Conversion Factors, Units and Logging Tool Responses to Common Minerals

(Courtesy of Theo. Grupping and Halliburton)

	S.I. UNIT			
Length	1 m	=	3.281	ft
		=	39.37	inches
Area	1 m^2	=	10.76	ft^2
		=	2.471×10^{-4}	acres
Volume	1 m^3	=	35.31	ft^3
		=	6.290	barrels
Vol./Vol.	1 m^3/m^3	=	7,758	barrels/acre-foot.
		=	43,560	ft^3/acre-foot.
Density	1 kg/m^3	=	10^{-3}	g/cm^3
		=	6.243×10^{-2}	lbs/ft^3
		=	0.433×10^{-3}	psi/ft
		=	8.345	lbs/U.S. gallon
Force	1 Newton	=	$1x10^5$	dynes
Pressure	1 Pascal	=	1	$Newton/m^2$
		=	9.869×10^{-6}	atm.
		=	1.450×10^{-4}	psi.
		=	10^{-5}	bar
		=	10	$dynes/cm^2$
Surface Tension	1 Newton/m	=	10^3	dynes/cm
Viscosity	1 Pascal.sec	=	10	Poise
Permeability	1 Darcy	=	0.9869×10^{-12}	m^2
Temperature	°C	=	(°F - 32) x $^5/_9$	
	°F	=	(°C x $^9/_5$) + 32	

Equivalents

Length (SI Unit = m)

1 inch (in)	= 25.4 mm
1 foot (ft)	= 30.48 cm
1 meter (m)	= 3.2808 ft
	= 39.3701 in

Area (SI Unit = m^2)

1 acre	= .4047 hectare (ha)
1 hectare (ha)	= 10,000 m^2
1 mi^2	= 640 acre
	= 2.589981 km^2

Volume (SI Unit = m^3)

1 U.S. gal	= 231 in^3 (0.133681 ft^3)
	= 3.785 liter
1 Imperial gal	= 1.20095 U.S. gal
	= 4.54596 liter
1 barrel (bbl)	= 42 U.S. gal
	= 5.614583 ft^3
	= 158.98284 liter
1 ft^3	= 7.4805195 U.S. gal
	= 28.316847 liter
1 liter (l)	= 0.26417205 U.S. gal.
	= 0.03531467 ft^3
	= .001 m^3
1 acre-foot	= 43560 ft^3
(acre-ft)	= 7758.3678 bbl

Mass (SI Units = kg) avoirdupois (avdp)

1 pound (lb avdp)	= .453592 kg
	= 7000 grains
1 ton (long)	= 2240.0 lb (avdp)
1 ton (metric)	= 2204.6226 lb (avdp)

Density (SI Unit = kg/m^3)

1 g/cc	= 62.427961 lb/ft^3
	= .0361273 lb/in^3
	= 8.345404 lb/gal x its density (g/cc) (U.S.)
	= 10.02241 lb/gal x its density (g/cc) (Imp)
	= 1000 kg/m^3

Concentration (SI Units = kg/m^3)

1 grain/U.S. gal	= 17.11854 ppm / density (g/cc)
	= 17.11854 mg/kg
1 g/liter	= 58.416197 grains/gal
1 g/liter	= 1000 ppm / density (g/cc)
1 wt ppm	= 1 mg/kg

Temperature (SI Unit = °K)

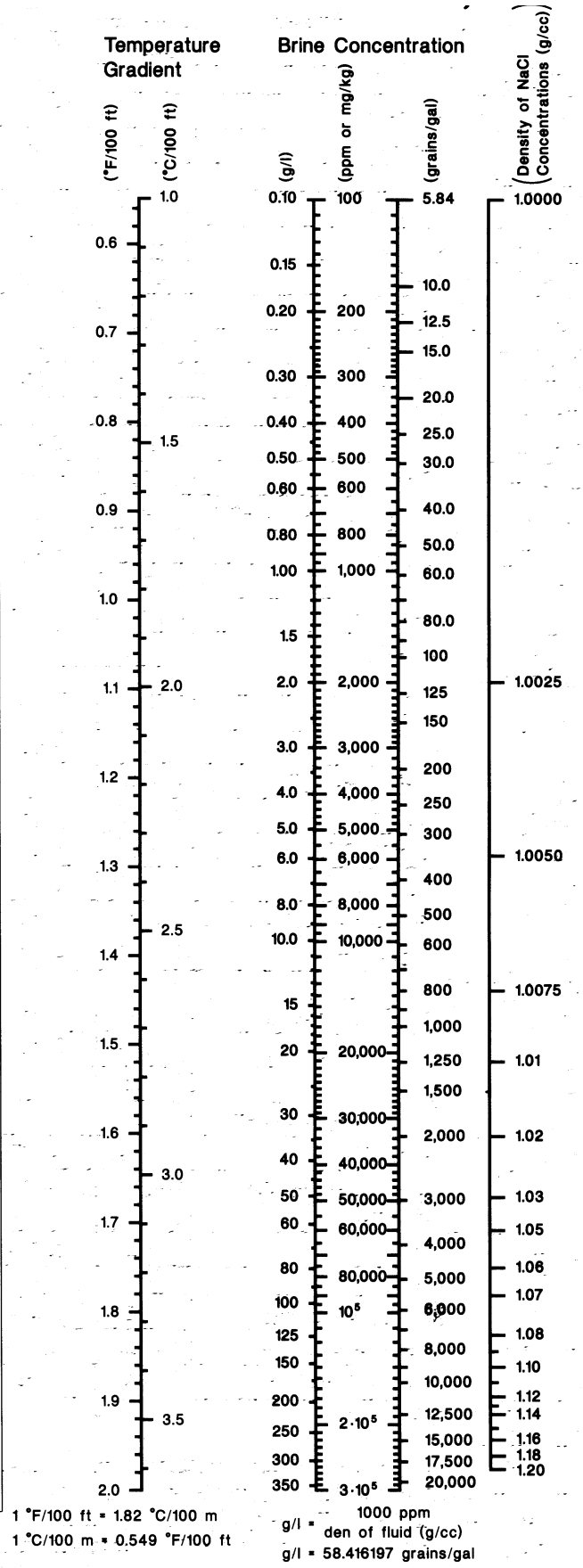
degree Fahrenheit (°F)	= (9/5 × °C) + 32
degree Centigrade (°C)	= 5/9 (°F - 32)
degree Kelvin (°K)	= °C + 273.16
degree Rankin (°R)	= °F + 459.69

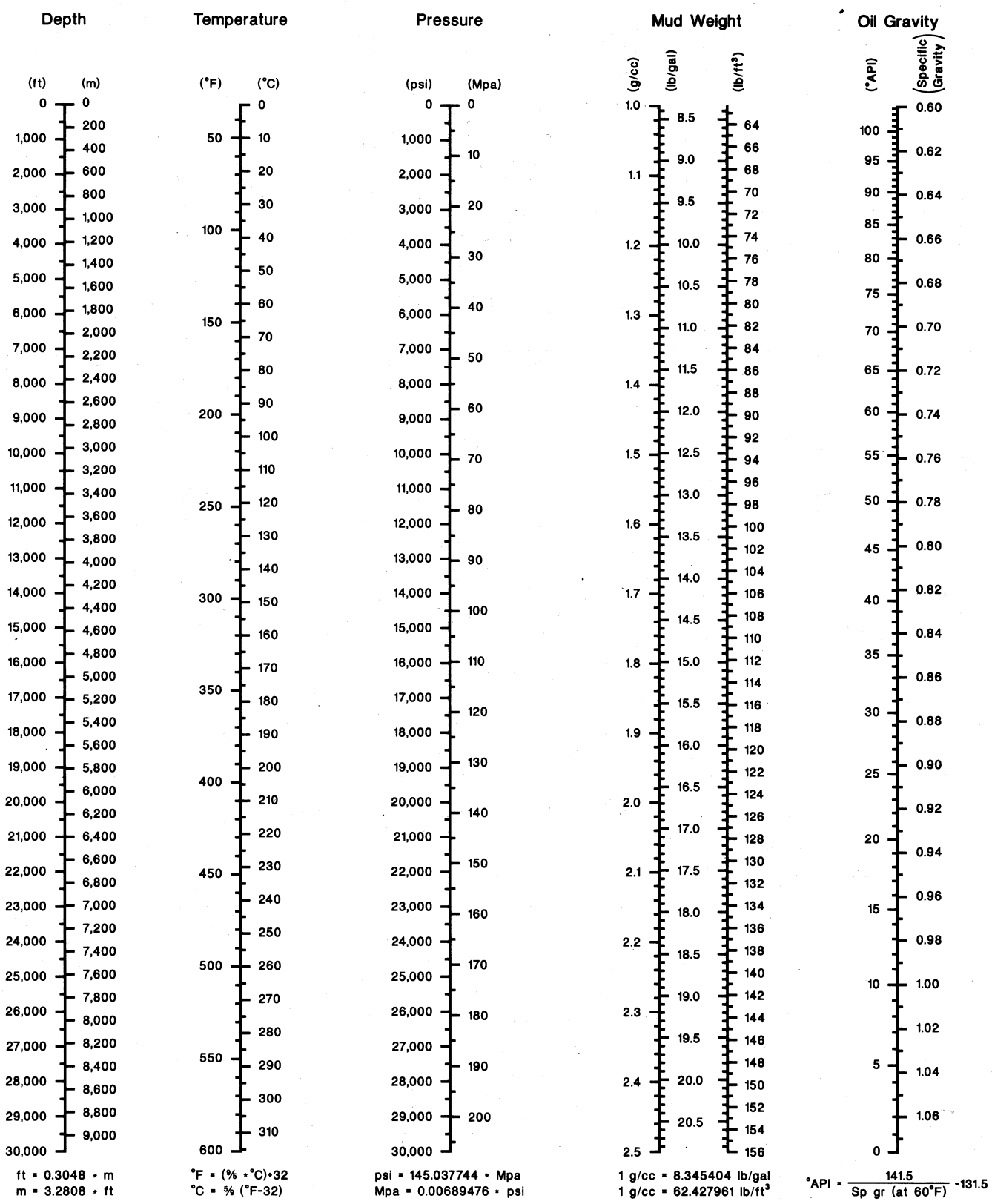
Pressure (SI Units =Pa)

1 atmosphere (atm)	= 14.6959438 psi
	= 1.03323 kg/cm^2
	= .1013254 Mpa
1 Mpa	= 1 psi / .00689476
1 psi	= .068046 atm
	= 145.037744 x Mpa

Pressure Gradient

psi/ft	= .433 x density (g/cc)
	= density (lb/gal) / 19.25
	= density (lb/ft^3) / 144.0
$kg/cm^2/m$	= .1 x density (g/cc)
	= 0.231 x psi/ft




Depth
(ft)
(m)
Temperature
(°F)
(°C)
Pressure
(psi)
(Mpa)
Mud Weight
(g/cc)
(lb/gal)
(lb/ft³)
Oil Gravity
(°API)
(Specific Gravity)
ft = 0.3048 * m
m = 3.2808 * ft
°F = (9/5 *°C)+32
°C = 5/9 (°F-32)
psi = 145.037744 * Mpa
Mpa = 0.00689476 * psi
1 g/cc = 8.345404 lb/gal
1 g/cc = 62.427961 lb/ft³
°API = 141.5 / Sp gr (at 60°F) -131.5

Name	Formula	ϕ_{NLS}* thermal (p.u.)	ρ_b g/cc	ρ_{LOG} g/cc	P_e	P_{em}[4]	Δt_c (μs/ft)	Δt_s (μs/ft)	Σ_{ma} (c.u.)
SILICATES									
Quartz	SiO_2	-1	2.65	2.64	1.81	1.81	55.5	74	4.6
Cristobalite	SiO_2	-1.4	2.33	2.30	1.81	1.81			4.0
Opal (3.5% H_2O)	$SiO_2(H_2O)_{.1209}$	2.0	2.13	2.10	1.75	1.74	58.0		3.8
Garnet									
Almandine	$Fe_3Al_2(SiO_4)_3$	1.8	4.32	4.31	11.1	10.3	35.8	63.9	45
Andradite	$Ca_3Fe_2Si_3O_{12}$	.4	3.86	3.88	10.13	9.67			32
Grossularite	$Ca_3Al_2Si_3O_{12}$	-.3	3.59	3.63	4.37	4.44			11
Pyrope	$Mg_3Al_2Si_3O_{12}$	.4	3.58	3.61	1.60	1.61			6.2
Zircon	$ZrSiO_4$	0	4.68	4.51	69.1	50	95.8	146.5	5.5
Hornblende	$Ca_2NaMg_2Fe_2AlSi_8O_{22}(O,OH)_2$	2.9	3.12	3.11	5.99	5.72	44	82	17.9
Tourmaline	$(Na,Ca)(Li,Mg,Al)(Al,Fe,Mn)_6(BO_3)_3(Si_6O_{18})(OH)_4$	11-22	3.00	2.93-3.00	1.9-10.5	1.3-9.5			4000
SHEET SILICATES									
Kaolinite	$Al_4(Si_4O_{10})(OH)_8$	40	2.61	2.63	1.49	1.45	212	328	12.9
Illite	$KAl_4(Si_7AlO_{20})(OH)_4$	9-10	2.65-2.69	2.64-2.69	2.04	2.05			12-14
Montmorillonite	$(Ca,Na)_7(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot 4H_2O$	18-53	2.2-2.7	2.2-2.7	1.3-1.55	1.24-1.5			14.7
Chlorite									
Clinochlore	$(Mg,Fe)_5Al(Si_3Al)O_{10}(OH)_8$	29-47	2.63-2.98	2.6-3.0	1.04-12.7	.95-11.7			35.6
Gonyerite	$(Mn,Mg)_5Fe^{3+}(Si_3Fe^{3+})O_{10}(OH)_8$	45	3.01	2.97	10-16	9.2-15			113
Nimite	$(Ni,Mg,Fe)_5Al(Si_3O)O_{10}(OH)_8$	75	3.19	3.20	1.3-17	1.2-15			45
Muscovite	$KAl_2(AlSi_3)O_{10}(OH)_2$	11	2.83	2.82	2.40	2.40	53	92	16.9
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$	10-12	3.01	2.95-3.03	2.3-10.2	2.3-9.5	49	82	35.2
Glauconite	$(K,Na,Ca)_{1.2\text{-}2}(Fe^{3+},Al,Fe,Mg)_4Si_{7\text{-}7.6}Al_{1\text{-}.4}O_{20}(OH)_4 \cdot 2H_2O$	11-18	2.45-2.85	2.42-2.83	5.1-6.1	4.8-5.9			17-22
FELDSPARS									
Microcline	$KAlSi_3O_8$	-1.3	2.59	2.56	2.86	2.87			15.8
Orthoclase	$KAlSi_3O_8$	-1.4	2.56	2.53	2.86	2.87	69		15.8
Anorthoclase	$KAlSi_3O_8$	-1.4	2.59	2.56	2.86	2.87	69		15.8
Albite	$NaAlSi_3O_8$	-1.1	2.62	2.59	1.68	1.68	49	85	7.7
Anorthite	$CaAl_2Si_3O_8$	-1.2	2.76	2.74	3.13	3.18	45		7.4
CARBONATES									
Calcite	$CaCO_3$	0	2.71	2.71	5.08	5.08	47.6	88.7	7.1
Aragonite	$CaCO_3$	.6	2.95	2.97	5.08	5.08	47.6	88.7	7.1
Dolomite	$CaMg(CO_3)_2$	.9	2.87	2.88	3.14	3.08	43.5	71	4.7
Siderite	$Fe(CO_3)_2$	6	3.96	3.89	14.7	13.4	43.8	84.9	52.8
Ankerite	$CaCO_3(Mg,Fe,Mn)CO_3$	≈1	2.94	2.90-2.95	7.3-8.7	6.9-8.1	53.0	83.6	24.9

* DSN-II Neutron Porosity only

Name	Formula	ϕ_{NLS}* thermal (p.u.)	ρ_b g/cc	ρ_{LOG} g/cc	P_e	P_{em}[4]	Δt_c (μs/ft)	Δt_s (μs/ft)	Σ_{ma} (c.u.)
SULPHATES									
Barite	$BaSO_4$	-1	4.48	4.09	267	144	69.7	132.7	20
Celestite	$SrSO_4$	-.8	3.96	3.79	55.2	41.2	60.7	168.8	23.5
SULPHIDES									
Pyrite	FeS_2	-1.7	5.02	5.00	17.0	16.1	38	59	91.2
Pyrrhotite	Fe_7S_8	-1.7	4.60	4.53	20.5	19.3	65	110	95.8
Galena	PbS	-2.3	7.40	6.30	1631	133			13.4
Sphalerite	ZnS	-2.3	4.10	3.96	35.9	31.7	57	108	41
Chalcopyrite	$CuFeS_2$	-1.9	4.20	4.07	26.7	24.4			102
Chalcocite	Cu_2S	-1.5	5.50	5.20	37.4	33.4			168
OXIDES									
Hematite	Fe_2O_3	4.8	5.27	5.18	21.5	19.8	46	72	102
Magnetite	Fe_3O_4	3.8	5.18	5.08	22.2	20.5	73	155	103
Limonite	$FeO{\bullet}OH{\bullet}nH_2O(n = 2.1)$	>100	3.85	3.98	12.9	11.8	57	103	78.5
Corundum	Al_2O_3	.5	4.02	4.03	1.55	1.57			11
Rutile	TiO_2	1	4.18	4.06	10.1	9.70			192
Spinel	$MgAl_2O_4$	-.1-(+1)	3.5-4.1	3.49-4.13	1.49	1.51			7.5-10
Ilmenite	$FeTiO_3$	2.0	4.70	4.60	16.6	15.5			162
EVAPORITES									
Halite	NaCl	-1.5	2.17	2.04	4.65	4.86	67	116	761
Sylvite	KCl	-2	1.99	1.87	8.51	8.71	74		572
Carnallite	$KMgCl_3{\bullet}6H_2O$	63	1.61	1.57	4.09	4.11	78		372
Anhydrite	$CaSO_4$	-1	2.96	2.98	5.05	5.14	50	97.5	12.6
Gypsum	$CaSO_4{\bullet}2H_2O$	53	2.32	2.35	3.99	3.99	52.5		18.6
Langbeinite	$K_2Mg_2(SO_4)_3$	-1.1	2.83	2.82	3.56	3.57	52		24.0
Polyhalite	$K_2Ca_2Mg(SO_4)_4{\bullet}2H_2O$	14.5	2.78	2.79	4.32	4.35	57.5		23.8
Kieserite	$MgSO_4H_2O$	37	2.57	2.59	1.83	1.79			14.1
MISCELLANEOUS									
Borax	$Na_2B_4O_7{\bullet}10H_2O$	>100	1.71	1.71	.473	.247			8305
Kernite	$Na_2B_4O_7{\bullet}4H_2O$	>100	1.91	1.87	.522	.314			13000
Flourite	CaF_2	-1.3	3.18	3.13	6.71	6.82			11
Apatite	$Ca_5(PO_4)_3(F,Cl,OH)$	1.2	3.15	3.15	5.8-6.1	5.9-6.2			52
Goethite	$FeO{\bullet}OH$	>100	4.37	4.34	19.0	17.5			80
Augite	$(CaNa)(Mg,Fe,Al)$-$(Si,Al)_2O_6$	-.7-(-1.1)	3.30	3.25-3.32	1.3-9.6	1.3-9.1			7-30
Sulphur	S_2	-2	2.07	2.02	5.40	5.80	122		20.6
COALS									
Anthracite	$CH_{.358}N_{.009}O_{.022}$	>60	1.60	1.57	.17	-.15	105		10.5
Bituminuous	$CH_{.793}N_{.015}O_{.078}$	>100	1.35	1.34	.17	-.16	120		20
Lignite	$CH_{.849}N_{.015}O_{.211}$	>45	1.10	1.05	.20	-.11	160		12.6

* DSN-II Neutron Porosity only

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