# **Appendix: Nomenclature**

### **Chapter 2: Roman letters**

$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Symbol	Meaning	Unit
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$Z$ terrestrial longitude with respect to lower transit rad or $^{\circ}$	y	<u> </u>	rad or $^{\circ}$
	y		
z vertical spatial co-ordinate m	Z		rad or $^{\circ}$
	Z	vertical spatial co-ordinate	m

#### **Chapter 2: Greek letters**

Symbol	Meaning	Unit
E Z Zeg	strain arbitrary tidal signal vertical displacement of sea-surface ('equilibrium tide')	- [various] m

$\zeta_{O}$	vertical displacement of sea-surface ('ocean tide')	m
$\zeta_S$	vertical displacement of Earth's surface ('solid tide')	m
λ	(terrestrial) latitude – angle above equator	rad or °
v	Poisson's ratio or Earth, $v \approx 0.25$	-
$ ho_0$	average density of seawater $\approx 1025 \text{ kg.m}^{-3}$	kg.m <sup>-3</sup>
$oldsymbol{\Phi}_L$	lunar phase parameter	-
$\Omega$	angular frequency	rad.s <sup>-1</sup>
$\omega$	angular frequency	rad.s <sup>-1</sup>
$\omega_j$	angular frequency of tidal component	rad.s <sup>-1</sup>

### **Chapter 3: Roman letters**

Symbol	Meaning	Unit
A	matrix used in Bayesian drift algorithm	_
$A_j(t)$	j'th (complex) harmonic constant (Admiralty Method)	-
$b_j(t)$	j'th basis function (Admiralty Method)	-
$b_j(t) \ \hat{b}_j(t)$	j'th basis function (Harmonic Method)	-
D	matrix used in Bayesian drift algorithm	-
$d_{j}$	drift signal in the time domain	[various]
$d_k(f)$	weights used in derivation of $\hat{S}_{MWPS}(f)$	
f	frequency	$s^{-1}$
$F_j(t)$	amplitude of j'th basis function (Admiralty Method)	-
$egin{array}{c} g_j \ \hat{oldsymbol{g}}_j \end{array}$	phase lag of j'th harmonic constant (Admiralty Method)	rad or °
$\hat{m{g}}_{j}$	phase lag of j'th harmonic constant (Harmonic Method)	rad or $^{\circ}$
$egin{aligned} H_j \ \hat{H}_j \end{aligned}$	magnitude of j'th harmonic constant (Admiralty Method)	[various]
$\hat{H}_{j}$	magnitude of j'th harmonic constant (Harmonic Method)	[various]
i	√-1	-
K	number of eigenspectra used to define $\hat{S}_{MWPS}(f)$	-
<i>K</i> ( <i>f</i> )	arbitrary kernel function	-
$K_F(f)$	Fejer kernel function	-
L(v)	marginal posterior likelihood	-
M	number of data sections used for section-averaging	-
N	number of data points in time-series	-
$\underline{P}$	extended parameter vector	[various]
$\overline{S}(f)$ $\hat{S}_{BA}(f)$	true power spectrum	[various]
$S_{BA}(f)$	band-averaged estimate of power spectrum	[various]
$\hat{S}_{MWPS}(f)$	multiple window estimate of power spectrum	[various]
$\hat{S}_P(f)$	(unwindowed) periodogram estimate of power spectrum	[various]
$\hat{S}_{SA}(f)$	section-averaged estimate of power spectrum	[various]
$\hat{S}_{WP}(f)$	windowed periodogram estimate of power spectrum	[various]
t	time	S
$t_j$	time of j'th data point	S
$T_{W}$	matrix of Admiralty Method basis functions	- s <sup>-1</sup>
W	bandwidth in frequency domain	S
$W_{S}(f)$	spectral window	-
$v_j^{(m)}$	m <sup>th</sup> discrete prolate spheroidal sequence	-
$w_j$	data window in the time domain	-
$W_m$	Huber weights used in robust section-averaging	-

<u>X</u>	extended data vector	[various]
$x_j$	data series in the time domain	[various]

## **Chapter 3: Greek letters**

Symbol	Meaning	Unit
$\Delta t$	sampling interval	S
$\varepsilon(t)$	error component of time-series	[various]
$\zeta(t)$	time-series to be analysed	[various]
$\underline{\theta}$	vector expressing harmonic constants	[various]
$\mu$	median of several estimates of a harmonic constant	[various]
v	hyperparameter controlling smoothness of drift signal	[various]
$\pi$	3.141592	-
$\sigma$	interquartile distance of estimates of a harmonic constant	[various]
$\sigma^2$	variance of random variable	[various]
${\sigma_B}^2$	data variance	[various]
$\varphi_j(t)$	phase of j'th basis function (Admiralty Method)	rad or $^{\circ}$
$\omega_j$	angular frequency of j'th tidal component	rad.s <sup>-1</sup>

### **Chapter 4: Roman letters**

Symbol	Meaning	Unit
T	temperature	°C
t	time	S
Teffk	Medusa effluent temperature (Teffk = $Th + Tk$ )	$^{\circ}\mathrm{C}$
Tefft	Medusa effluent temperature (Teffk = $Th + Tt$ )	$^{\circ}\mathrm{C}$
Th	Medusa thermistor channel (calibrated)	$^{\circ}\mathrm{C}$
Th	Medusa thermistor channel (uncalibrated)	_
Tk	Medusa type-K thermocouple channel (calibrated)	$^{\circ}\mathrm{C}$
Tk	Medusa type-K thermocouple channel (uncalibrated)	-
Tt	Medusa type-T thermocouple channel (calibrated)	$^{\circ}\mathrm{C}$
Tt	Medusa type-T thermocouple channel (uncalibrated)	-
v	Medusa velocity channel (calibrated)	$\mathrm{mm.s}^{-1}$
$\nu$	Medusa velocity channel (uncalibrated)	-
ve	eastward velocity measured by current meter	$\mathrm{mm.s}^{-1}$
vn	northward velocity measured by current meter	$mm.s^{-1}$
z	depth below seafloor	m

### **Chapter 4: Greek letters**

Symbol	Meaning	Unit
$egin{array}{c} arepsilon_j \ \kappa \ arphi_j \end{array}$	attenuation factor thermal diffusivity phase lag	m <sup>2</sup> .s <sup>-1</sup>

# **Chapter 5: Roman letters**

Symbol	Meaning	Unit
$egin{array}{c} c_p \ d \ F \ g \ H \ H_R \end{array}$	specific heat capacity vertical distance of penetration of thermal signal fluxibility gravitational acceleration = 9.80665 m.s <sup>-2</sup> depth of magma chamber below seafloor thickness of reaction zone	J.kg <sup>-1</sup> .K <sup>-1</sup> m J.s.m <sup>-5</sup> m.s <sup>-2</sup> m
h k	specific enthalpy	J.kg <sup>-1</sup> m <sup>2</sup>
$L \atop L_D$	permeability half-width of magma chamber half-width of discharge zone	m m
p	pressure	Pa
$Ra_L$ $S$ $T$	local Rayleigh number specific entropy temperature	J.K <sup>-1</sup> .kg <sup>-1</sup> °C
$T_0$	temperature of 'cold' water in convection cell	°C
$t$ $t_D$	residence time in discharge zone	S S
$t_R$	residence time in reaction zone (vector) Darcy velocity	s m.s <sup>-1</sup>
u	horizontal Darcy velocity	m.s <sup>-1</sup> m.s <sup>-1</sup>
w x z	vertical Darcy velocity horizontal spatial coordinate vertical spatial coordinate	m m

## **Chapter 5: Greek letters**

Symbol	Meaning	Unit
$\Delta p$	pressure difference	Pa
$\Delta T$	temperature difference	°C
λ	thermal conductivity	$W.m^{-1}.K^{-1}$
$\mu$	dynamic viscosity of fluid	Pa.s
$\pi$	3.141592	-
ho	fluid density	kg.m <sup>-3</sup> kg.m <sup>-3</sup>
$ ho_0$	density of cold water	kg.m <sup>-3</sup>
$\Phi$	order of magnitude of advective heat flux	$W.m^{-2}$

### **Chapter 6: Roman letters**

Symbol	Meaning	Unit
A	complex amplitude of incremental velocity	$m.s^{-1}$
B	complex amplitude of incremental enthalpy	J.kg <sup>-1</sup>
d	skindepth	m
$d_{1d}$	1-d skindepth	m
$d_{2d}$	2-d skindepth	m

$\hat{e}_{ij}$	incremental strain tensor of fluid-filled porous medium	-
g	gravitational acceleration = 9.80665 m.s <sup>-2</sup>	$\mathrm{m.s}^{-2}$
$\overline{H}$	depth below seafloor of impermeable layer	m
h	steady specific enthalpy	J.kg <sup>-1</sup>
$h_0$	steady specific enthalpy on seafloor	Pa
$\hat{h}$	incremental specific enthalpy	J.kg <sup>-1</sup>
$K_f$	fluid bulk modulus	Pa
$K_{fh}$	isenthalpic fluid bulk modulus	Pa
$K_{fT}$	isothermal fluid bulk modulus	Pa
$\stackrel{{}_\circ}{K_m}$	grain bulk modulus	Pa
$K_m$	matrix bulk modulus	Pa
k	permeability	$m^2$
L	half-width of magma chamber	m
$M_T$	tidal flow magnitude parameter	$m^{5/2}.s^{-1/2}.kg^{-1/2}$
p	steady pore pressure	Pa
$p_0$	steady pressure on seafloor	Pa
$\stackrel{p_0}{\hat{p}}$	incremental pore pressure	Pa
$\hat{p}_c$	incremental confining pressure	Pa
$p_T$	magnitude of tidal pressure oscillation on seafloor	Pa
$egin{array}{c} p_T \ Q \ S \ T \end{array}$	heat sink	$W.m^{-3}$
S	storage compressibility	Pa <sup>-1</sup>
T	steady temperature	°C
t	time	S
w	steady vertical velocity	m.s <sup>-1</sup>
$\hat{w}$	incremental vertical velocity	m.s <sup>-1</sup>
$\boldsymbol{x}$	horizontal spatial coordinate	m
$x_i$	(1 <sup>st</sup> rank tensor) spatial coordinate	m
Z	vertical spatial coordinate	m

### **Chapter 6: Greek letters**

Symbol	Meaning	Unit
α	coefficient of effective stress	-
β	Skempton ratio	-
Γ	vertical enthalpy gradient	J.kg <sup>-1</sup> .m <sup>-1</sup>
$\gamma_{1d}$	1-d loading efficiency	-
γ <sub>2d</sub>	2-d loading efficiency	-
$\delta_{ij}$	Kronecker delta tensor	-
$\kappa$	diffusivity	$\mathrm{m}^2.\mathrm{s}^{-1}$
$\kappa_{ld}$	1-d diffusivity	$\mathrm{m}^2.\mathrm{s}^{-1}$
$\kappa_{2d}$	2-d diffusivity	$\mathrm{m}^2.\mathrm{s}^{-1}$
$\mu$	dynamic viscosity of fluid	Pa.s
v	Poisson's ratio	-
$\pi$	3.141592	-
ho	steady fluid density	kg.m <sup>-3</sup>
$\hat{ ho}$	incremental fluid density	kg.m <sup>-3</sup> kg.m <sup>-3</sup>
$\hat{\sigma}_{\scriptscriptstyle ij}$	incremental stress tensor of fluid-filled porous medium	Pa
$arphi_0$	porosity	-
$\varphi_c$	critical porosity	-

 $\omega$  angular frequency rad.s<sup>-1</sup>

## **Chapter 7: Roman letters**

Symbol	Meaning	Unit
p	pressure	Pa
T	temperature	°C
X	salinity (wt % NaCl)	-
$X_g$	salinity of gas phase (wt % NaCl)	-
$X_l$	salinity of liquid phase (wt % NaCl)	-

# **Chapter 7: Greek letters**

Symbol	Meaning	Unit
$ ho_{\mathit{SW}}$	seawater resitivity	$\Omega$ .m