Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 23-05-2025 **Time:** 01:00 pm –04:00 pm

School: SOE	**Program:** B. Tech.-PET	
Course Code: PET2002	**Course Name:** Fundamentals of Geophysical Logging Techniques	
Semester: IV	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	06	08	42	22	22

Instructions:

1. *Read all questions thoroughly and answer them as directed.*
2. *Do not write anything on the question paper except your Roll Number, and only in the designated space.*
3. ***Charts/Plots related to certain questions are provided at the end of the question paper. Use only these to solve the respective problems.***
4. ***Do not write your Roll Number or any personal identification on the Charts/Plots.***
5. ***On the Charts/Plots, write only the corresponding Question Number and the answer relevant to that question (i.e. plots, and plots related text).***
6. ***At the end of the examination, detach the Charts/Plots from the question paper and place them immediately after the first page of your answer script for evaluation.***

Part A

Answer ALL the Questions. Each question carries 2 Marks. **10Q x 2M=20M**

1.	Select the correct answer: _____ is most commonly encountered during well logging. a) Electrical short circuits b) Corrosion of casing c) Stuck logging tools d) Blowout preventer failure	**2 Marks**	**L1**	**CO1**

2.	Selectthe correct answer: If a logging tool gets stuck in the borehole, _____. a) Abandon the well b) Perform a fishing operation to retrieve the tool c) Increase the drilling speed d) Inject more drilling fluid without any further action	**2 Marks**	**L1**	**CO1**
3.	Name the right words to fill in the blanks: Pipe-Conveyed Logging (PCL) is primarily used in wells that have high _____ angles where conventional _____ tools cannot be deployed.	**2 Marks**	**L1**	**CO1**
4.	Select the correct answer: The primary effect of permeability on well log measurements is _____. a) It influences the movement of formation fluids b) It directly affects the rock's resistivity c) It controls the sonic velocity of the rock d) It has no impact on log responses	**2 Marks**	**L1**	**CO2**
5.	Identify the statement Ture or False: Permeability is the ability of a rock to allow fluids to flow through its pore spaces.	**2 Marks**	**L1**	**CO2**
6.	Define borehole effects in well log measurements.	**2 Marks**	**L1**	**CO2**
7.	Identify the statement is Ture or False: Borehole invasion effects can distort well log measurements, making interpretation more complex.	**2 Marks**	**L1**	**CO2**
8.	Identify the correct answer: A temperature log is primarily useful in: a) Identifying radioactive zones b) Determining lithology c) Locating fluid movement and wellbore integrity issues d) Measuring formation porosity	**2 Marks**	**L1**	**CO3**
9.	Identify the statement Ture or False: Production logging is used only in open-hole wells.	**2 Marks**	**L1**	**CO4**
10.	Fill in the blanks with one word: Neutron logs are most responsive to the presence of _____ atoms in the _____.	**2 Marks**	**L1**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Describe the application of Temperature Logs in identifying fluid movement and evaluating well integrity.	**10 Marks**	**L2**	**CO3**
	b.	Explain the working principle of the Induction Log along with its usefulness in non-conductive mud systems.	**10 Marks**	**L2**	**CO3**
		Or			
12.	(a) Predict Porosity (ϕ) with the help of Chart No. PU1 and the data shared below in P1, and P2. (P1) ρ_b = 2.50 g/cc, ρ_{ma} = 2.87 g/cc, and ρ_f = 0.80 g/cc (P2) ρ_b = 2.62 g/cc, ρ_{ma} = 2.71 g/cc, and ρ_f = 1.00 g/cc		**20 Marks**	**L3**	**CO3**

	(b) Compute Porosity (ϕ) from Formation Density Log (ρ_b) using the data shared above in P1, and P2. **DO NOT FORGET TO SHARE THE CHART.**			

13.	**a.**	Discuss the role of Nuclear Magnetic Resonance (NMR) Log in reservoir characterization and fluid typing.	**10 Marks**	**L2**	**CO4**
	b.	Describe the basic operating principle of the Formation MicroImager (FMI/FMS) and outline its applications in structural geology.	**10 Marks**	**L2**	**CO4**
		Or			
14.		Cement bond log analysis is vital to ensure well integrity isn't compromised. Illustrate the scenarios with appropriate schematic diagram to remember while evaluating the cement bond log.	**20 Marks**	**L3**	**CO4**

15.	**a.**	Describe the advantages of using Neutron–Density logs in shaly sand interpretation.	**10 Marks**	**L2**	**CO5**
	b.	Explain the limitations of cross-plot analysis in complex reservoir formations.	**10 Marks**	**L2**	**CO5**
		Or			
16.		The geophysical log data for PU Well 1 is shared below. Appy your knowledge to identify the appropriate chart (Chart No. 3 through Chart No. 8) shared below (separately) and predict cross-plot porosity as well as lithology for the freshwater-invaded zone using the Neutron Porosity – Bulk Density cross-plot technique.	**20 Marks**	**L3**	**CO5**

Sl. No.	Depth (ft)	GR (API)	RHOB (g/cc)	NPHI (frac)	RES_D (Ohm_m)	RES_S (Ohm_m)	RES_ MICR	DT (us/ft)
1	617	94	2.65	0.11	16	18	20	74.78
2	626	30	2.47	0.07	16	16	8	75.61
3	643	28	2.39	0.11	2	2	2	70.94
4	653	45	2.55	0.08	4	4	5	70.82
5	667	60	2.67	0.11	2	2	3	68.56

Copy the following Table in the Answer-script and fill out predicted results:

Neutron Porosity – Bulk Density Cross-plot			
Sl. No.	**Chart No.**	**Cross-plot Porosity**	**Lithology**
1			
2			
3			
4			
5			

17.	**a.**	Illustrate the application of SP logs to correlate stratigraphic units between adjacent wells.	**10 Marks**	**L3**	**CO3**
	b.	Apply neutron logs to estimate formation porosity in a sandstone reservoir.	**10 Marks**	**L3**	**CO3**
Or					
18.	Interpret the well log responses presented in Chart No. PU2 to answer the following: (a) Pick GR_{sa} and GR_{sh} from the inspection of the logs (b) Calculate V_{sh}, when recorded GR values are 36.744 API, and 27.974 API at 625.145 ft and 646.024 ft respectively. (c) Pick the likely position of the OWC, and (d) Assuming appropriate fluid densities for the oil and water legs (well was drilled with fresh WBM) and a grain density of 2.70 g/cc, calculate the porosity.		**20 Marks**	**L3**	**CO3**

PET2002 - Fundamentals of Geophysical Logging Techniques

Charts / Plots

(To be shared with the students separately)

Instructions:

1. ***Do not write your Roll Number or any personal identification on the Charts/Plots.***
2. ***On the Charts/Plots, write only the corresponding Question Number and the answer relevant to that question (i.e. plots, and plots related text).***
3. ***At the end of the examination, detach the Charts/Plots from the question paper and place them immediately after the first page of your answer script for evaluation.***
4. ***Chart No. PU1 through Chart No. PUX are shared below.***

Chart No.: PU1

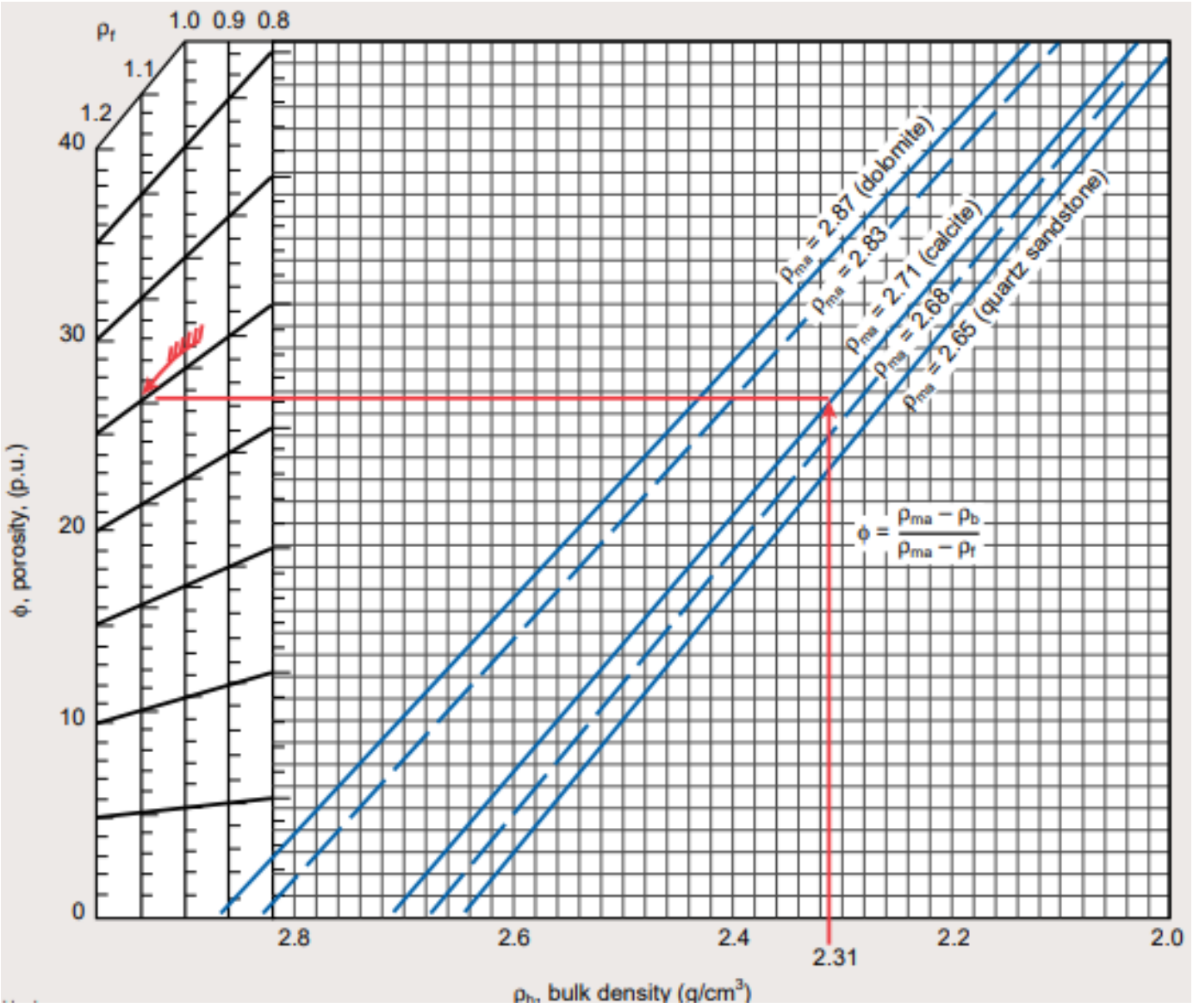


Chart No.: PU2

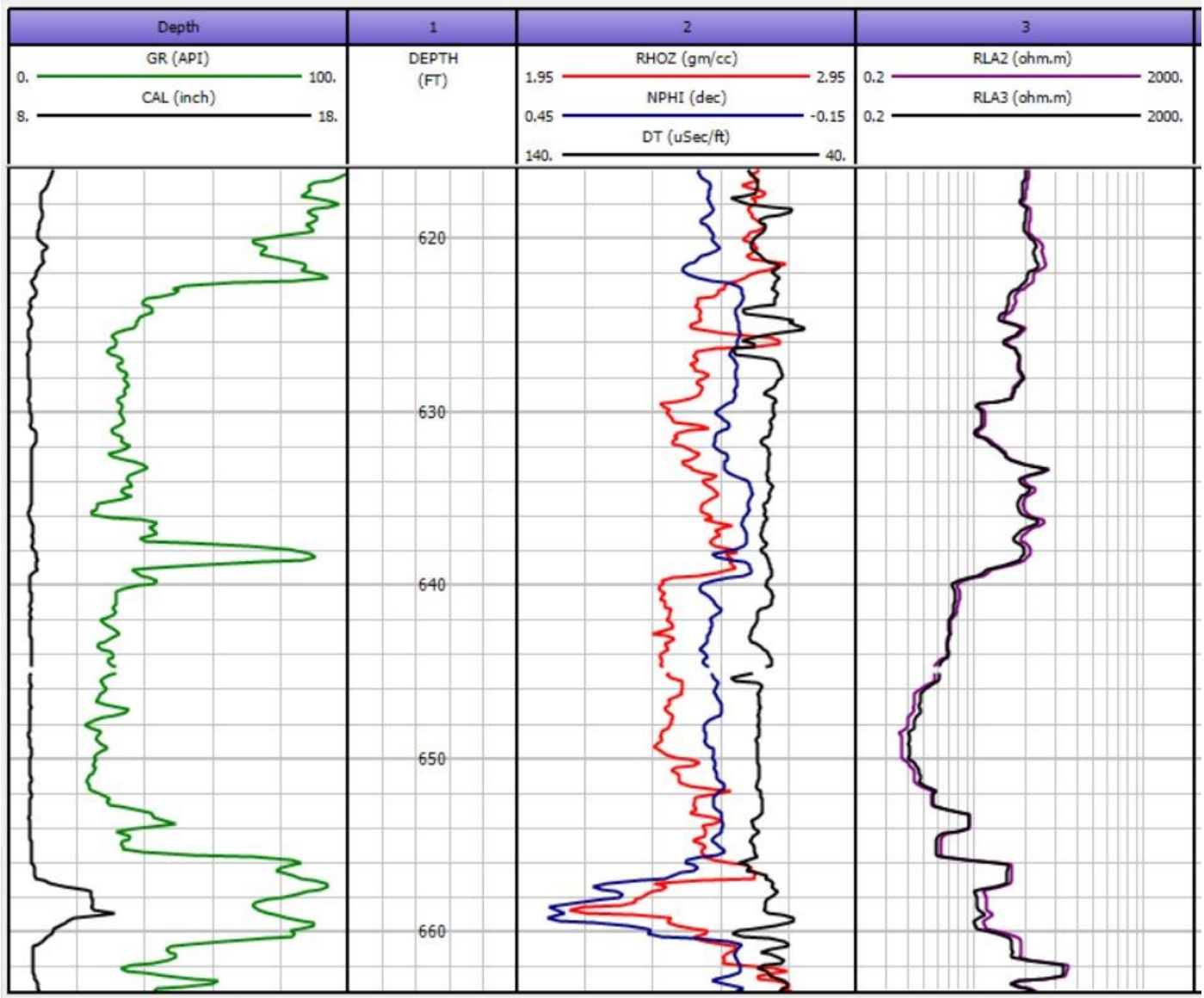

Depth
GR (API)
0.
100.
CAL (inch)
8.
18.
1
DEPTH
(FT)
620
630
640
650
660
2
RHOZ (gm/cc)
1.95
2.95
NPHI (dec)
0.45
-0.15
DT (uSec/ft)
140.
40.
3
RLA2 (ohm.m)
0.2
2000.
RLA3 (ohm.m)
0.2
2000.

Chart No.: PU3

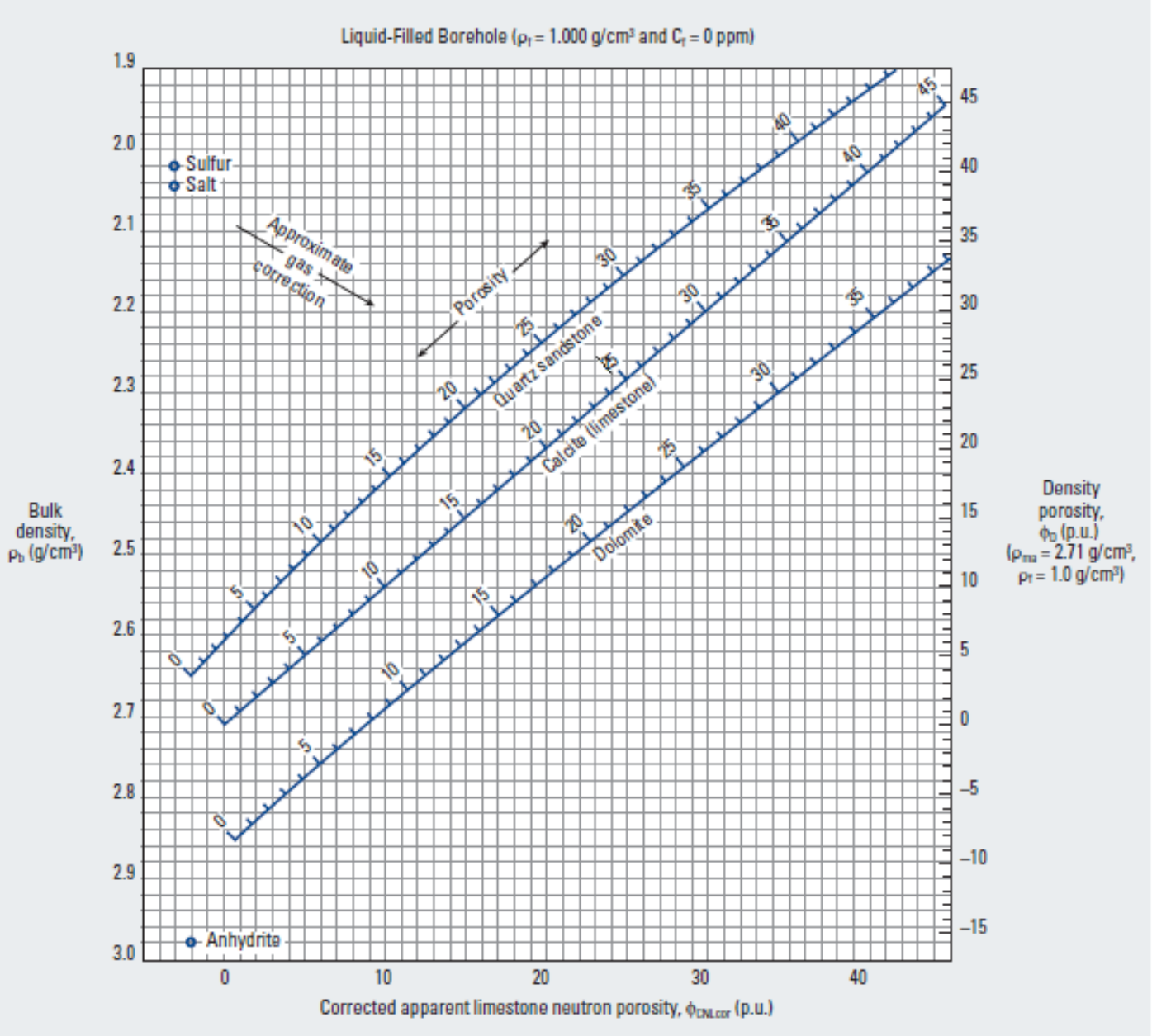

Liquid-Filled Borehole (ρ_f = 1.000 g/cm³ and C_f = 0 ppm)
Sulfur
Salt
Approximate gas correction
Porosity
Quartz sandstone
Calcite (limestone)
Dolomite
Anhydrite
Bulk density, ρ_b (g/cm³)
Density porosity, ϕ_D (p.u.) (ρ_{ma} = 2.71 g/cm³, ρ_f = 1.0 g/cm³)
Corrected apparent limestone neutron porosity, $\phi_{CNL,cor}$ (p.u.)
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
0
10
20
30
40
45
35
25
15
5
−5
−10
−15

Chart No.: PU4

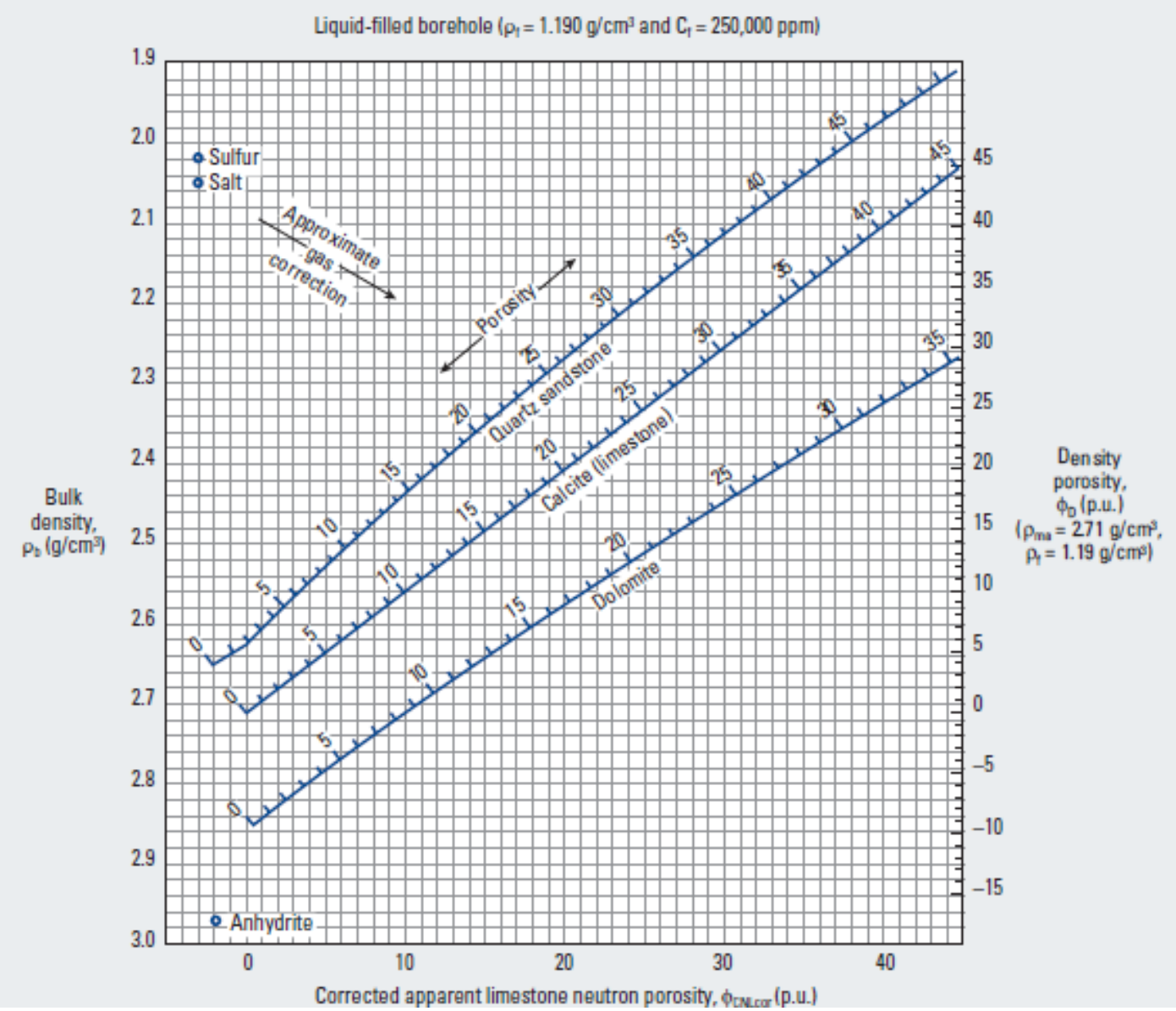

Liquid-filled borehole (ρ_f = 1.190 g/cm³ and C_f = 250,000 ppm)
Sulfur
Salt
Approximate gas correction
Porosity
Quartz sandstone
Calcite (limestone)
Dolomite
Anhydrite
Bulk density, ρ_b (g/cm³)
Density porosity, ϕ_D (p.u.) (ρ_{ma} = 2.71 g/cm³, ρ_f = 1.19 g/cm³)
Corrected apparent limestone neutron porosity, ϕ_{CNLcor} (p.u.)
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
0
10
20
30
40
45
40
35
30
25
20
15
10
5
0
−5
−10
−15

Chart No.: PU5

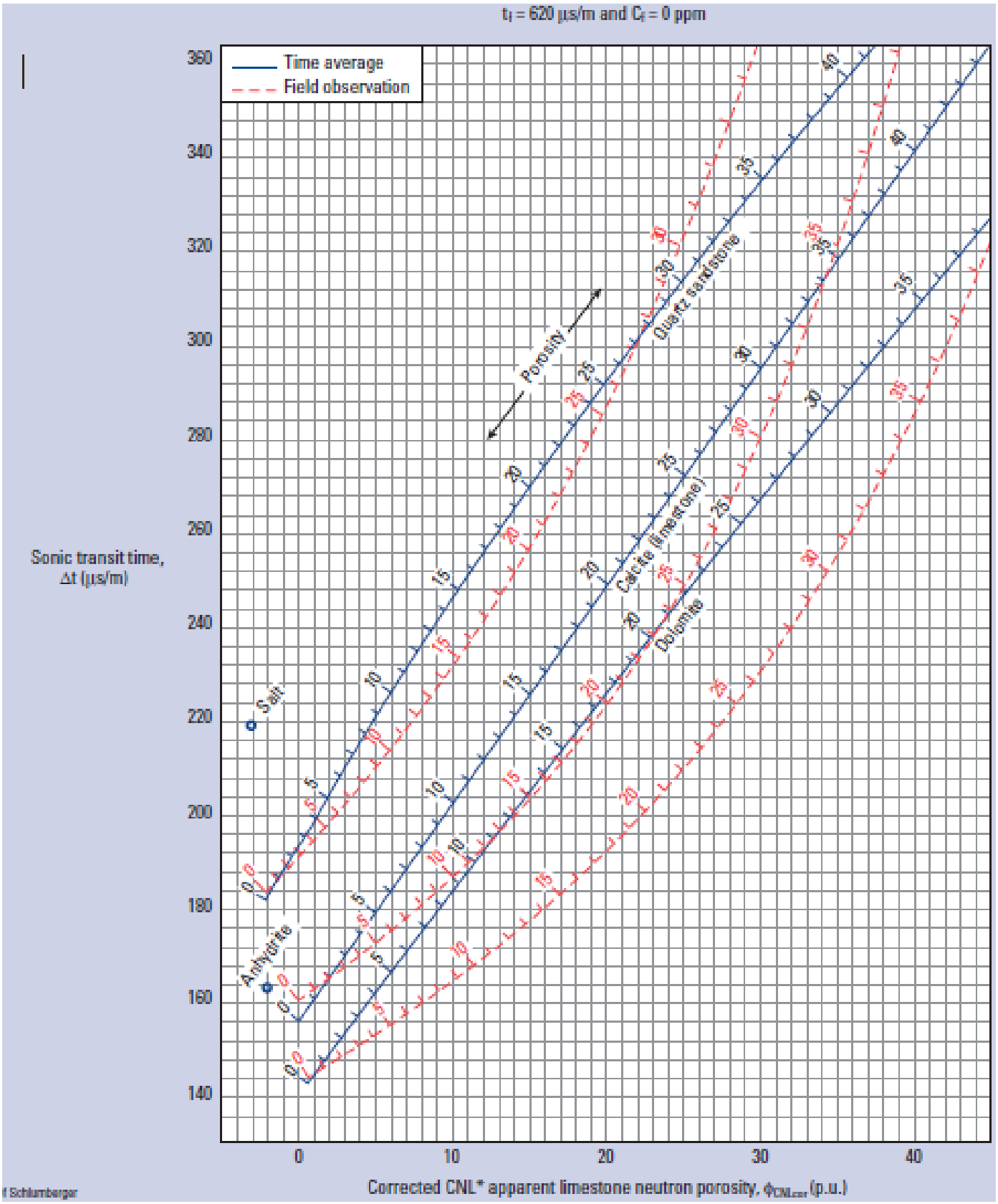

t_f = 620 µs/m and C_f = 0 ppm
Time average
Field observation
Porosity
Quartz sandstone
Calcite (limestone)
Dolomite
Salt
Anhydrite
Sonic transit time, Δt (µs/m)
Corrected CNL* apparent limestone neutron porosity, $\phi_{CNL,cor}$ (p.u.)
360
340
320
300
280
260
240
220
200
180
160
140
0
10
20
30
40

Chart No.: PU6

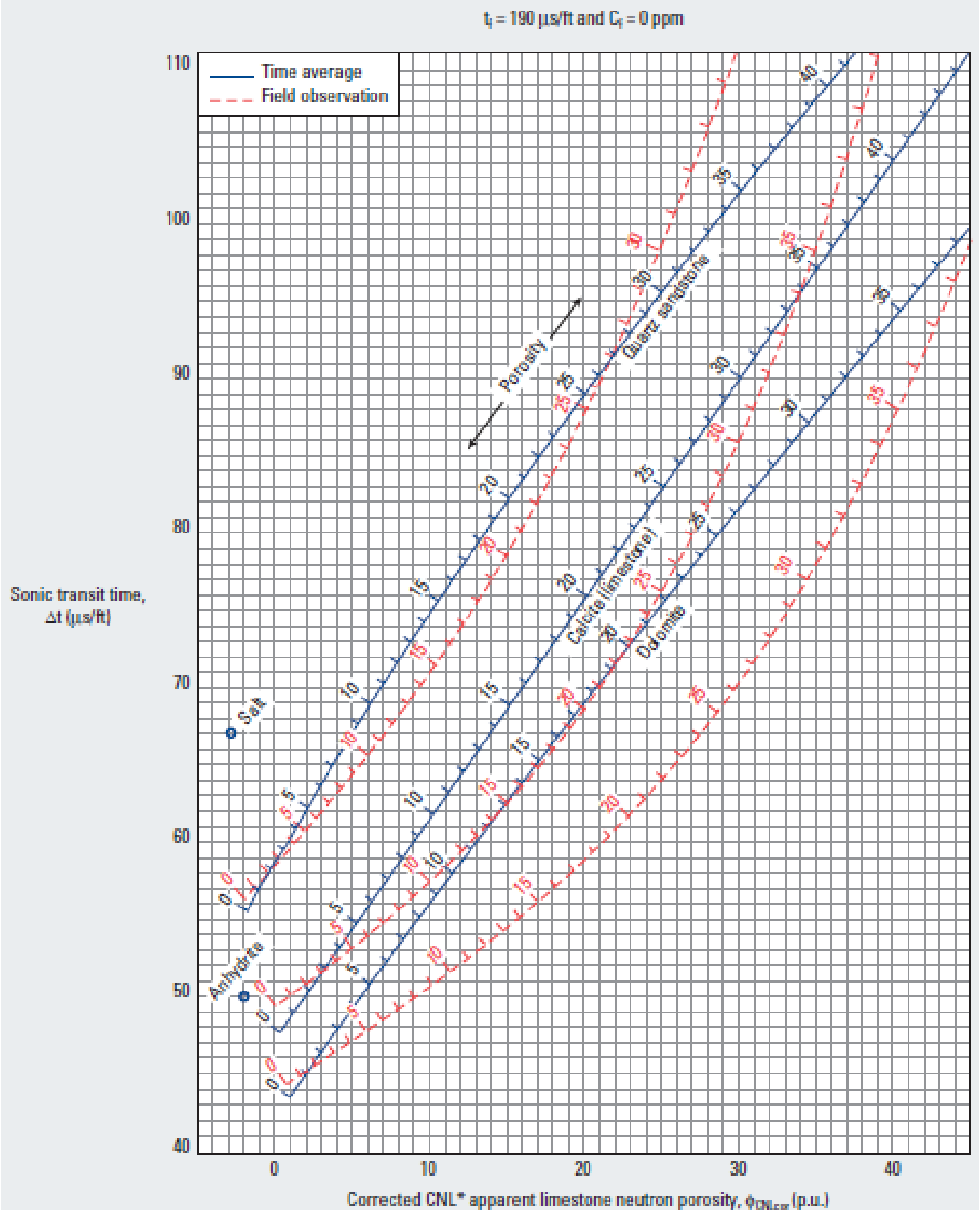

t_f = 190 µs/ft and C_f = 0 ppm
Time average
Field observation
Porosity
Quartz sandstone
Calcite (limestone)
Dolomite
Salt
Anhydrite
Sonic transit time, Δt (µs/ft)
Corrected CNL* apparent limestone neutron porosity, $\phi_{CNL_{cor}}$ (p.u.)
110
100
90
80
70
60
50
40
0
10
20
30
40

Chart No.: PU7

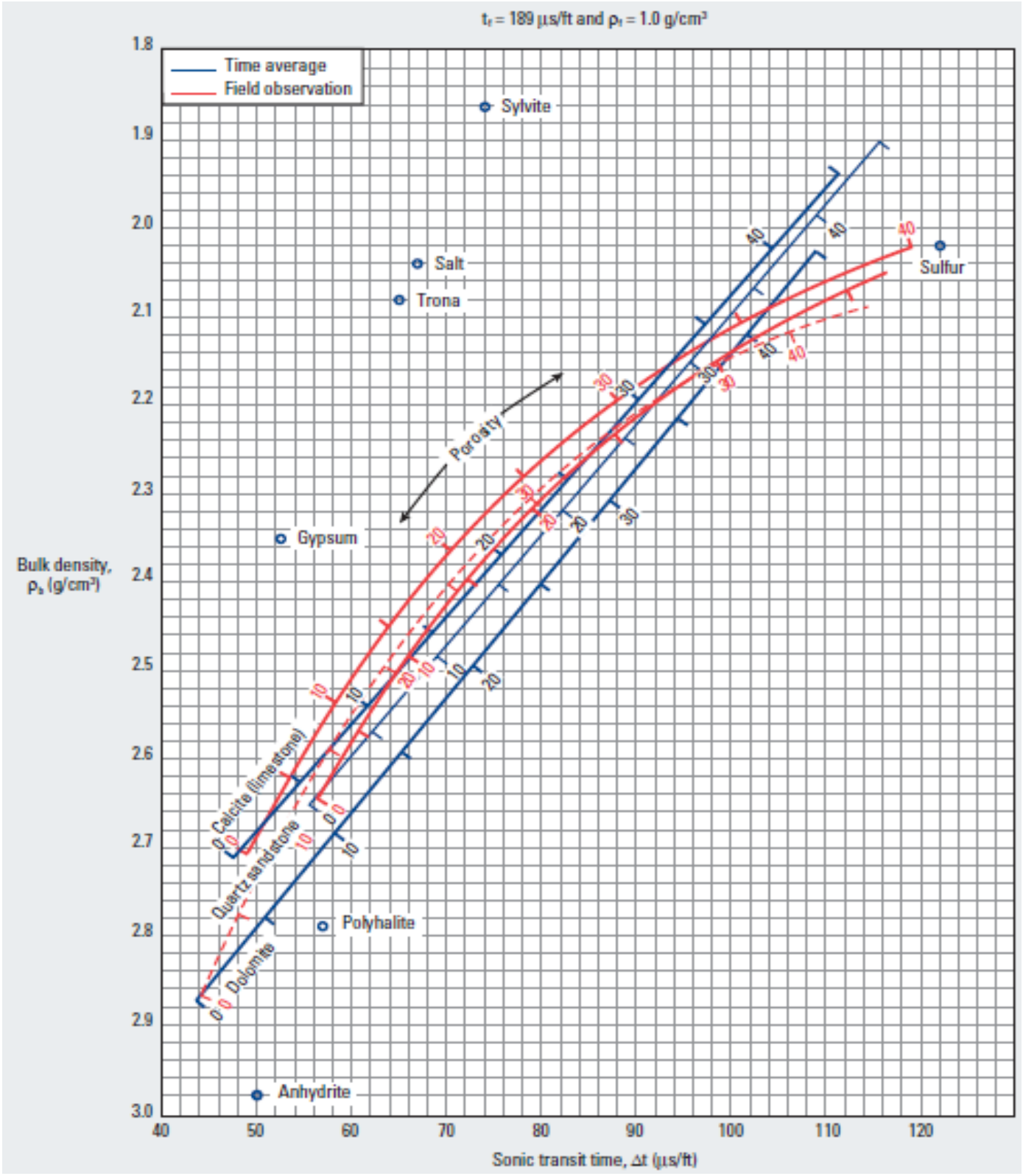
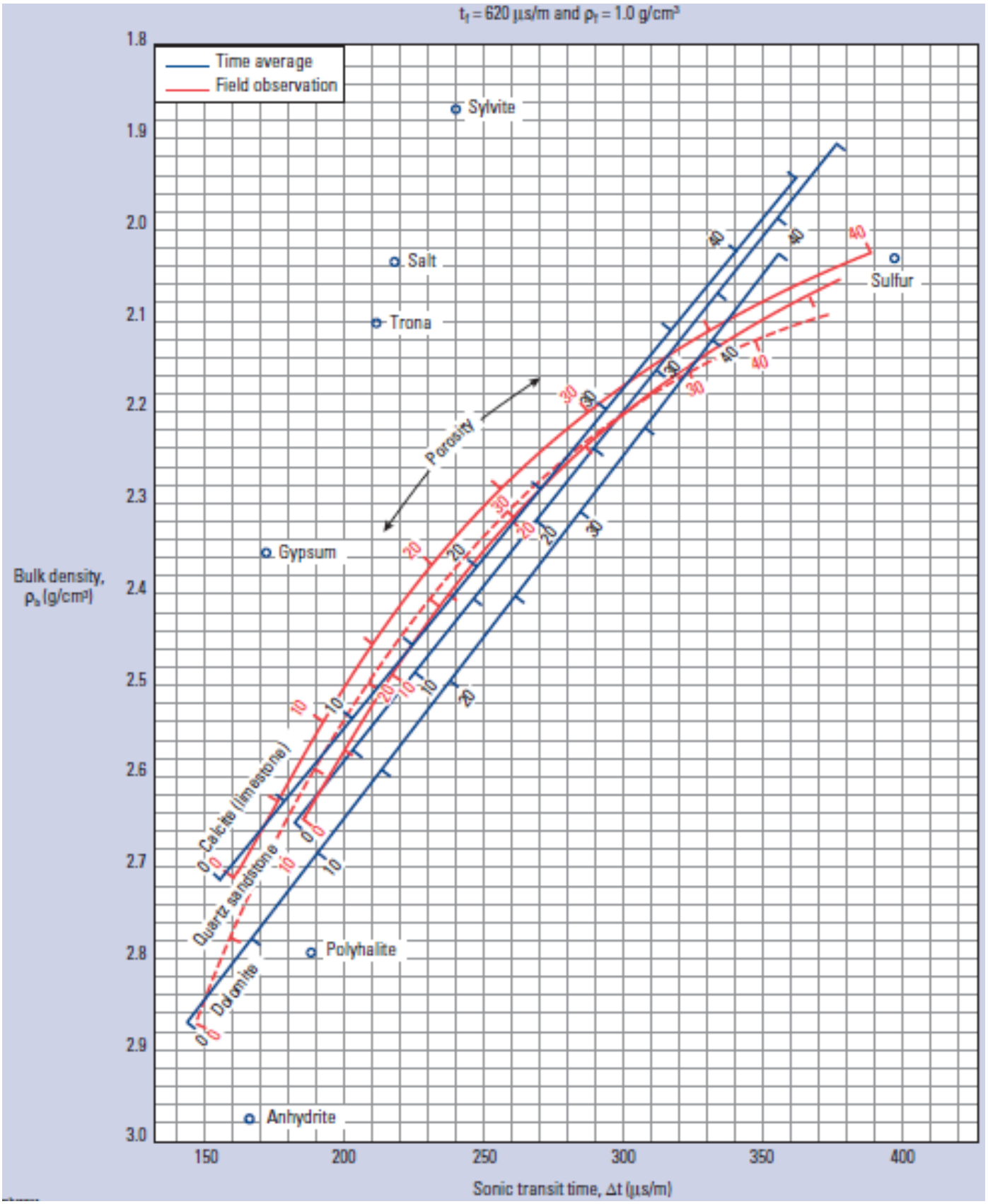

t_f = 189 µs/ft and ρ_f = 1.0 g/cm³
Time average
Field observation
Sylvite
Salt
Trona
Sulfur
Gypsum
Polyhalite
Anhydrite
Porosity
Calcite (limestone)
Quartz sandstone
Dolomite
Bulk density, ρ_b (g/cm³)
Sonic transit time, Δt (µs/ft)
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
40
50
60
70
80
90
100
110
120

Chart No.: PU8


t_f = 620 µs/m and ρ_f = 1.0 g/cm³
Time average
Field observation
Sylvite
Salt
Trona
Sulfur
Porosity
Gypsum
Calcite (limestone)
Quartz sandstone
Dolomite
Polyhalite
Anhydrite
Bulk density, ρ_b (g/cm³)
Sonic transit time, Δt (µs/m)
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
150
200
250
300
350
400