Contents

Ι	Preliminaries	1
1	The tectonic agenda	3
	1.1 A useful description?	3
	1.2 The tectonic agenda	5
	1.3 What is the lithosphere?	7
	1.4 About these notes	9
2	The geophysical observables	11
	2.1 Topography	11
	2.2 The geoid	13
	2.3 Heat flow	15
	2.4 Active seismicity	16
	2.5 The <i>in-situ</i> stress field	16
3	Gravity and the lithosphere	17
	3.1 Isostasy	17
	3.2 The flexural strength of the lithosphere	19
	3.3 Gravitational potential energy	20
	3.4 Lithospheric potential energy and geoid anomalies	23
4	The strength of the lithosphere	25
	4.1 A rheological primer	25
	4.2 Background to lithospheric rheology	27
	4.3 A model lithosphere	28
	4.4 Uncertainties	31
5	The heat of the matter	33
	5.1 Conduction and advection	33
	5.2 The thermal energy balance	34
	5.3 Thermal time constants	37

ii *CONTENTS*

	5.4	Continental geotherms	37		
	5.5	Natural convection	38		
6	Isot	ope Geodynamics	45		
	6.1	Geochemical reservoirs	45		
	6.2	Radioactive isotopic decay	47		
	6.3	Isotopic fractionation during melting	50		
	6.4	The chondritic earth	51		
	6.5	The depleted mantle	54		
II	Th	ne oceans	57		
7	The	ocean lithosphere	59		
	7.1	Age, bathymetry and heatflow	59		
	7.2	Force balance on the ocean ridge	63		
	7.3	Formation of the oceanic crust	65		
	7.4	Coupling of the -spheres?	67		
	7.5	Oceanic basalt chemistry	68		
8	Subduction and arc formation				
	8.1	Buoyancy of the ocean lithosphere	73		
	8.2	Therml structure of subducted slabs	75		
	8.3	The magnitude of slab pull	76		
	8.4	Arc dynamics	78		
	8.5	Arcs and crustal growth	80		
II	I T	he continents	89		
9	Con	tinental Deformation	91		
U	9.1	Deformation of the lithosphere subject to an end load	92		
	9.2	Deformation within the lithosphere due to basal trac-			
	0.2	tions	94		
10	Stre	etching continents	95		
	10.1	Isostatic calculations	95		
	10.2	Mechanical consequences of extension	101		
	10.3	Sedimentation in stretched basins	107		
	10.4	Topography of normal fault terrains	110		

CONTENTS	iii
CONTENTS	111

IV	Synthesis	113
11	The driving mechanisms reviewed	115
	11.1 Torque balance and plate velocity	115
	11.2 The African plate	117
	11.3 Torque balance in the Indo-Australian Plate	119
12	Precambrian geodynamics	125
13	Crustal growth models	127
	13.1 Rare gas constraints	127
\mathbf{A}		i
	A.1 The equations of motion	
	A.2 Calculation of ridge-push force	iii