Hydrogeochemical Study to Determine Active Hydrodynamic Flow in Hydrocarbon Reservoir: The Case Study of Central Sumatra Basin

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N°1790

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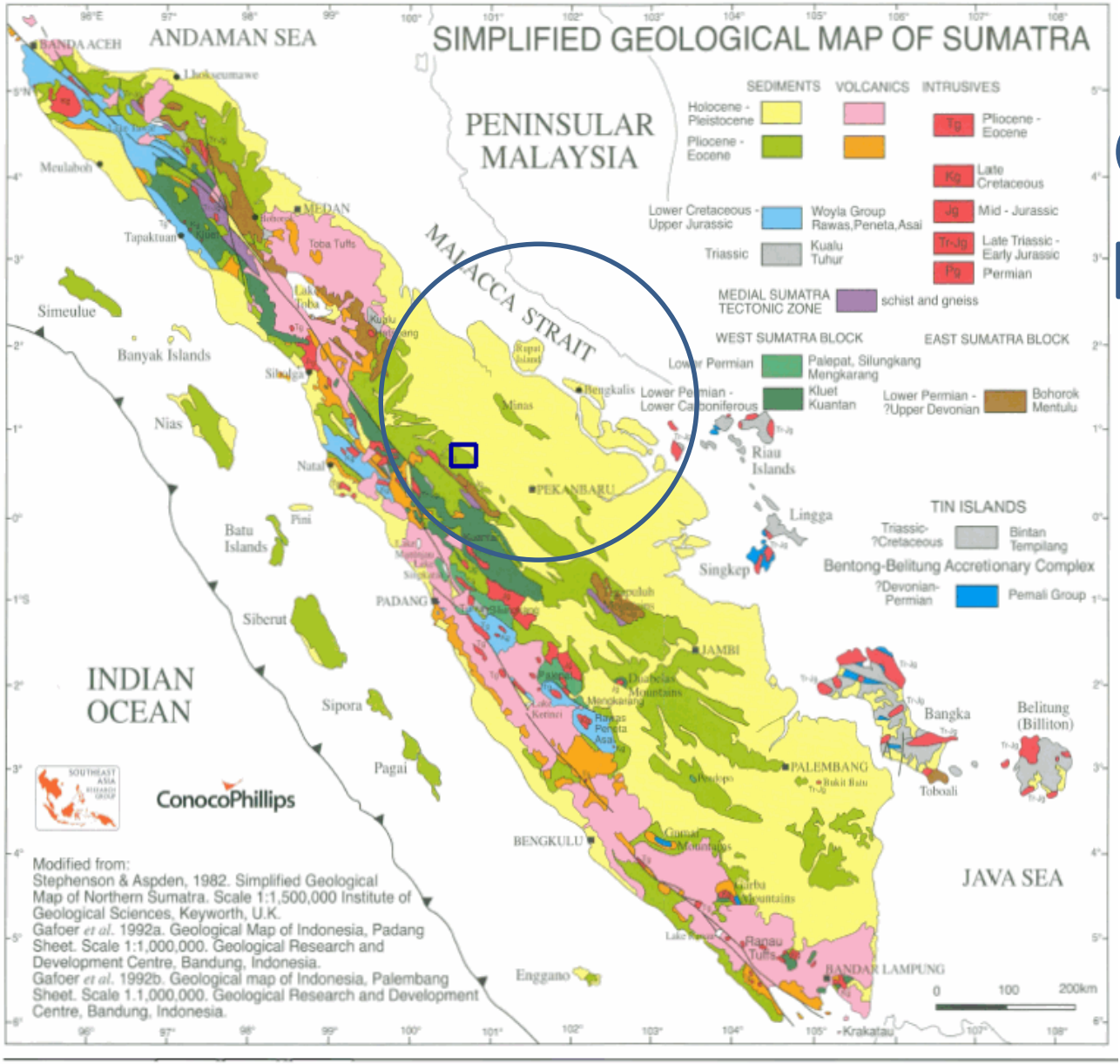
25-29th September 2016 Montpellier, France CORUM CONFERENCE CENTER 43rd IAH congress

Background

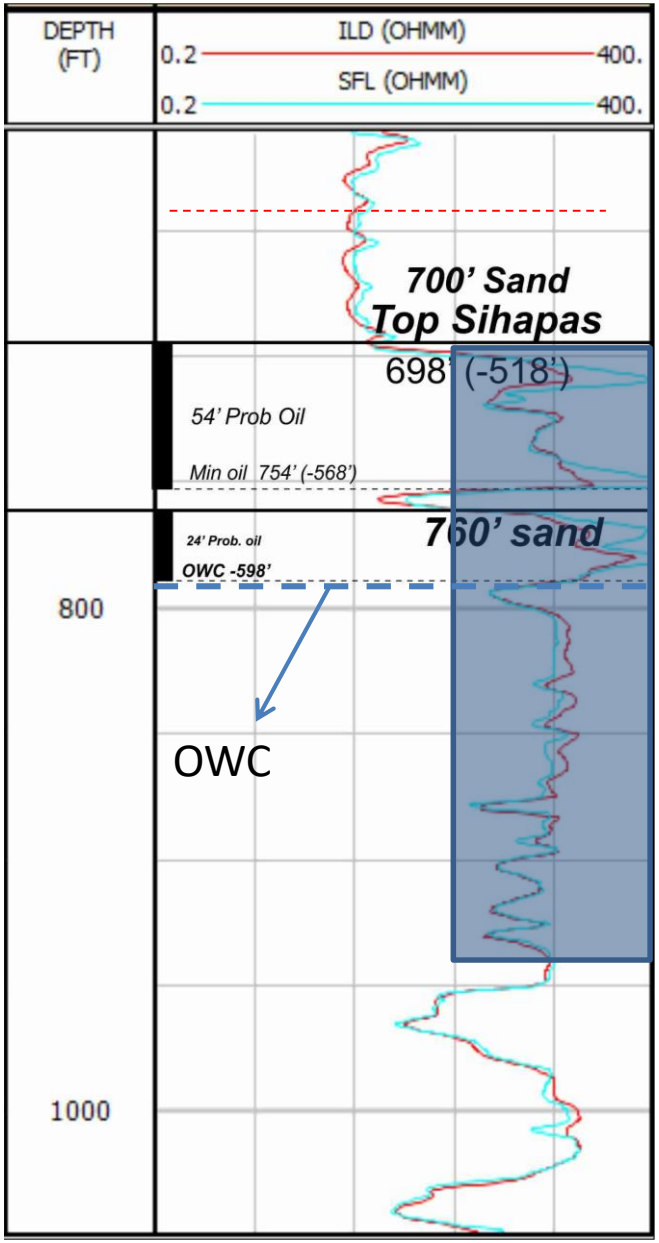
Research Area



Central Sumatra Basin

Research Area

Resistivity Data



Average resistivity value: 300 – 400 ohmmeter

Serra (2007):

- → Igneous rocks
- → Metamorphic rocks
- → Low porosity sedimentary rocks
- → Non-conductive material: oil, gas, fresh water, bitumen, asphalt

Fresh water (?)

Objectives

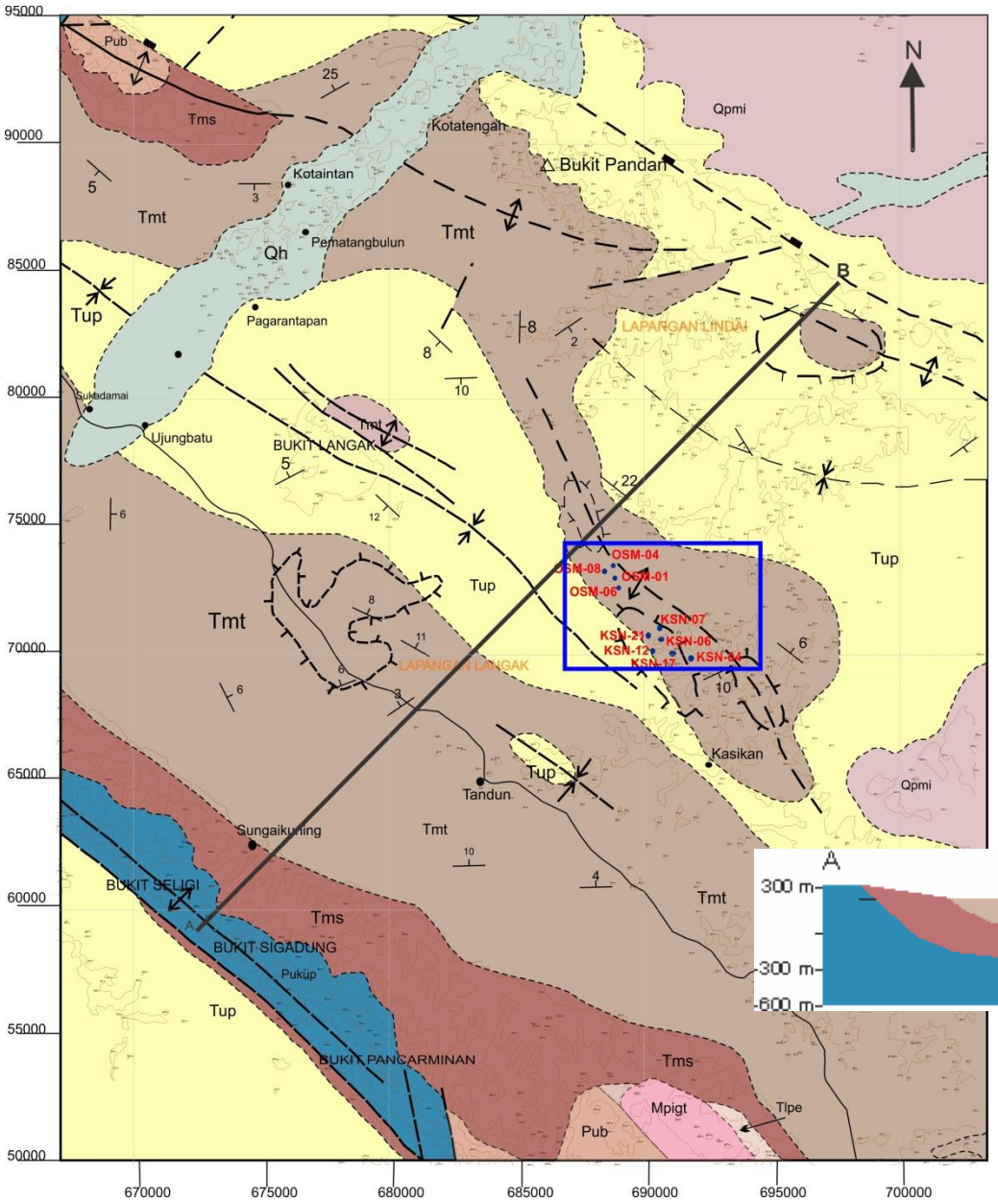
1. To determine formation water characteristics

2. To determine the source of water in reservoir

→ To investigate the presence of active hydrodynamic flow

Geological Setting

Geological Map



LEGEND :

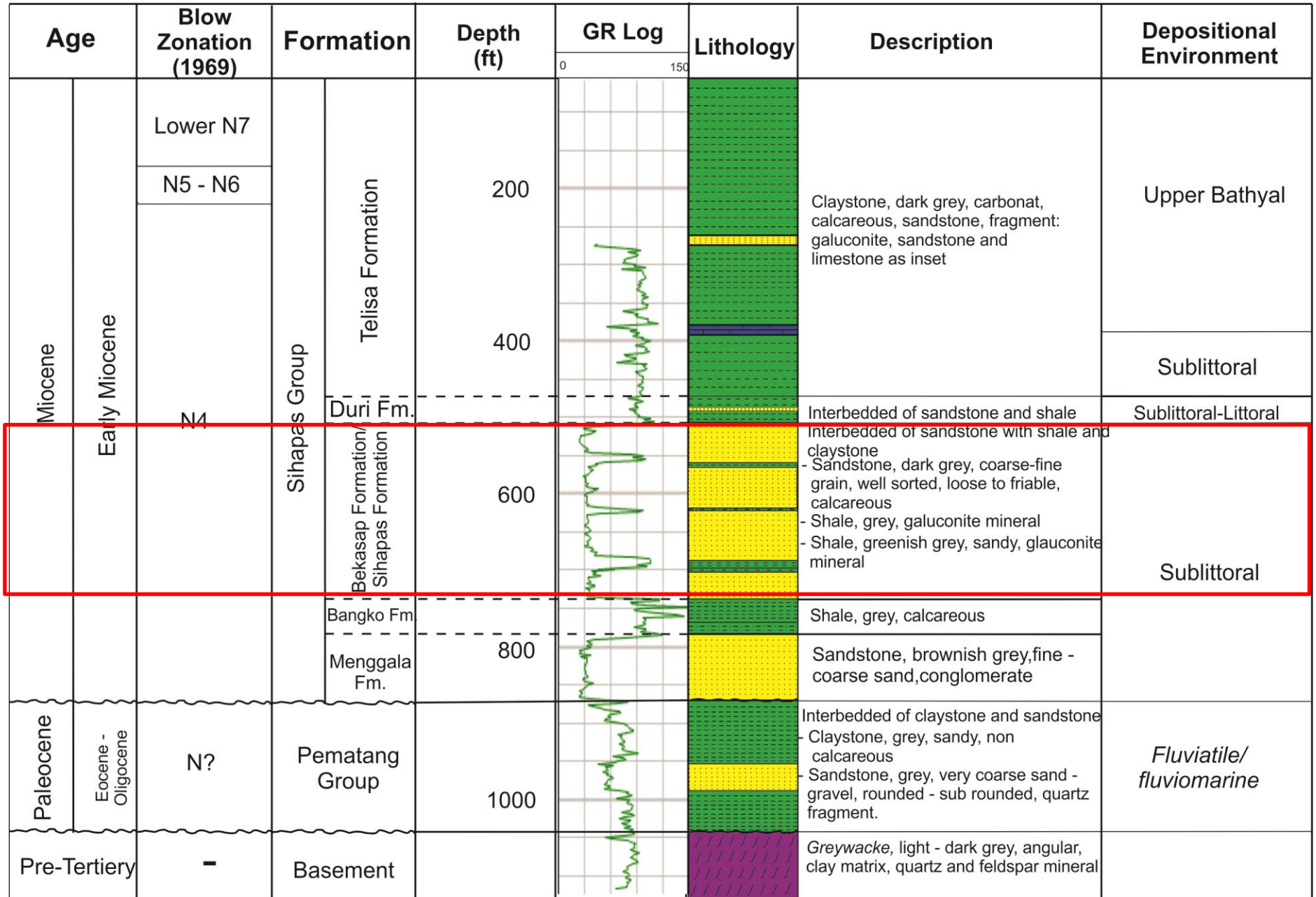
- Qh — Alluvium
- Qpmi — Minas Formation
- Tup — Petani Formation
- Tmt — Telisa Formation
- Tms — Sihapas Formation
- Tlpe — Pematang Formation
- Pukup, Pub — Basement
- Mpigt — Granite Giti
- Formation Boundary
- Interpreted Strudture
- Dip
- Interpreted Fold
- Research Area

Scale

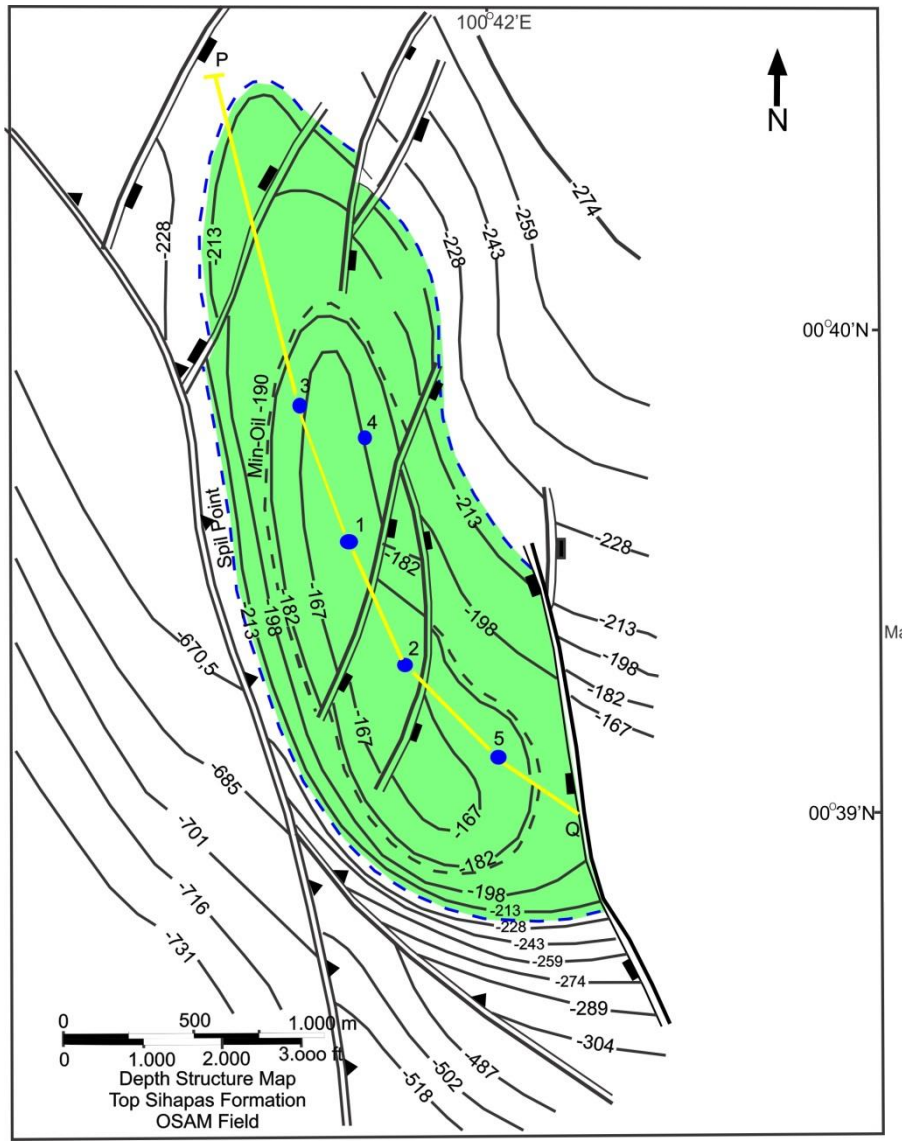
0 km 2.5 km 5 km 7.5 km 10 km

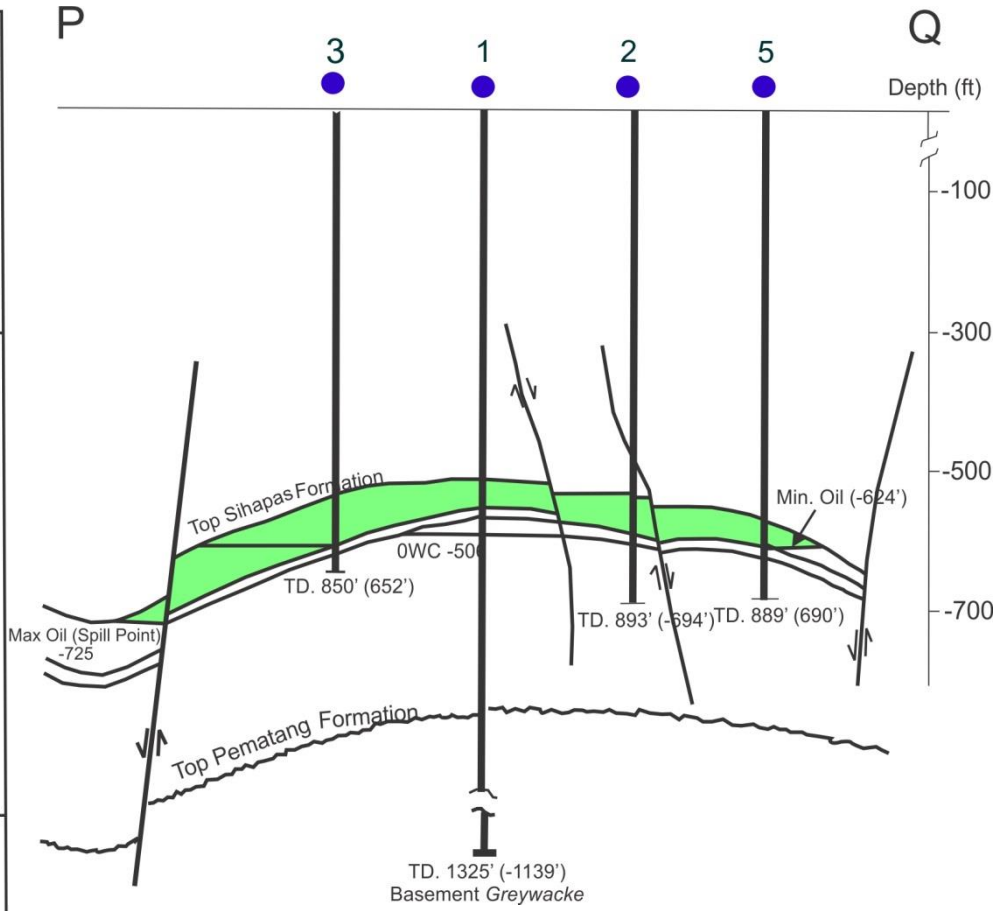
(modified after Clarke, et al., 1982)

Stratigraphy



Geological Structure

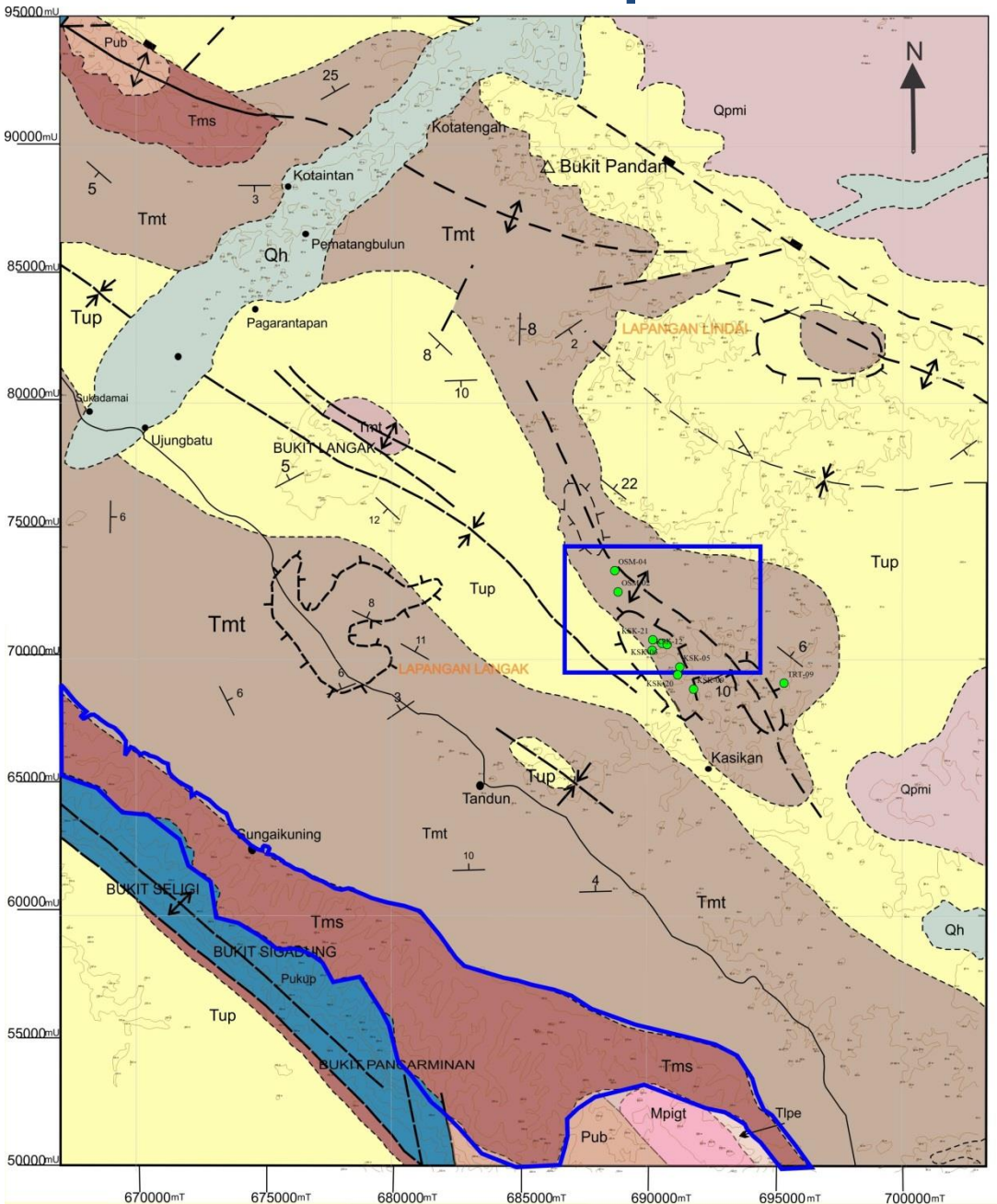




(Courteney et al., 2006)

Hydrochemistry Study

Sample Locations



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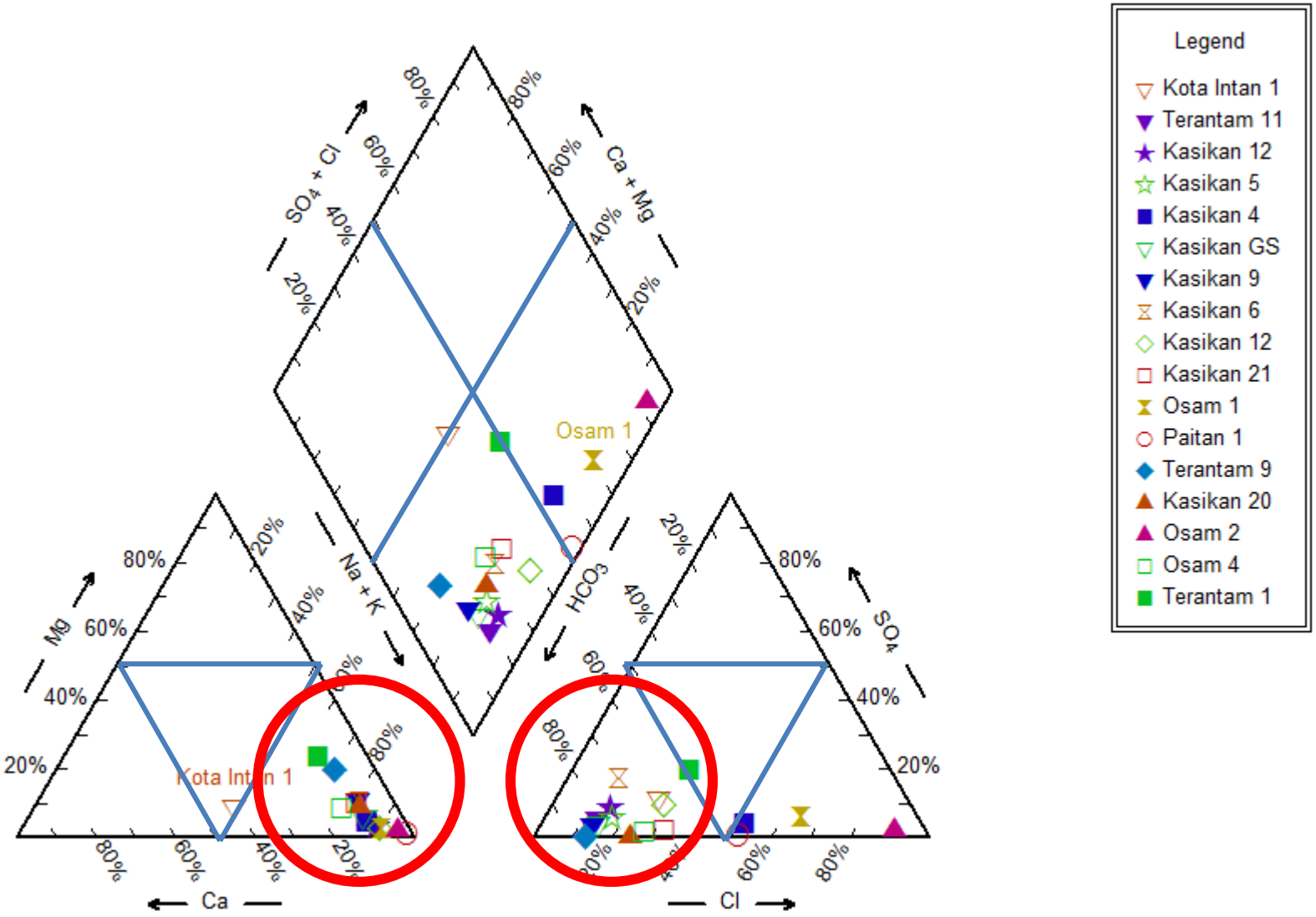
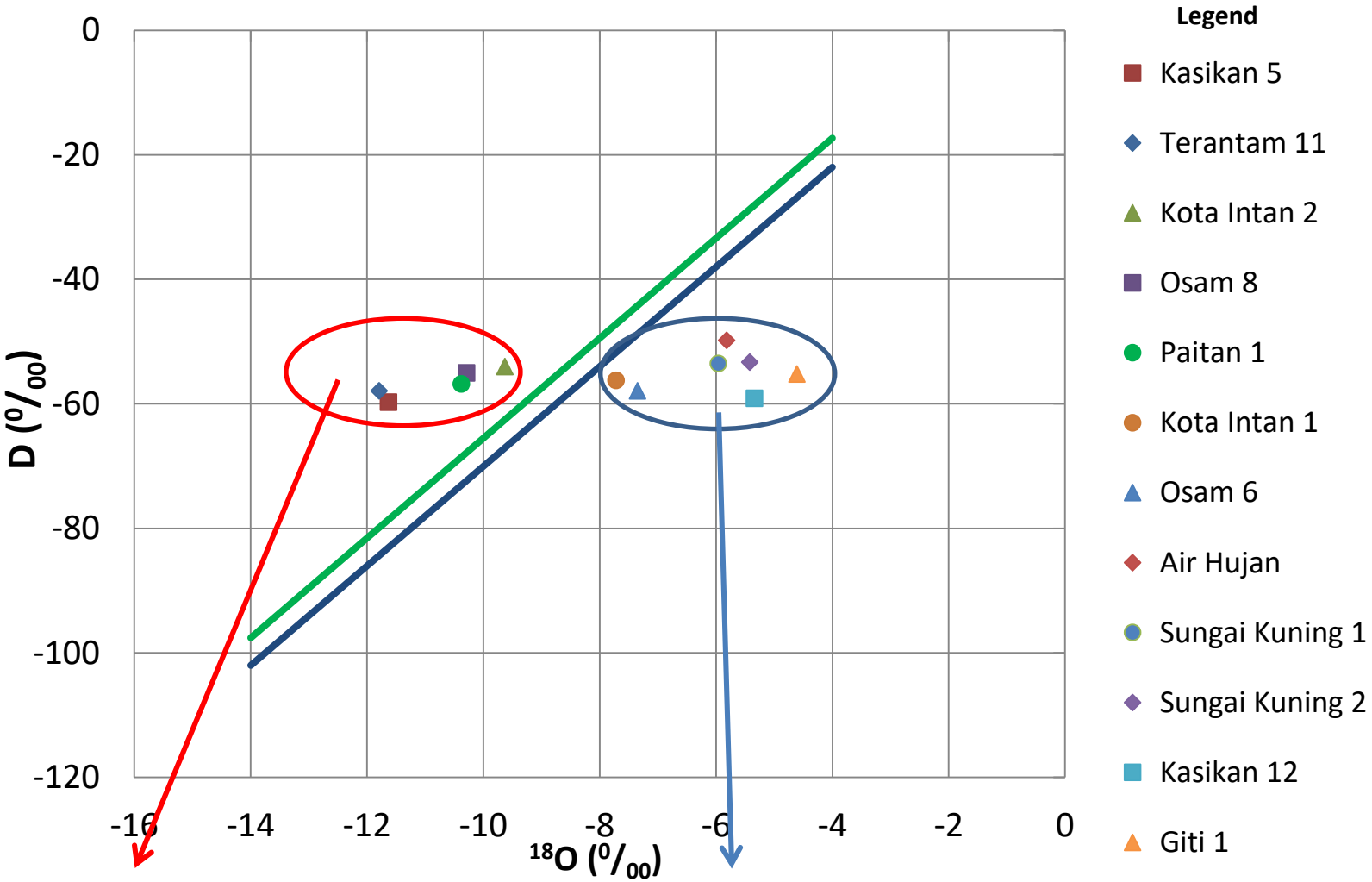
Piper Diagram



Na-bicarbonate water characteristics

Stable Isotop Analysis



Reaction with CO2

Evaporation

Hydraulic Conductivity

Samples Name	dl (m)	dh (m)	Water Age (year)	K (m/day)
KTI-2	24247	252	42.6	**69.5**
OSM-8	21960	265,4	40.8	**120**
OSM-6	22245	265	67.3	**75**
KSN-12	22284	264	54	**94**
GTI-1	28746	265	51.4	**164**

Unconsolidated sandstone

Discussion

1. Water Characteristics

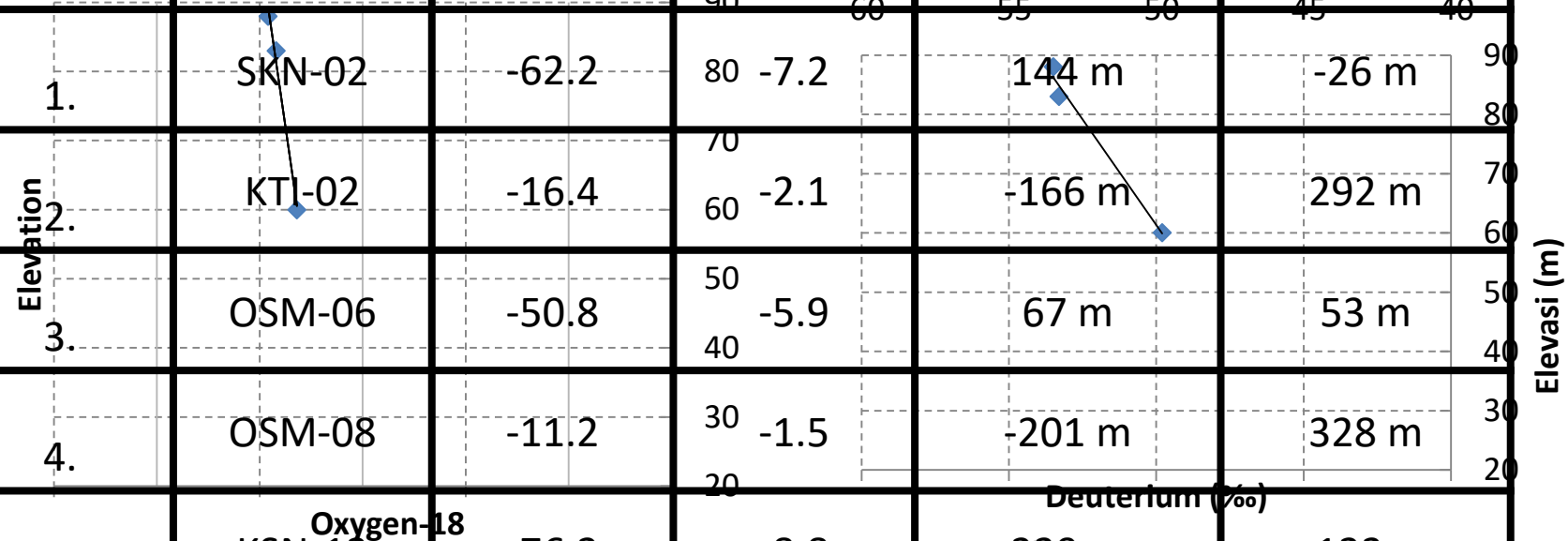
- High resistivity
- Water chemistry : Na-bicarbonate
- Isotope : Evaporation and reaction with CO2

→ The water is originated from meteoric water

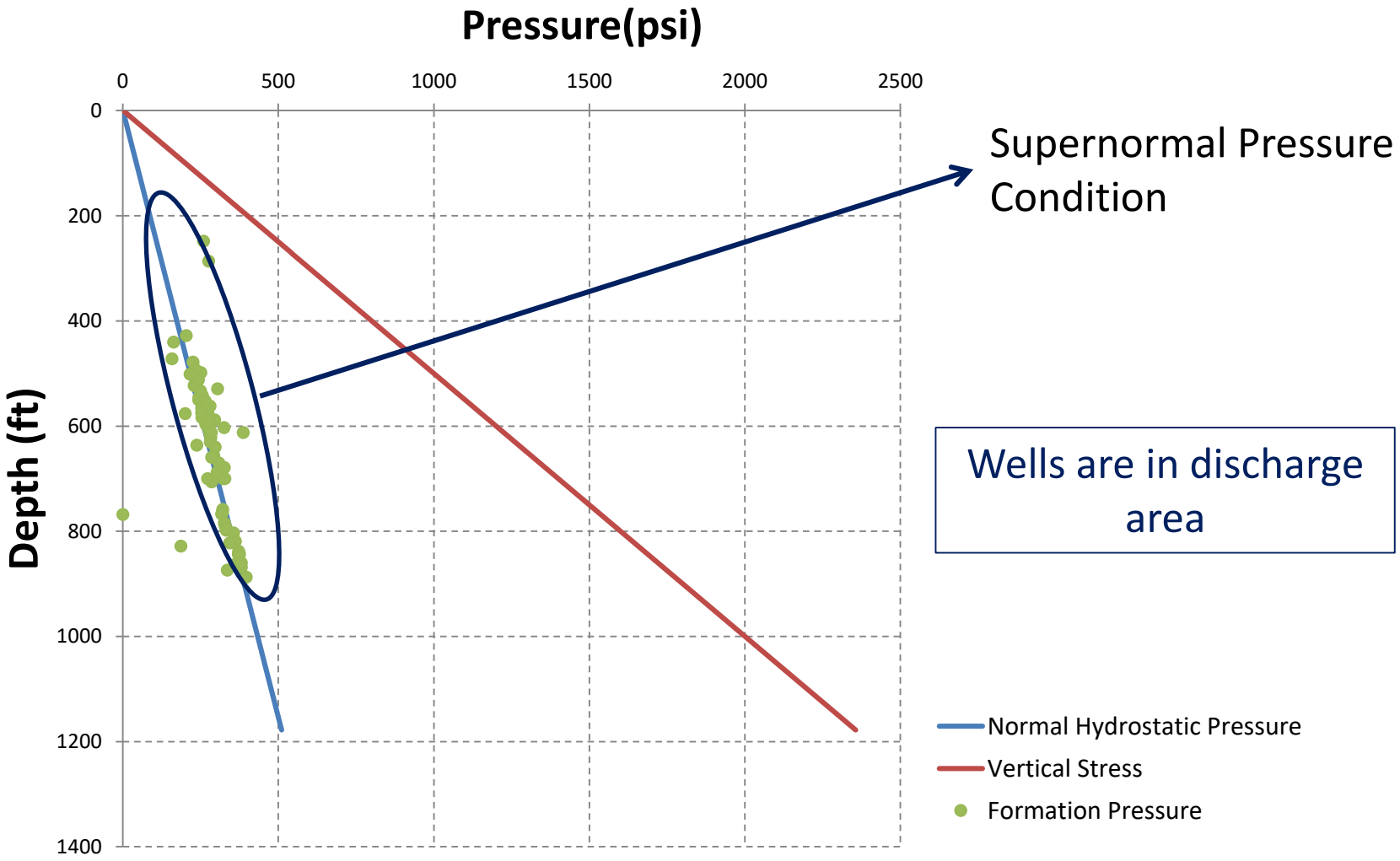
2. Recharge Area

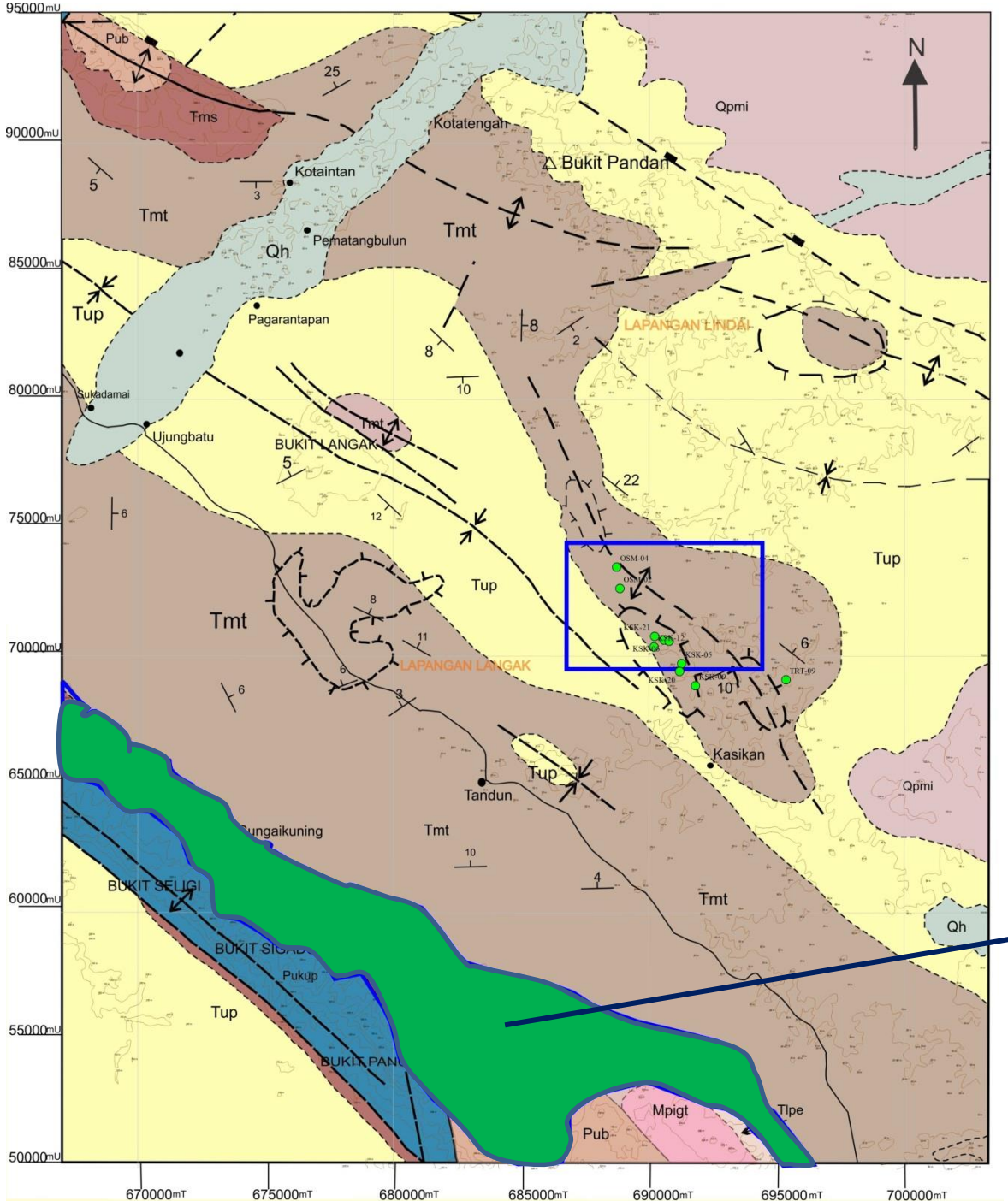
- Equation of the Elevation of recharge area

No	Oxygen-18 Sample	Intercept		Elevation (Deuterium)	Elevation (Oxygen-18)
		Deuterium	Oxygen-18		
1.	SKN-02	-62.2	-7.2	144 m	-26 m
2.	KTI-02	-16.4	-2.1	-166 m	292 m
3.	OSM-06	-50.8	-5.9	67 m	53 m
4.	OSM-08	-11.2	-1.5	-201 m	328 m
5.	KSN-12	-76.2	-8.8	239 m	-123 m
6.	GTI-01	-46.3	-2.8	37 m	247 m



Formation Pressure vs Normal Hydrostatic Pressure





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Recharge Area

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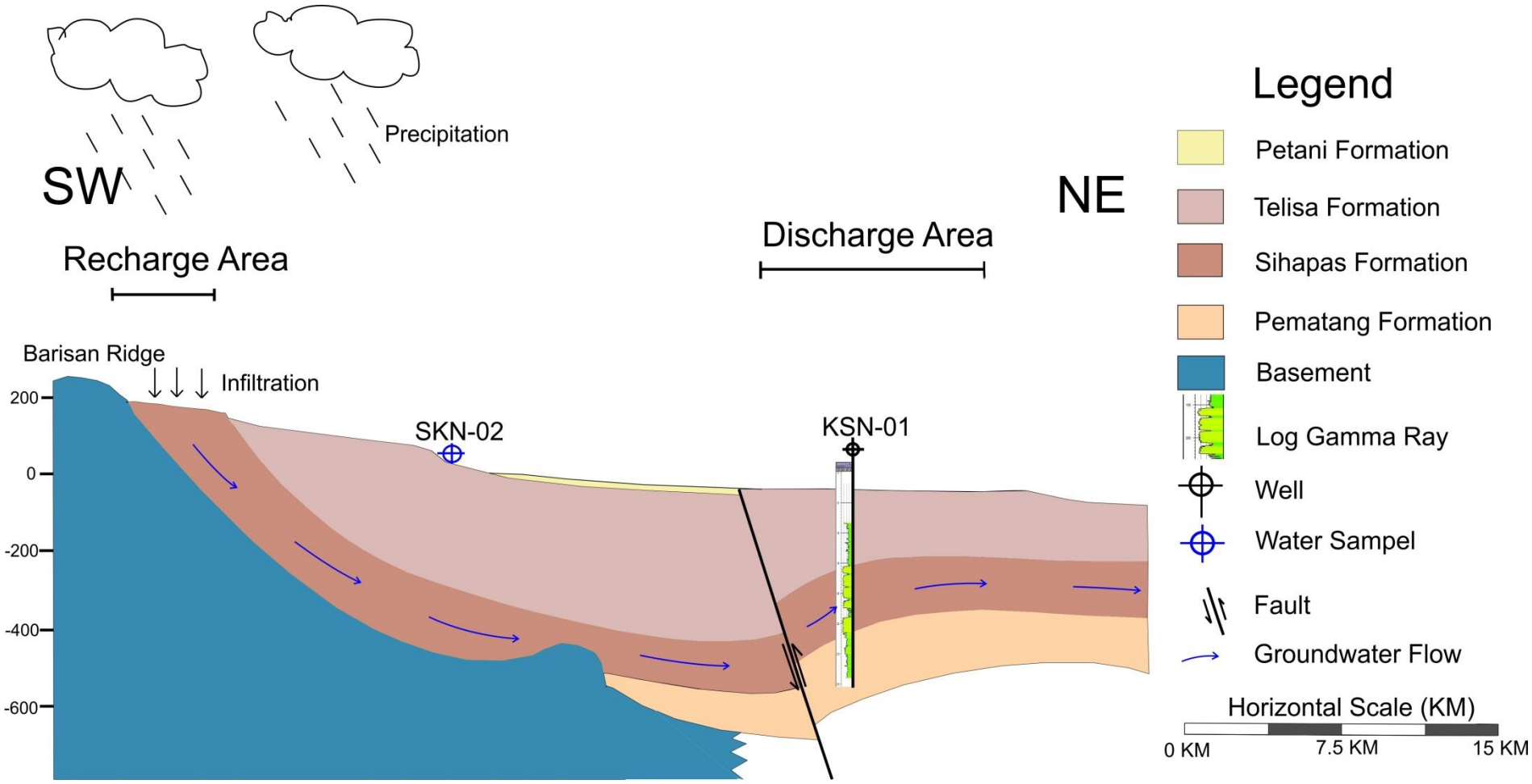
Groundwater Flow Scheme



Conclusion

Conclusions

1. Formation water is dominated by Na-bicarbonate water type

2. Source of groundwater → meteoric water that entering the reservoir from the outcrop in recharge area

→ Indication of active hydrodynamic flow

Thank You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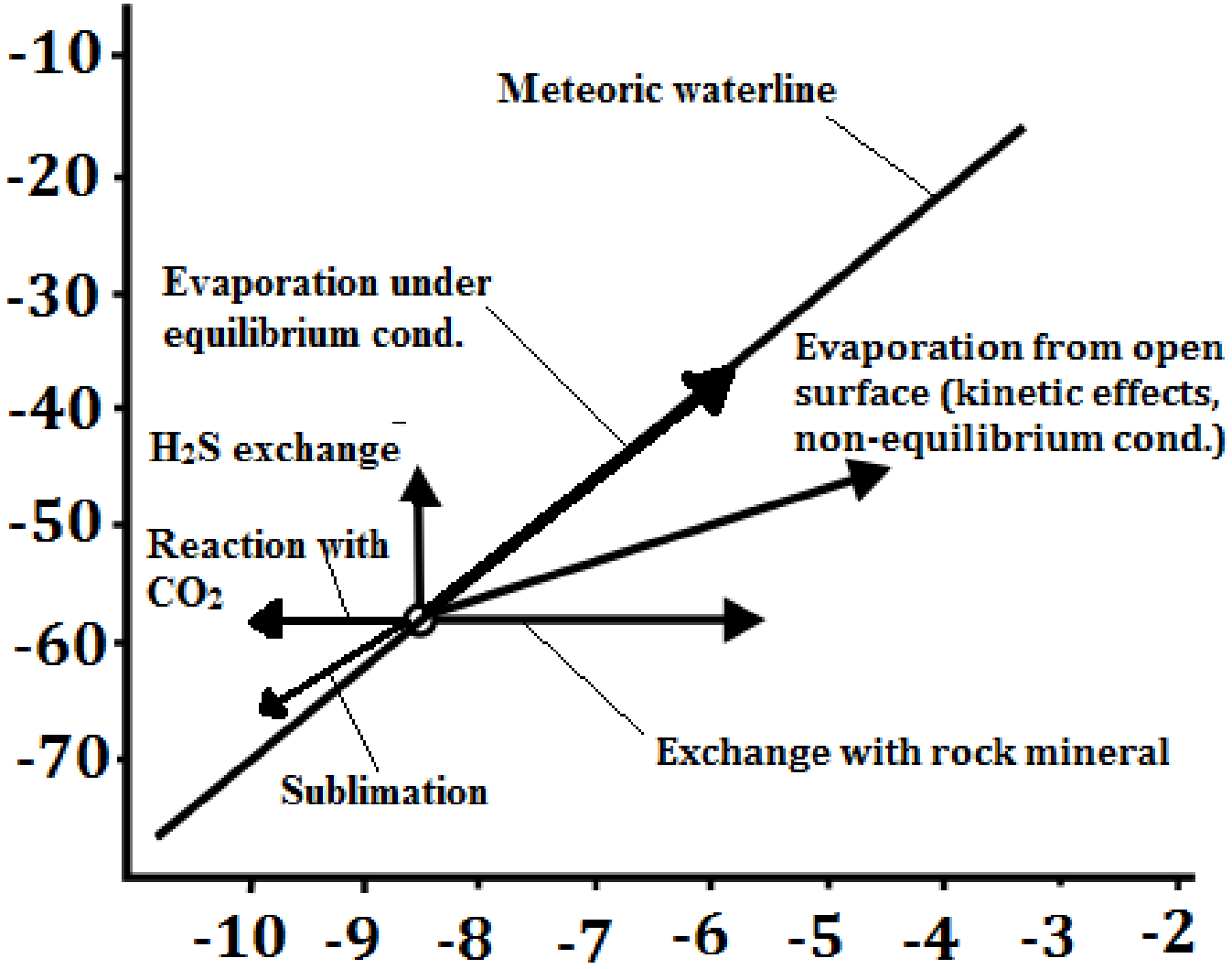
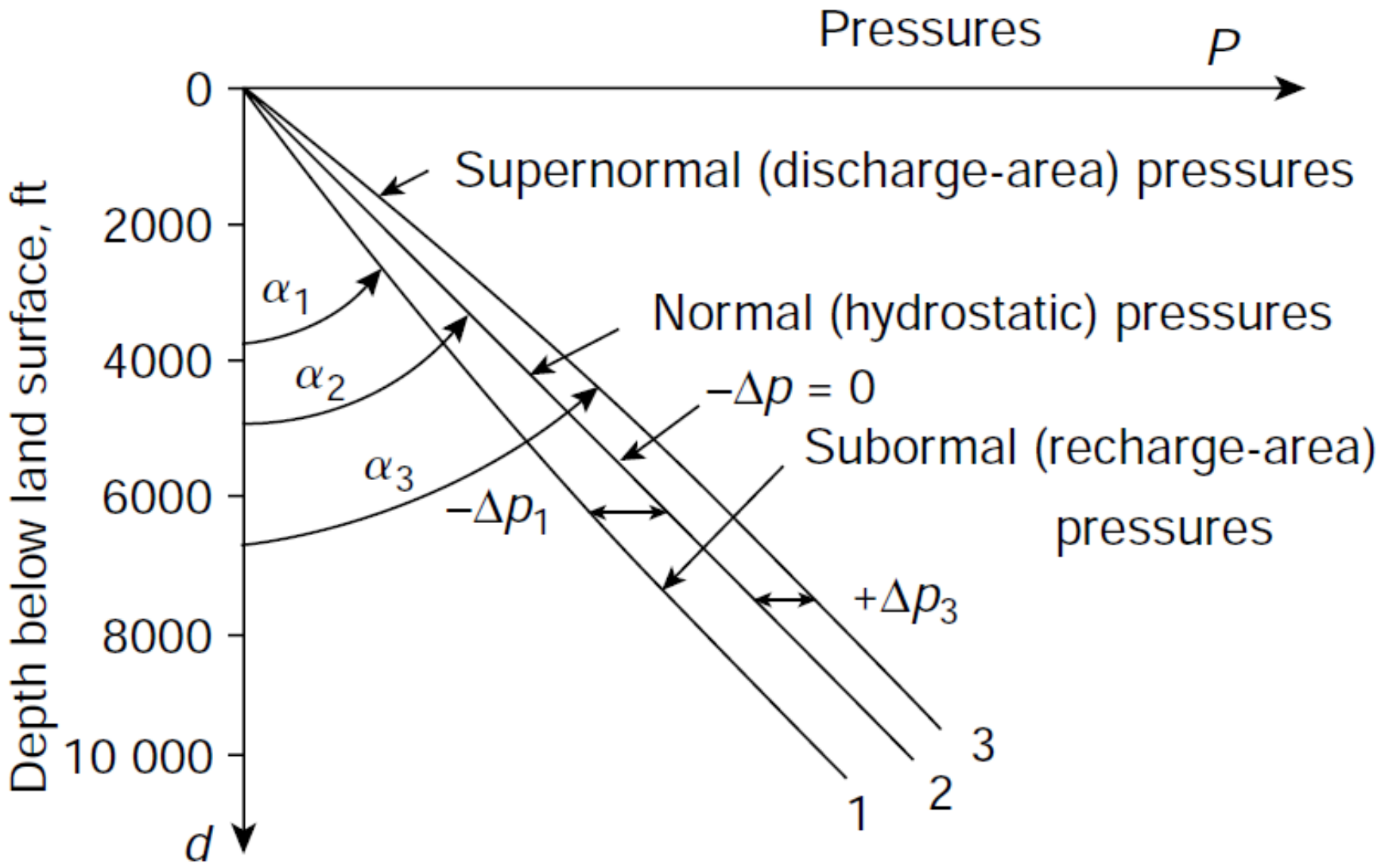
PERHIMPUNAN AHLI AIRTANAH INDONESIA

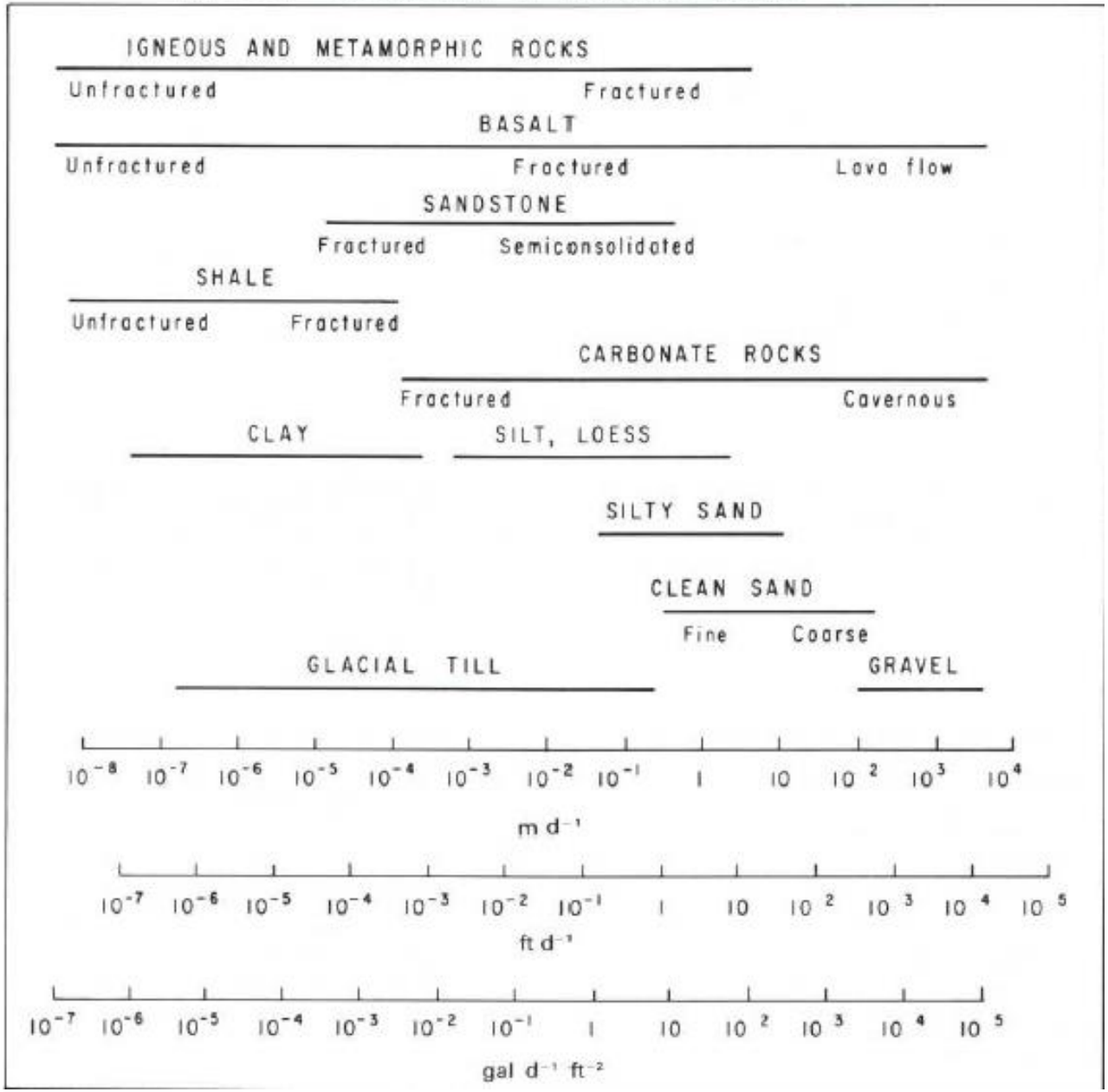

Early Career
Hydrogeologists'
Network



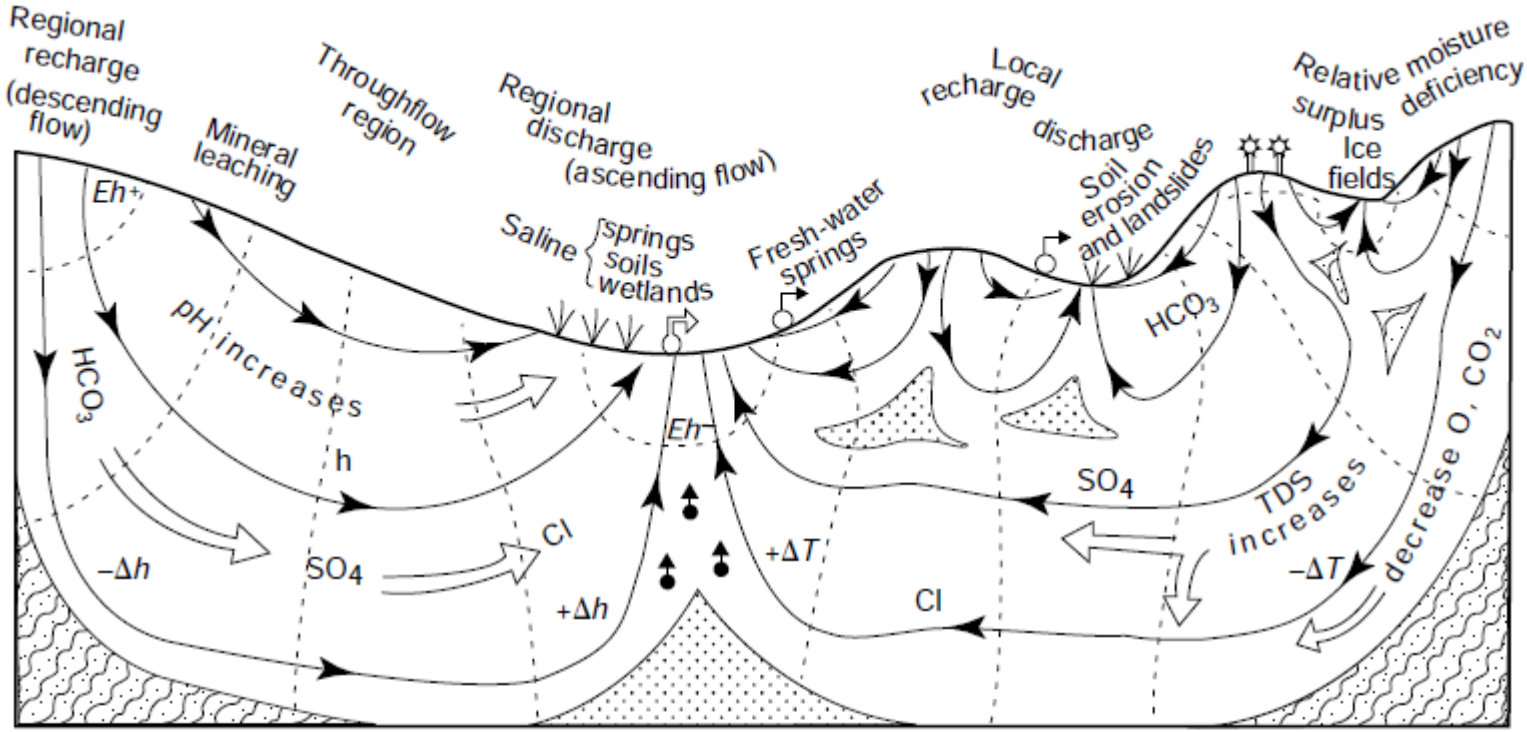
Isotopic variations as a results of evaporation or exchange processes (IAEA, 1983)



(Toth, 2009)



(Heath, 1983)



EXPLANATION

- Line of equal hydraulic head
- Flow line
- Spring: cold, warm
- Phreatophytes
- Xerophytes
- Eh^+ Redox conditions: oxidizing
- Eh^- reducing
- Mineral (metallic, evaporite, hydrocarbon) traces above accumulations
- $-\Delta h$ Hydraulic heads: subhydrostatic
- h hydrostatic
- $+\Delta h$ superhydrostatic
- Hydraulic trap: convergence and accumulation of transported matter and heat
- Quasi-stagnant zone: increased TDS
- $+\Delta T, -\Delta T$ Geothermal temperature and gradient anomaly: positive, negative

(Toth, 2009)