log (Porosity)

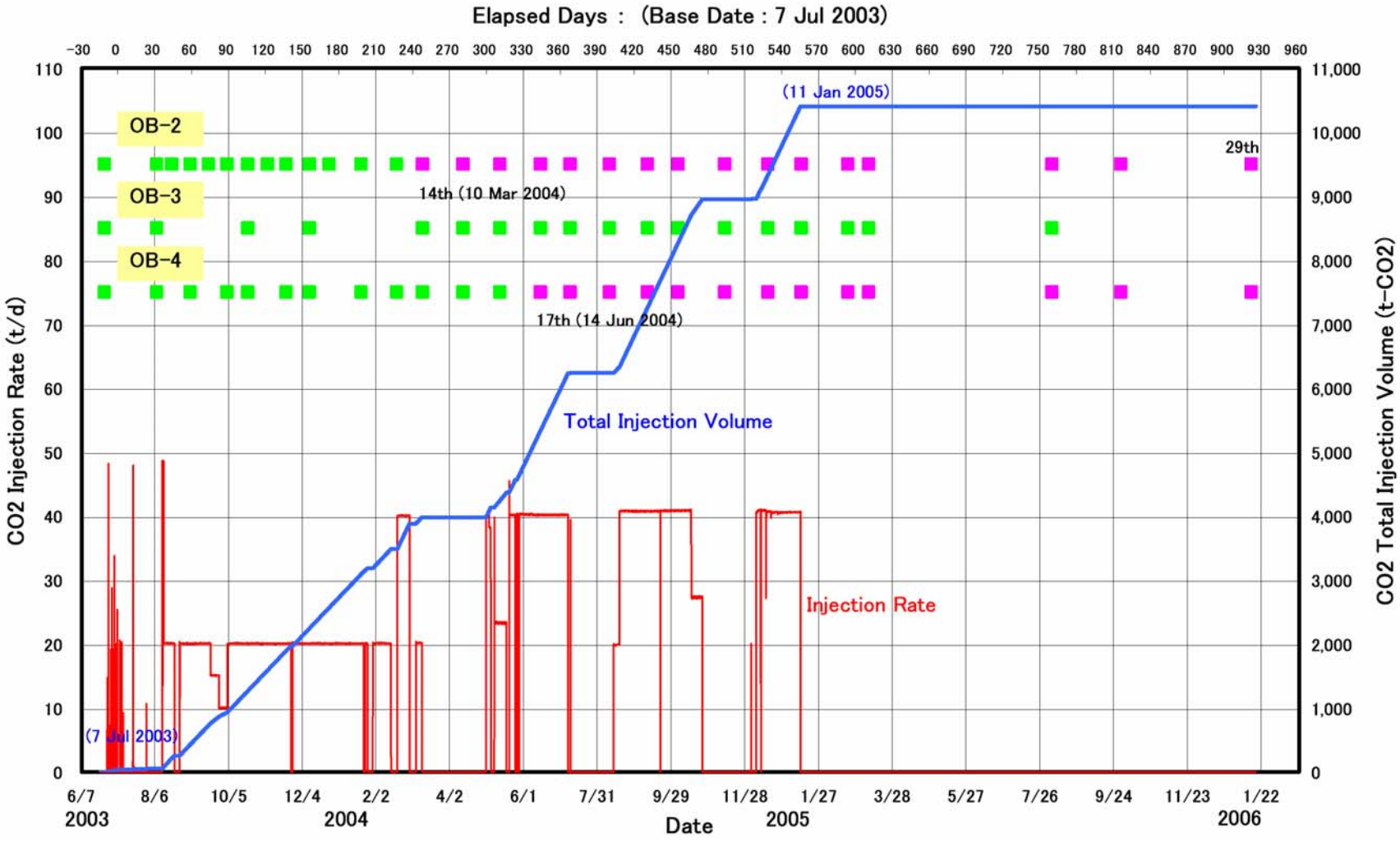
Acoustic Log (Acoustic Velocity)

Wireline logging unit at Iwanohara field

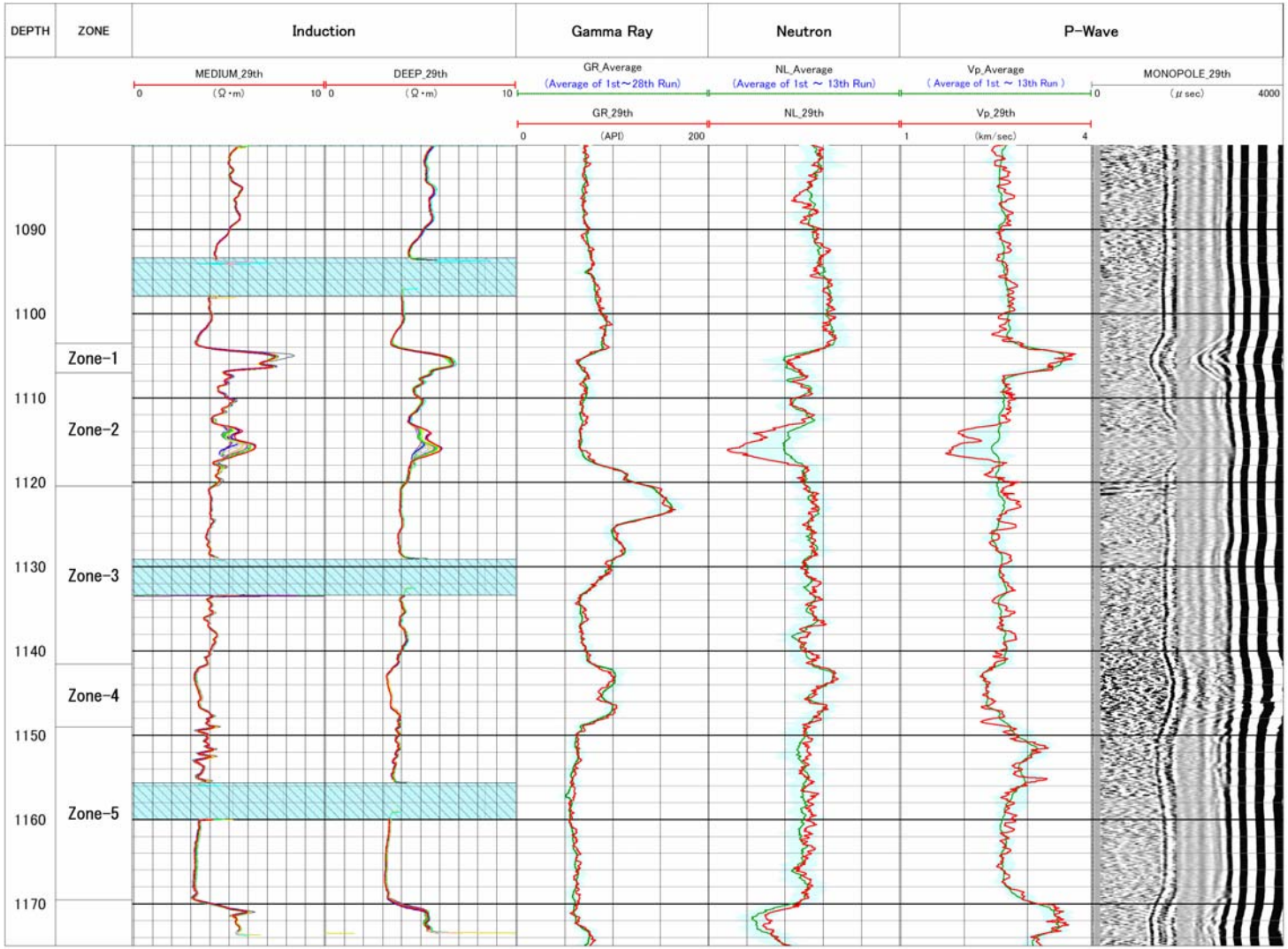
3D configuration of the wells



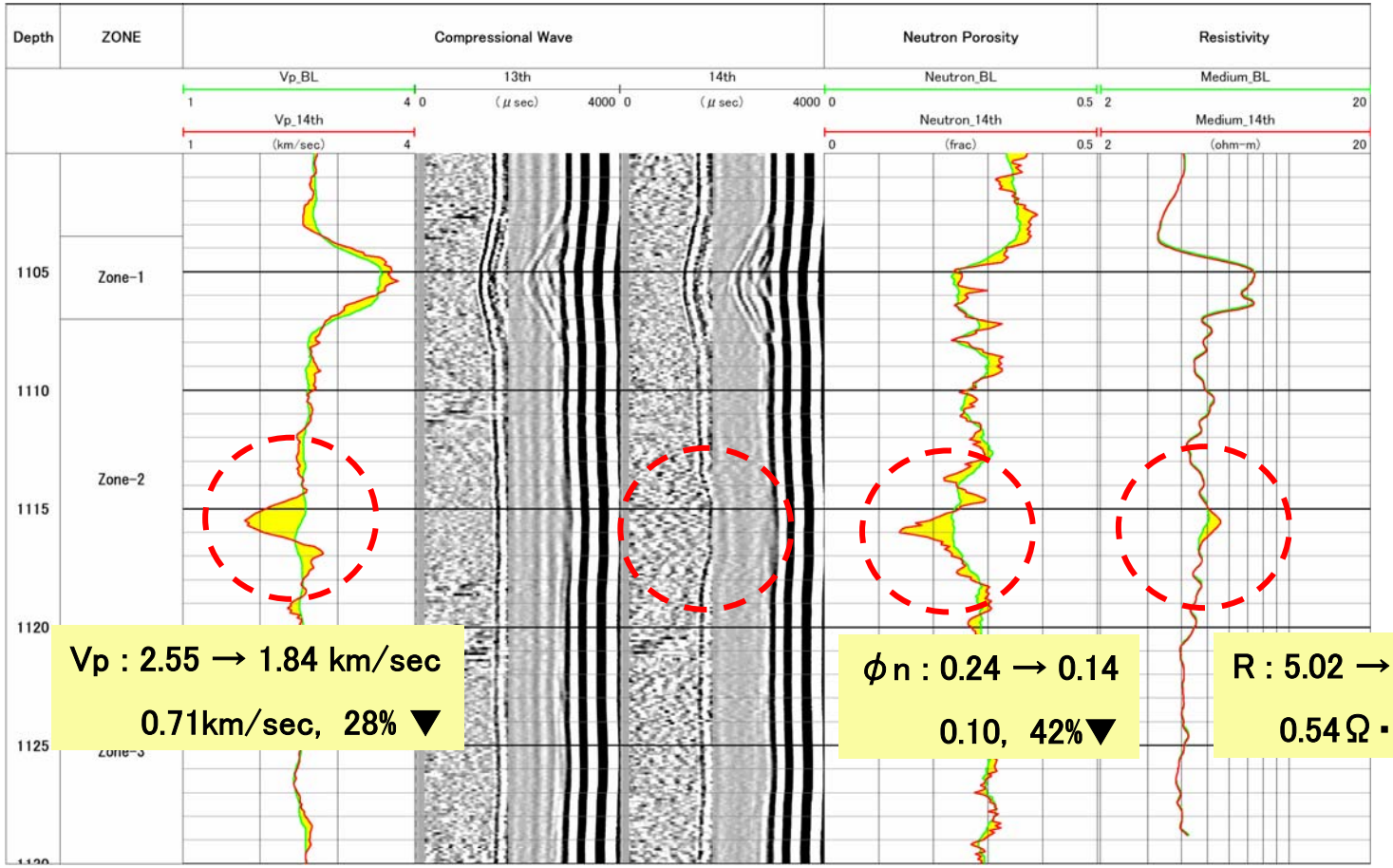
Time lapse logging schedule



Results of time lapse logging (OB-2)



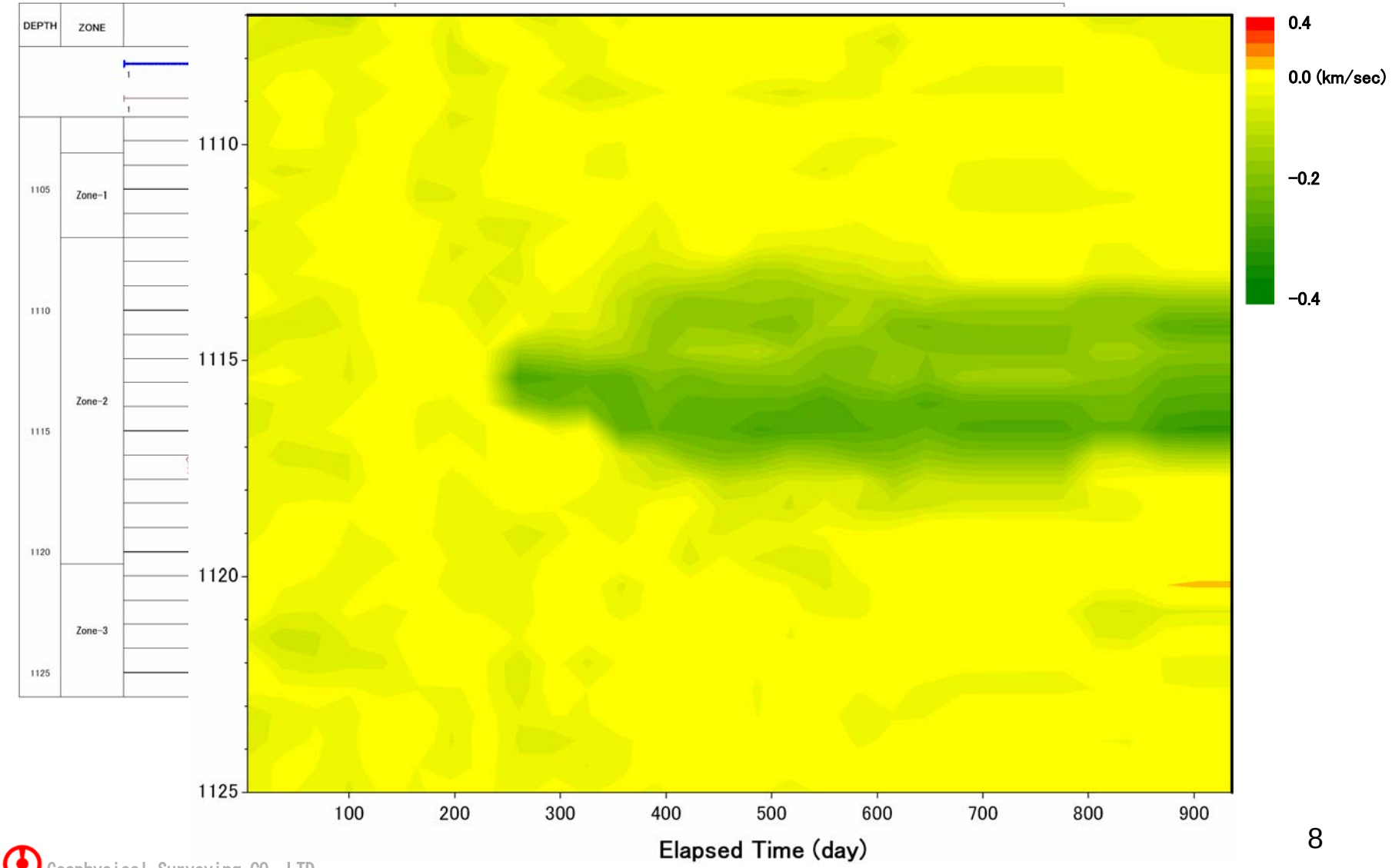
CO_2 Breakthrough (OB-2)



Feb. 12. 2004 → Mar. 10. 2004

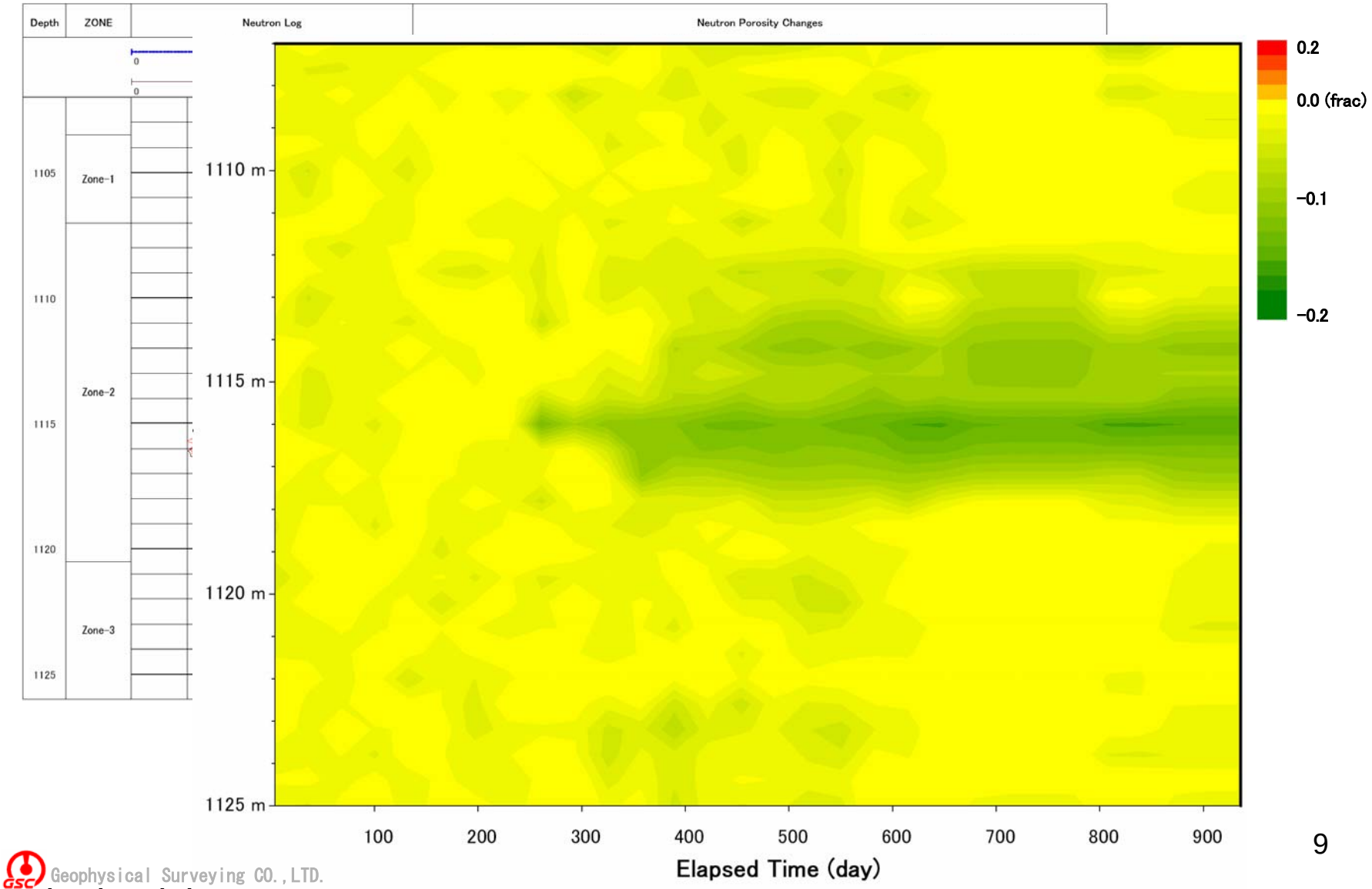
Change of ΔVp (OB-2)

Acoustic Log



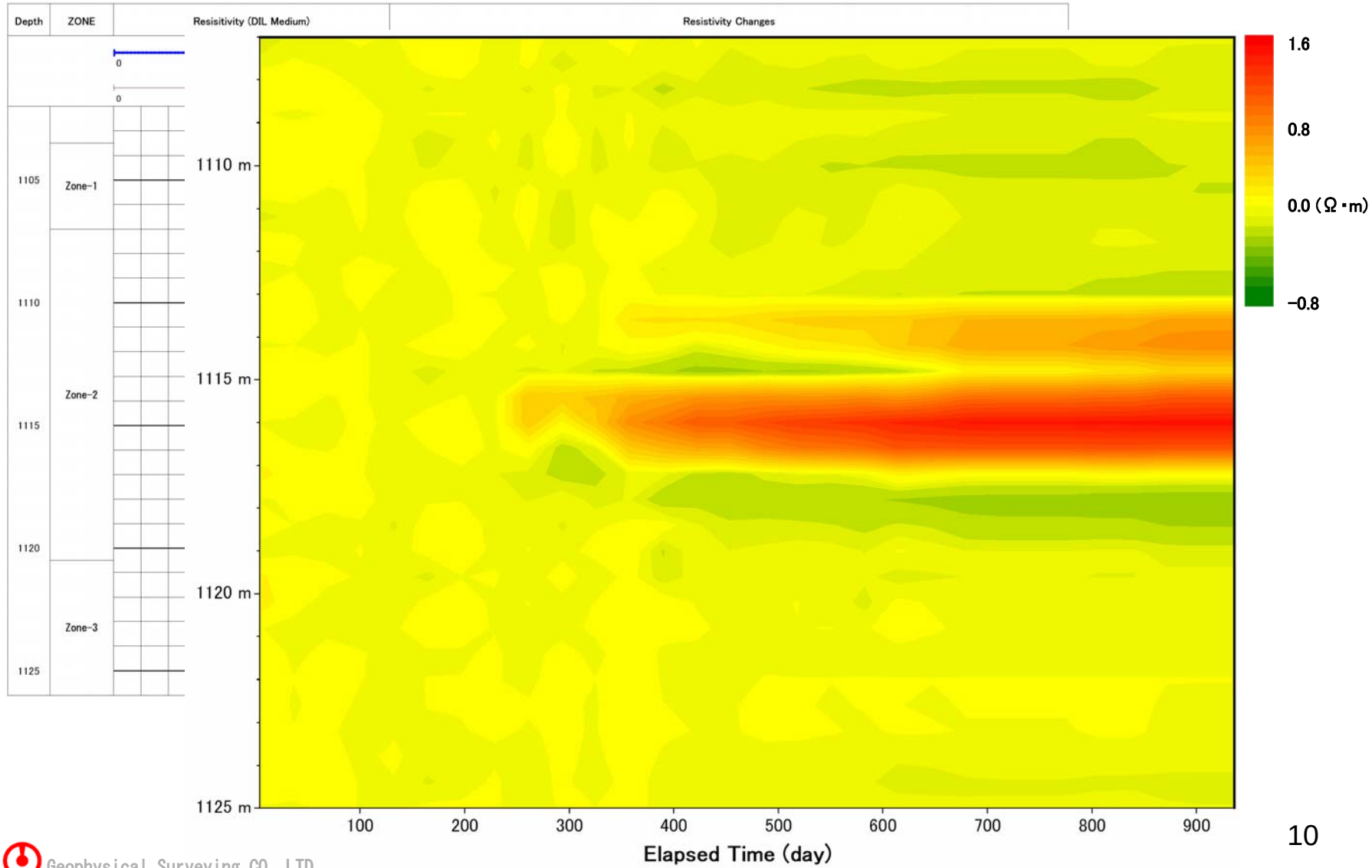
Change of $\Delta\phi n$ (OB-2)

Neutron Log

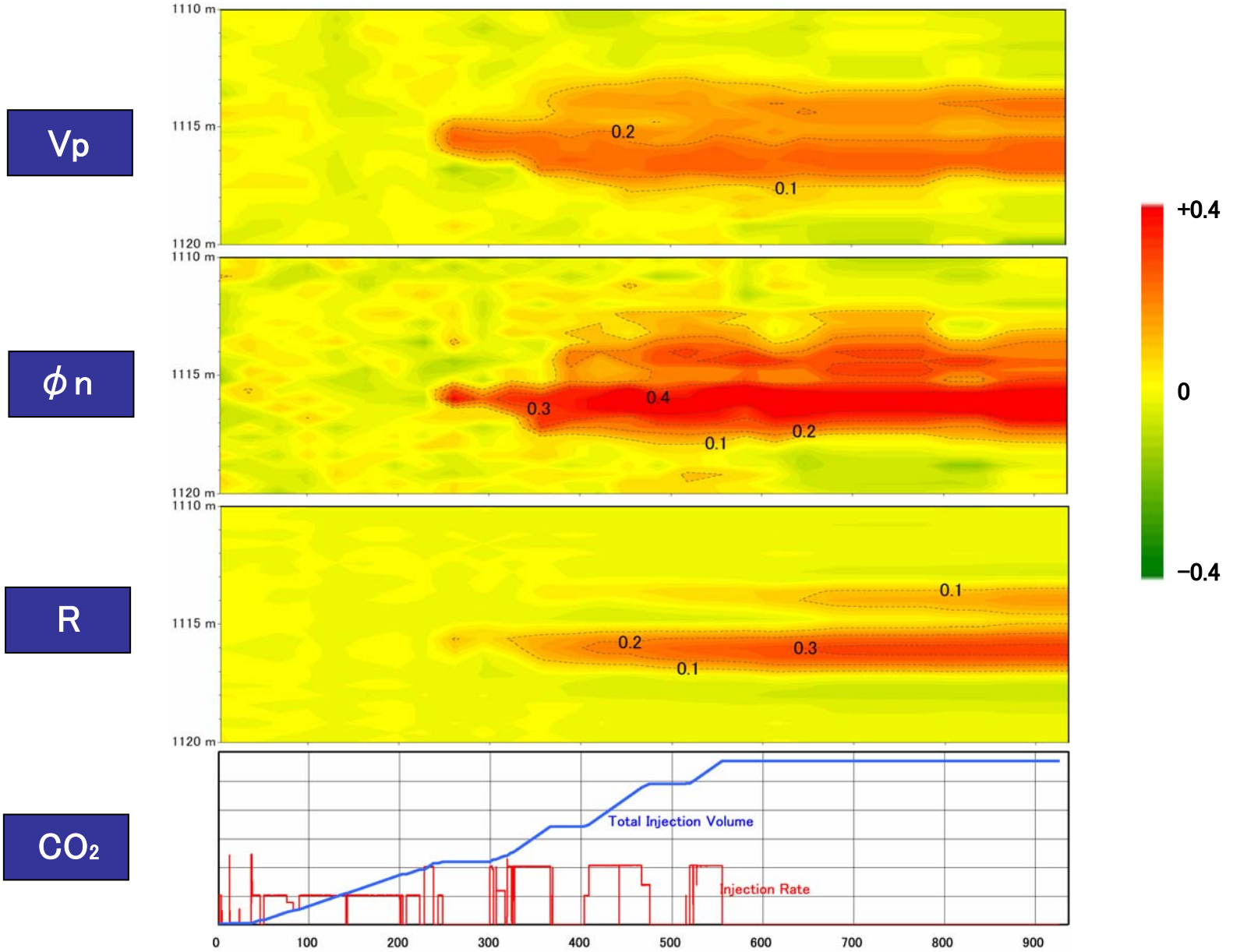


Change of ΔR (OB-2)

Induction Medium Log



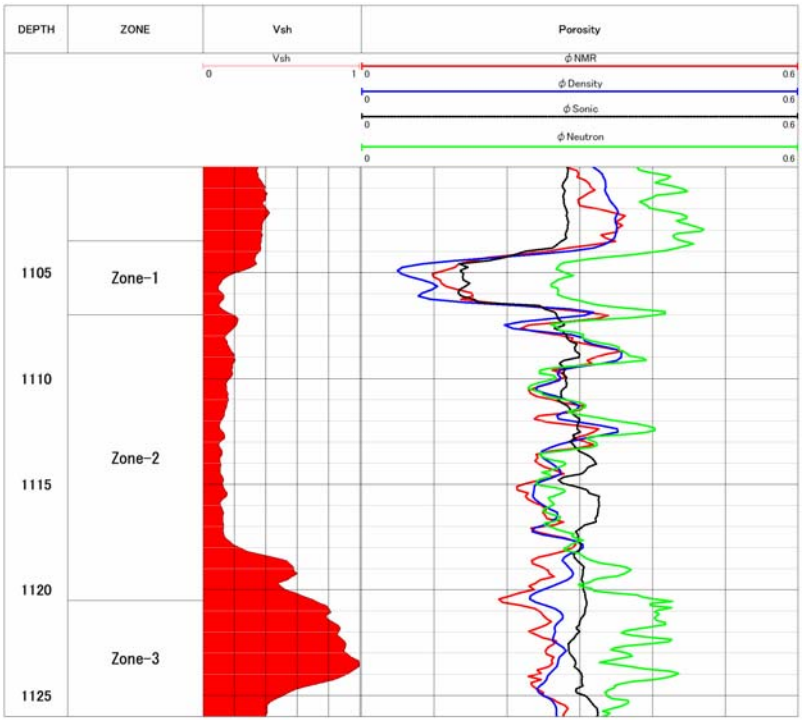
Rate of changes (OB-2)



Estimation of CO_2 saturation

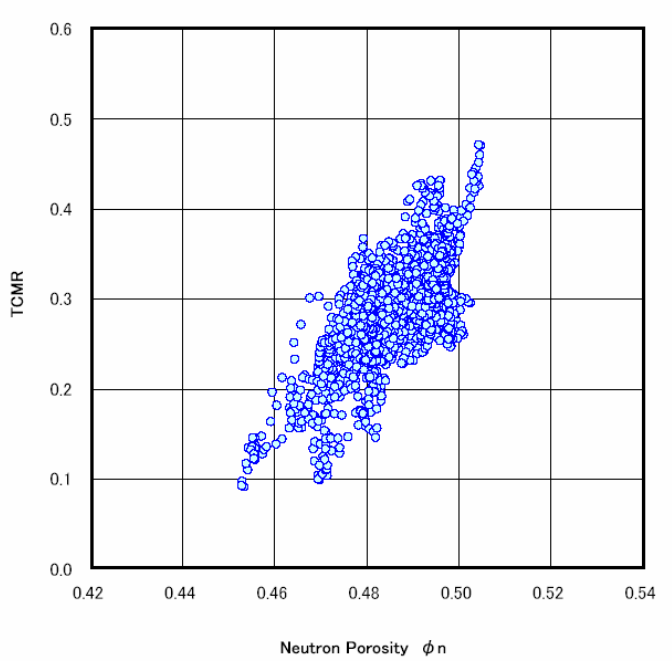
Assumptions :

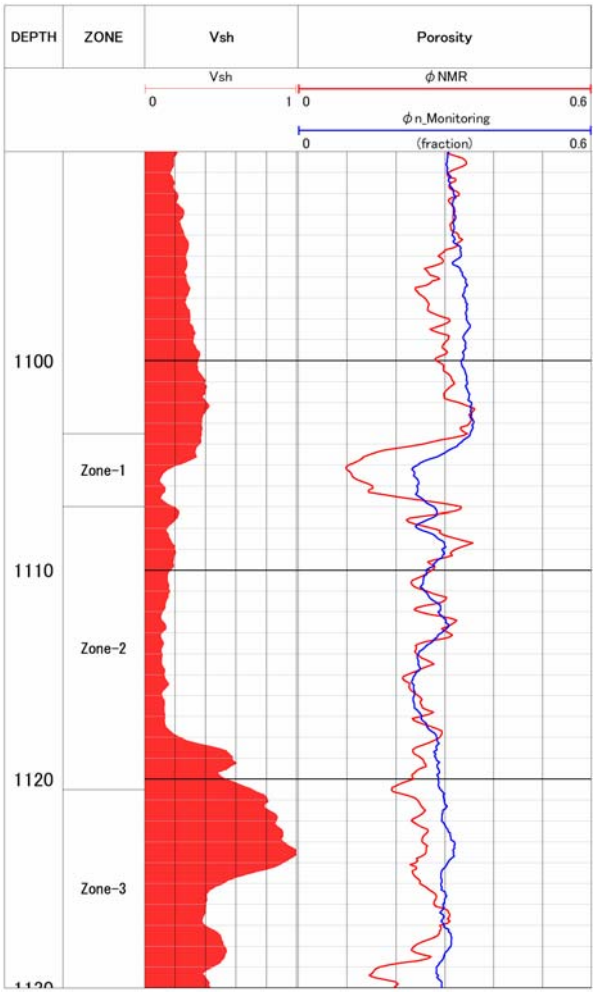
- ◆ No gas and oil in the aquifer before CO_2 breakthrough.
- ◆ The time lapse neutron log is equivalent the open hole porosity log.



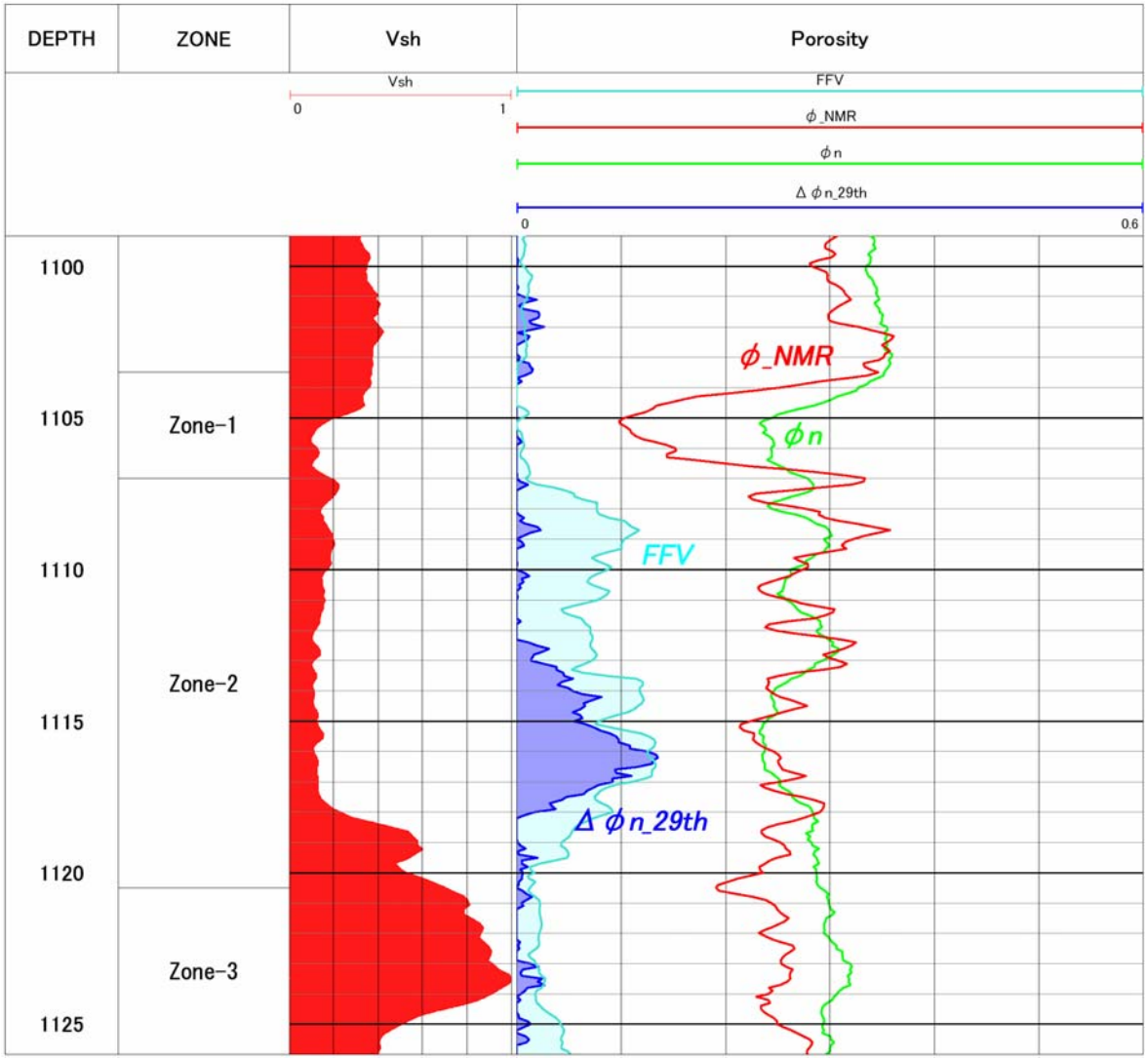
Time lapse neutron log calibration

NMR log Vs Time lapse neutron log

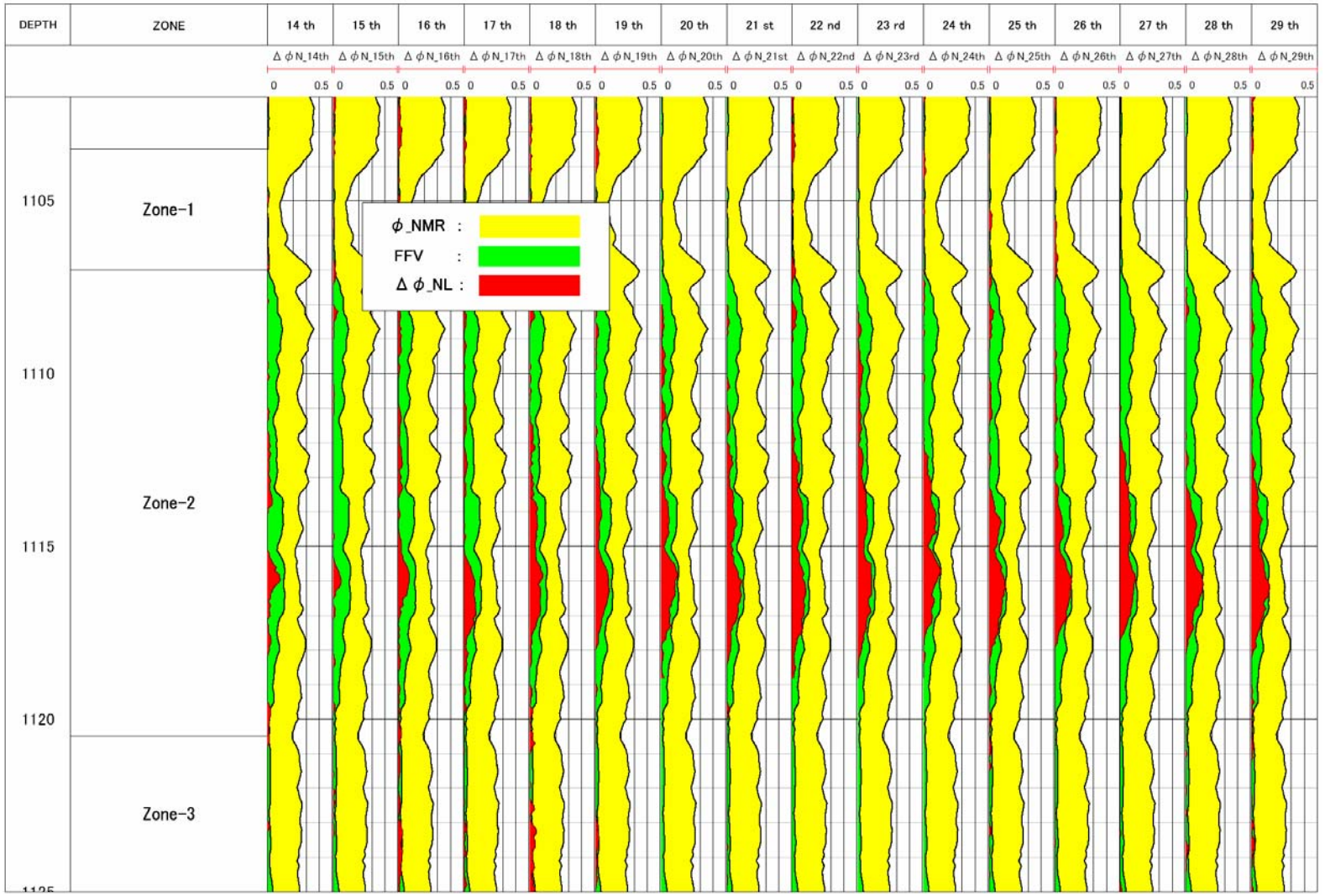




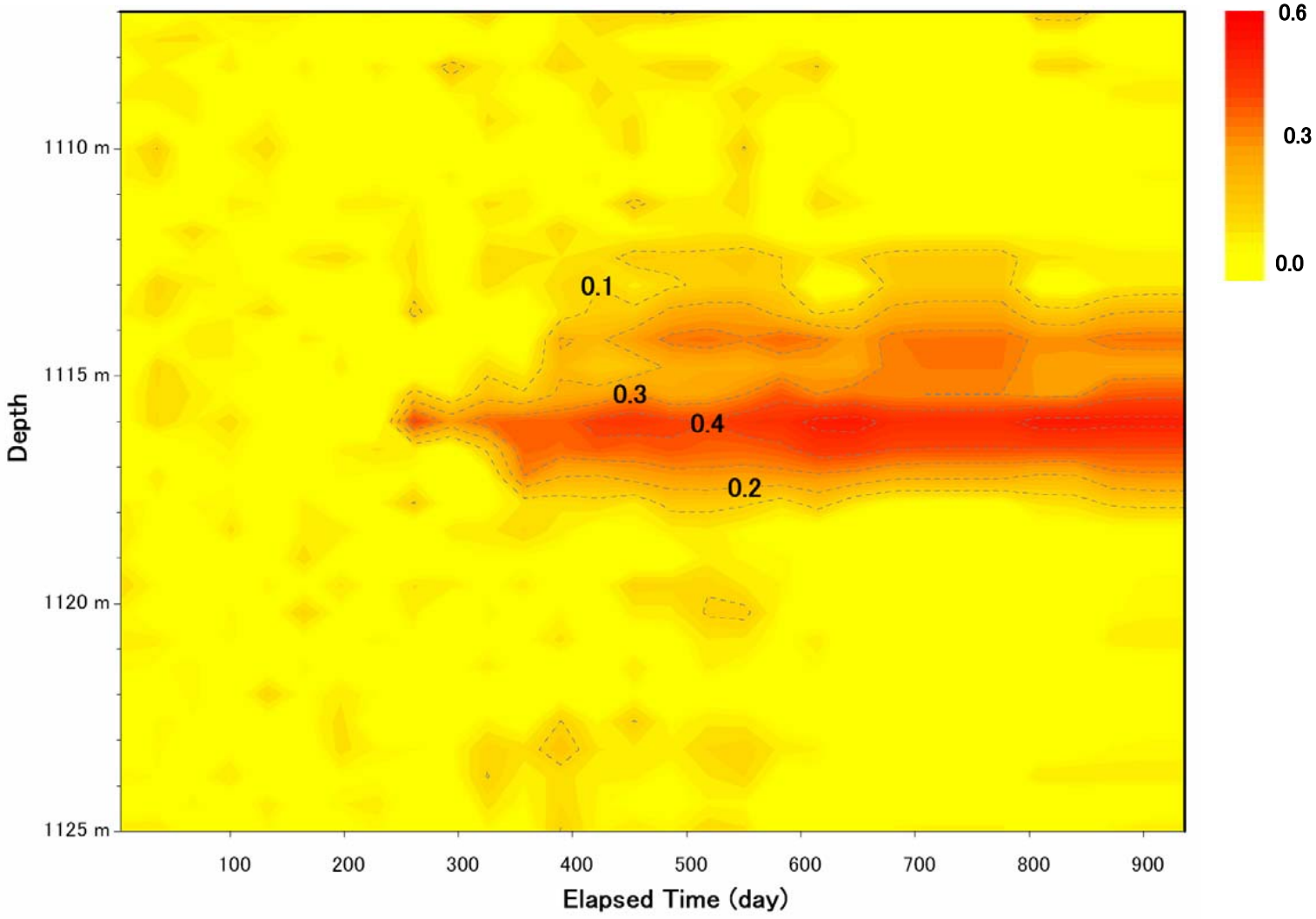
Porosity Log （OB-2）



Change of Porosity （OB-2）



CO_2 Saturation Map （OB-2）



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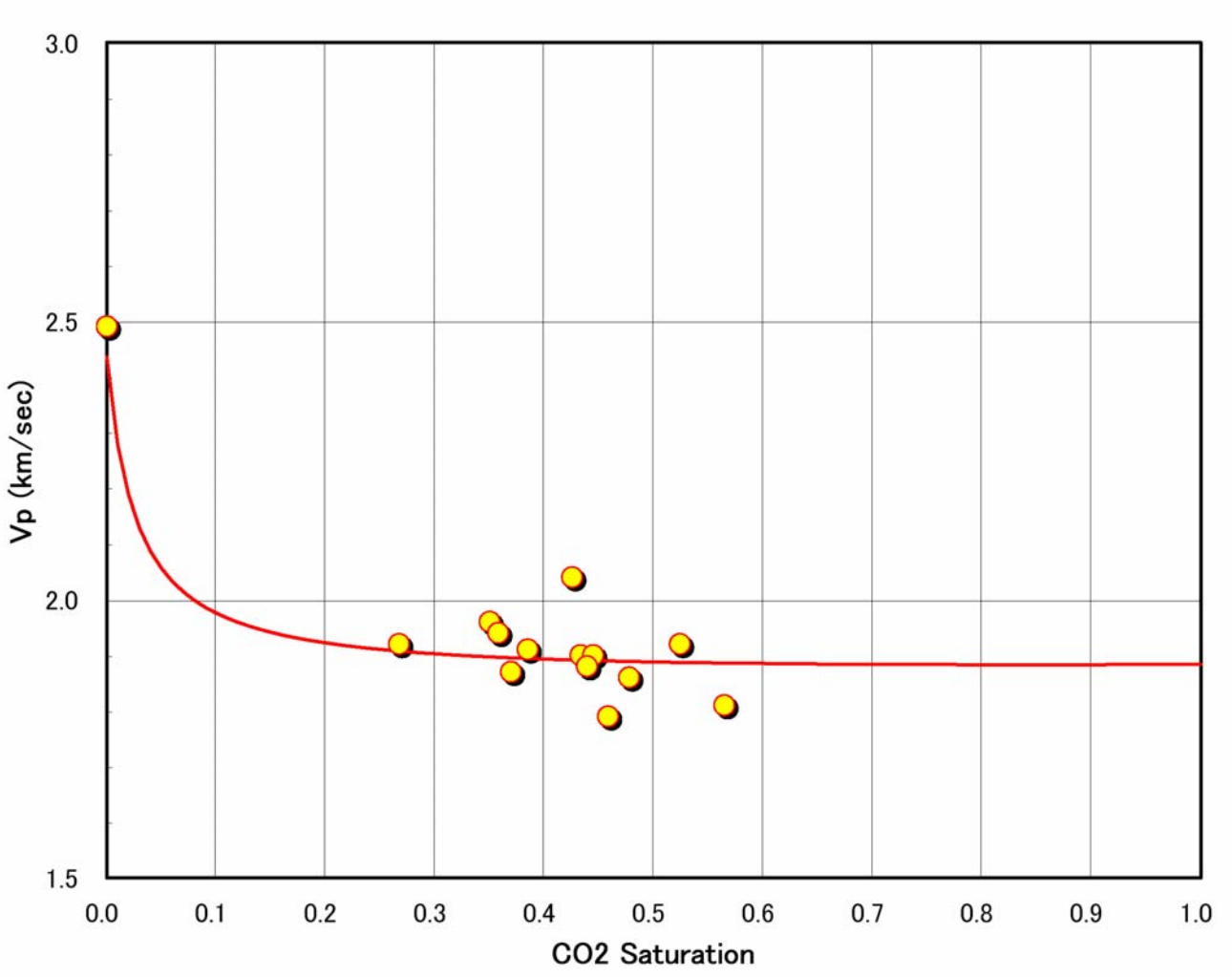
Vp Response (OB-2, @1,116m)



Conclusions 1

Resistivity

- The resistivity log is good in reproducibility.
- CO_2 saturation from resistivity is smaller than CO_2 saturation from neutron log . It is difficult to estimate correct CO_2 saturation from resistivity on present form. The phase behavior of CO_2 in the reservoir is still unknown.

Neutron

- The hydrogen index measurement is easiest and certain way to estimate CO_2 saturation.

Conclusions 2

Acoustic

- A small amount of CO_2 causes a large drop in Vp.
- The relation between Vp and CO_2 saturation from neutron log agree with Gassmann theory.
- CO_2 saturation can be presumed from change of Vp.

Jan. 13. 2006