UT Geofluids & Hydrates Style Guide

Rev C, Jan 2016, MAN

1) We call our specimens 'mudrocks'

2) Observe the following naming conventions for mudrocks. Color codes apply to all plots / graphics that have more than one mudrock on them, and to any other plots / graphics where it is reasonable to adopt such a color scheme

Full name	**Abbreviation**	**Fill Color (RGB)**
Resedimented Boston Blue Clay	RBBC	Royal Blue (0, 21, 255)
Resedimented Gulf of Mexico - Eugene Island Block	RGoM-EI	Red (255, 0, 0)
Resedimented San Francisco Bay Mud	RSFBM	Green (0, 255, 0)
Resedimented Gulf of Mexico - Ursa	RGoM-Ursa	Purple (125, 0, 255)
Resedimented Presumpscot Clay	RPC	Dark Yellow (255, 200, 0)
Resedimented Nankai	RNC	Orange (255, 120, 0)
Resedimented Ugnu Clay	RUC	Grey (204, 204, 204)
Resedimented Cornwall Kaolin	RK-Cornwall	White / Open (255, 255, 255)
Resedimented Edgar Plastic Kaolin	RK-EPK	Cyan (0, 255, 255)
Resedimented Villanova Tulo White Kaolin	RK-VWK	Pink (255, 115, 212)
Skibbereen Silt	SS	Maroon (171, 0, 56)
Illite	Illite	Teal (171, 0, 56)
Resedimented London Clay	RLC	Brown (190, 92, 28)
Resedimented Florida Bay Mud	RFB	Dark Red (for now)
Modified Clay fraction of any of the above	<% clay> + parent abbreviation (e.g. 39% clay RBBC)	Shades of parent color relative to % clay fraction (i.e. less clay = lighter, more clay = darker)

3) Where there are multiple depth intervals of the same mudrock, add the depth interval following the name / acronym in parentheses, e.g. RGoM-URSA (309)

4) Keep BLACK color as a floater color for comparing properties between the SAME material (i.e. comparing permeability and resistivity of RBBC)

Rules for Plots:

General Notes:

Permeability in m^2

Stress in Mpa

Label axis with title, symbol, and units e.g. "Void ratio, e", or "Permeability, k (m^2)"
Often, plot porosity in reverse order (high to low) to simute increasing stress to the right (comparable with a stress scale)

Permeability Plots

y axis: Permeability in m^2, log scale

x axis: Porosity or Stress in Mpa

Compression plots:

y axis: void ratio or porosity, depending on soil and message

x axis: Stress in Mpa, log scale

Resistivity plots:

y axis: resistivity in Ωm OR formation factor, in log scale

x axis: porosity or stress in Mpa

Anisotropy plots:

y axis: anisotropy

x axis: porosity or stress in Mpa

Velocity plots:

y axis: velocity in m/s

x axis: porosity or density or stress in Mpa

Orientation Plots

y axis: Particle orientaion in degrees

x axis: porosity or stress in Mpa

Other plots:

Salinity is on a log scale, in g/L

List of Symbols - Geofluids:

Symbol	Typical Units	Units	Dimensions
a	-	Archie's Law fitting parameter (tortuosity parameter)	-
A	-	Alternate permeability anisotropy definition suggested by Meegoda et al (1989)	-
A, a	m^2	Area for falling head test (big and small, respectively)	
a_H	-	Archie's Law fitting parameter (tortuosity parameter) in the horizontal direction	-
a_σ	-	Archie's Law fitting parameter (tortuosity parameter) for the conductivity anisotropy	-
a_V	-	Archie's Law fitting parameter (tortuosity parameter) in the vertical direction	-
C	nF, mF, F	Capacitance	
c_c	-	Slope of virgin compression line e vs. log stress space (space assumed)	-
c_c	-	Slope of swelling line e vs. log stress space (space assumed)	-
c_{c-e}	-	Slope of virgin compression line e vs. log stress space (space defined)	-
c_{c-e}	-	Slope of swelling line e vs. log stress space (space defined)	-
c_{c-n}	-	Slope of virgin compression line n vs. log stress space (space defined)	-
c_{c-n}	-	Slope of swelling line n vs. log stress space (space defined)	-
CEC	equivalents / kg	Cation Exchange Capacity	
c_k	-	Slope of permeability curve in log permeability vs. n space	-
Co	unit/m^3	Initial Concentration. Unit may be charge, volume or mass.	unit/Volume
C_v	cm^2/s	Coefficient of consolidation	
c_α	-	Log time rate of secondary compression	
dr_k/dn	-	Slope of permeability anisotropy curve in permeability anisotropy vs. porosity space	-
e	-	Void ratio. Equal V_v/V_s	[ ]
e_o	-	Initial void ratio OR void ratio intercept fixed at e = 1.0; corresponds to n_o	-
F	-	Formation factor (general) or intrinsic formation factor	-
F_a	-	Apparent Formation Factor	-
g	9.807 cm/s^2	Gravitational Constant	L/T^2

Gs	-	Specific gravity	[ ]
h	m	Hydraulic head	
H	cm, m	Height of sample	
H_o	cm, m	Initial height of sample	
i	-	Gradient	[ ]
k	m^2, millidarcy	Permeability. Property of the medium. Also known as intrinsic permeability.	[L2]
K	cm/s, m/s	Hydraulic conductivity. Property of the medium and the fluid. Often mis-referred to as permeability by engineers.	[L/T]
k_H	m^2, millidarcy	Horizontal or radial permeability	[L2]
K_H	cm/s, m/s	Horizontal or radial hydraulic conductivity.	[L/T]
K_o	-	Coefficient of Lateral Earth Pressure at rest	[ ]
k_V	m^2, millidarcy	Vertical permeability	[L2]
K_V	cm/s, m/s	Vertical hydraulic conductivity.	[L/T]
L	cm, m	Length	[L]
L_o	cm, m	Direct path length	L
log K_o	cm/s, m/s	intercept of permeability model (at either n = 0 c/o Julia or n = 0.5 c/o Amy & Brendan)	
M		Mass	
m	-	Aspect Ratio	-
m	-	Archie's Law cementation exponent	-
m_H	-	Archie's Law cementation exponent in the horizontal direction	-
M_s		Mass of solids	
m_σ	-	Archie's Law cementation exponent for the conductivity anisotropy	-
M_t		Total mass	
m_V	-	Archie's Law cementation exponent in the vertical direction	-
m_v	1/Mpa	Coefficient of volume compressibility	
n	-	Porosity. Equal to V_v/V_t.	[ ]

n	-	Measurement number in measurement sequence bias correction	
n_o	-	Initial porosity OR porosity intercept fixed at n = 0.5; corresponds to e_o	-
OCR	-	Over consolidation ratio	-
P	MPa, kPa	Pressure	
p'	MPa, kPa	$p' = (\sigma'_1 + \sigma'_3)/2$	M/LT^2
PI	%	Plasticity Index	[%}
θ	degrees	Particle orientation relative to the horizontal	degrees
Q	cm^3/s, m^3/s	Volumetric flow Rate	
q	cm/s, m/s	Linear flow rate (geotechnical applications)	L/T
q	$cm^3/(cm^2s)$, $m^3/(m^2s)$	Volumetric flux	L^3/L^2T
q	MPa, KPa	Deviatoric shear stress	M/LT^2
θ_o	degrees	Initial particle orientation	degrees
$\theta_{\varepsilon v}$	degrees	Particle orientation relative to the horizontal at a fixed volumetric strain εv	degrees
R	Ω	Resistance	R
r_k	-	Permeability anisotropy	[ ]
r_{ko}	-	Permeability anisotropy intercept at porosity 0.5	-
r_ρ	-	Resistivity anisotropy	[ ]
r_σ	-	Conductivity anisotropy	[ ]
r_v	-	Velocity anisotropy	[ ]
Ss	m^2/g, m2/kg	Mass based specific surface area. Equal to the surface area per unit mass.	$[L^2/M]$
S		Saturation	
Sa	1/m	Volumetric specific surface area. Equal to the surface area per unit volume.	$[L^2/L^3]$
T	Degrees Celsius, Degrees Kelvin	Temperature	Degrees
t	s	Time	
t_D	nm	Debye Length	L
u	MPa, kPa	Pore pressure	M/LT^2

u_b	MPa, kPa	Back pressure (pore pressure in a laboratory experiment)	M/LT^2
V		Volume	
V	V, mV	Voltage	
V_s	cm^3, m^3	Volume of the solid grains	$[L^3]$
V_t	cm^3, m^3	Total volume	$[L^3]$
V_v	cm^3, m^3	Volume of the voids	$[L^3]$
V_P	m/s	Compressional Velocity	[L/T]
V_S	m/s	Shear Velocity	[L/T]
V_{SHH}	m/s	Shear Velocity in the horizontal direction polarized horizontally	[L/T]
V_{SHV}	m/s	Shear Velocity in the horizontal direction polarized vertically	[L/T]
V_{SV}	m/s	Shear Velocity in the vertical direction	
w_l	%	Liquid limit	[%]
w_p	%	Plastic limit	[%]
x		Successive measurement sequence bias correction factor	
x'		Non-successive measurement sequence bias correction factor	
βs		Surface mobility	
γ_p	kN/m^3	Unit weight of permeant. Equal to γ_w if the permeant is water.	$[ML/L^3T^2]$ = $[M/L^2T^2]$
γ_w	kN/m^3	Unit weight of water	$[ML/L^3T^2]$ = $[M/L^2T^2]$
Δ	-	Change (in a parameter that follows)	-
ε	-	Strain; strain rate with dot on top	
ε_V	-	Volumetric strain	-
λ	cm^2/ eq Ω	Equivalent Ionic conductance	L2/ eq R
μ_p	Pa·s	Dynamic viscosity of the permeant.	[M/LT]
ν	m^2/s	Kinematic viscosity, equal to μ/ρ	MT^2/L^2
ρ	g/cm^3, kg/m^3	Total mass density	$[M/L^3]$

ρ	Ωm	Electrical resistivity	[RL]
ρ_w	Ωm	Pore fluid resistivity	[RL]
σ	S/m	Electrical conductivity	[G/L]
σ'_m	MPa, kPa	Mean effective stress (first invariant of the effective stress tensor)	M/LT^2
σ_m	MPa, kPa	Mean total stress (first invariant of the total stress tensor)	M/LT^2
σ'_p	MPa, kPa	Maximum past pressure	M/LT^2
τ	-	Tortuosity, equal to L/Lo	-
τ_H	-	Horizontal Tortuosity	-
τ_V	-	Vertical Tortuosity	-
ϕ	-	Friction angle	-
ψ	-	Dialation angle	-

List of Symbols - Hydrates:

Symbol	Typical Units	Units	Dimensions
Subscript			
g	-	Gas phase	-
h	-	Hydrate phase	-
i	-	Ice phase	-
l	-	Liquid phase	-
R	-	Solid phase	-
β	-	Phase index	-
D	-	Dimensionless parameters	-
Superscript			

e	-	Energy component	-
m	-	Methane component	-
s	-	Salt component	-
w	-	Water component	-
κ	-	Component index	-
a	-	Archie's Law fitting parameter (tortuosity parameter)	-
A	m^2	Area of interface	L^2
cl	wt. %	Salinity	-
cl_{ini}	wt. %	Initial salinity	-
cl_{equi}	wt. %	Salinity at three-phase equilibrium	-
C_R	J kg^{-1} $^oC^{-1}$	Heat capacity of solid grain	L^2 T^{-2} K^{-1}
D_l^κ	m^2 s^{-1}	Molecular diffusion coefficient of component κ in liquid phase in sediment	L^2 T^{-1}
D_{l0}^κ	m^2 s^{-1}	Molecular diffusion coefficient of component κ in free water	L^2 T^{-1}
F_β	kg m^{-2} s^{-1}	Mass flux of phase β	M L^{-2} T^{-1}
F^e	W m^{-2}	Energy flux	M T^{-1}
F^κ	kg m^{-2} s^{-1}	Mass flux of component κ	M L^{-2} T^{-1}
F_β^κ	kg m^{-2} s^{-1}	Mass flux of component κ in phase β	M L^{-2} T^{-1}
g	m s^{-2}	Acceleration due to gravity	L T^{-2}
h_β	J kg^{-1}	Specific enthalpy of phase β	L^2 T^{-2}
J_β^κ	kg m^{-2} s^{-1}	Diffusive flux of component κ in phase β	M L^{-2} T^{-1}
k	m^2	Sediment intrinsic permeability	L^2
k_0	m^2	Sediment intrinsic permeability in absence of hydrate	L^2
$k_{r\beta}$	-	Relative permeability of phase β	-

L_h	J kg^{-1}	Latent heat for hydrate formation and dissociation	L^2 T^{-2}
L_i	J kg^{-1}	Latent heat for ice formation and melting	L^2 T^{-2}
M	kg mol^{-1}	Molecular weight	M (MOL)$^{-1}$
M^e	J m^{-3}	Energy accumulation	M L^{-1} T^{-2}
M_β^κ	kg m^{-3}	Mass accumulation of component κ in phase β	M L^{-3}
n	-	Iteration index	-
N	-	Hydration number	-
P_{cgw}	Pa	Gas-water capillary pressure	M L^{-1} T^{-2}
P_{chw}	Pa	Hydrate-water capillary pressure	M L^{-1} T^{-2}
P_{c0}	Pa	Capillary pressure in ice and hydrate free sediments	M L^{-1} T^{-2}
P_d	Pa	Capillary entry pressure	M L^{-1} T^{-2}
P_β	Pa	Pressure of phase β	M L^{-1} T^{-2}
q^e	J m^{-3} s^{-1}	Energy generation rate	M L^{-1} T^{-3}
q^κ	kg m^{-3} s^{-1}	Source or sink of component κ	M L^{-3} T^{-1}
q_β	m s^{-1}	Volumetric flux or Darcy's velocity of phase β	L T^{-1}
R_β^κ	kg m^{-3}	Mass residual of component κ in phase β	M L^{-3}
S_{rg}	-	Residual gas phase saturation	-
S_{rl}	-	Residual liquid phase saturation	-
S_β	-	Saturation of phase β	-
S_β^*	-	Effective saturation of phase β	-
t	s	Time	T
T	ºC	Temperature	K
u_β	J kg^{-1}	Specific internal energy of phase β	L^2 T^{-2}
v_β	m s^{-1}	Pore flow velocity of phase β	L T^{-1}

V_β	m^3	Volume of phase β	L^3
x_{l+g}^m	-	Liquid gas equilibrium methane solubility	-
x_{l+h}^m	-	Liquid hydrate equilibrium methane solubility	-
x_β^κ	-	Mass fraction of component κ in phase β	-
Greek letter			
ϕ	-	Porosity	-
ϕ_0	-	Porosity in absence of hydrate	-
ρ_b	kg m^{-3}	Bulk density	M L^{-3}
ρ_β	kg m^{-3}	Density of phase β	M L^{-3}
ρ_R	kg m^{-3}	Density of solid grain	M L^{-3}
μ_β	kg m^{-1} s^{-1}	Dynamic viscosity of phase β	M L^{-1} T^{-1}
λ	W m^{-1} $^oC^{-1}$	Bulk thermal conductivity of the porous media	M T^{-3} K^{-1}
λ_β	W m^{-1} $^oC^{-1}$	Thermal conductivity of phase β	M T^{-3} K^{-1}
τ	-	tortuosity	-
θ	rad	Slope angle	rad
σ_{gw}	J m^{-1}	Interfacial tension between gas and water	M L T^{-2}

List of Abbreviations - Hydrates:

BSR	Bottom simulating reflector
BHSZ	Base of hydrate stability zone
G	Gas
H	Hydrate
HSZ	Hydrate stability zone
L	Liquid
mbsf	Meter below sea floor
mbsl	Meter below sea level
I	Ice
RHSZ	Regional hydrate stability zone

List of Abbreviations:

A/D	Analogue-to-Digital Converter
AC	Alternating Current
BASIC	Beginner's All Purpose Symbolic Instruction Code
CF	Clay Fraction
CH	High Plasticity Clay
CL	Low Plasticity Clay
CRS	Constant Rate of Strain
D/A	Digital-to-Analogue Converter
DC	Direct Current
LIR	Load Increment Ratio
LVDT	Linear Variable Differential Transformer
MIT	Massachusetts Institute of Technology
NC	Normally Consolidated
OC	Over Consolidate
OCR	Over Consolidation Ratio
PC	Personal Computer
PID	Proportional-Integral-Derivative
PVA	Pressure Volume Actuator
PVC	Pressure Volume Controller
RMS	Root Mean Squared
UT	University of Texas