

Structure and Composition of the Earth's Interior (GEO4-1401)

Tentamen - 8 November 2006

Jeannot Trampert

The numbers in () indicate the percentage for evaluation. No documents are allowed during the examination, but calculators are useful. Please write clearly and don't forget to indicate your name.

1. (20) How did the planets form in our solar system? What do we know and what are the unknowns in such planetary formation models?
2. (20) Why do we need thermodynamics if we want to investigate the Earth's deep interior?
3. (20) The Bullen parameter is given by $\eta = \frac{dK_s}{dP} + \frac{1}{g} \frac{d\Phi}{dr}$. Explain all the parameters in this expression. Calculate η at a depth of about 2000km for the PREM model (attached). What does this tell us about the Earth?
4. (40) We have seen at least 4 different papers which combine geophysical and geochemical data to try and understand the dynamics of the deep Earth. What are the main geophysical and geochemical data which need to be explained? Why is it so difficult to combine them? Which is your preferred model and why?

Good luck.

TABLE A-1 (continued)

Level	Radius (km)	Depth (km)	Density (g/cm ³)	V _p (km/s)	V _s (km/s)	Q _μ	Q _K	Q _p	Φ (km ² /s ²)	K _s (kbar)	μ (kbar)	σ	Pressure (kbar)	dK/dP	B.P.	Gravity (cm/s ²)
31	2800.0	3571.0	10.85	9.05	0.	0	57822	57822	81.91	8889	0	0.500	2055.9	3.41	1.00	904.1
32	2900.0	3471.0	10.73	8.92	0.	0	57822	57822	79.68	8550	0	0.500	1956.9	3.44	1.00	930.2
33	3000.0	3371.0	10.60	8.79	0.	0	57822	57822	77.36	8202	0	0.500	1856.4	3.47	1.00	955.7
34	3100.0	3271.0	10.46	8.65	0.	0	57822	57822	74.96	7846	0	0.500	1754.4	3.49	1.00	980.5
35	3200.0	3171.0	10.32	8.51	0.	0	57822	57822	72.47	7484	0	0.500	1651.2	3.52	1.00	1004.6
36	3300.0	3071.0	10.18	8.36	0.	0	57822	57822	69.89	7116	0	0.500	1546.9	3.54	0.99	1028.0
37	3400.0	2971.0	10.02	8.19	0.	0	57822	57822	67.23	6743	0	0.500	1441.9	3.56	0.99	1050.6
38	3480.0	2891.0	9.90	8.06	0.	0	57822	57822	65.04	6441	0	0.500	1357.5	3.57	0.98	1068.2
39	3480.0	2891.0	5.56	13.71	7.26	312	57822	826	117.78	6556	2938	0.305	1357.5	1.64	0.99	1068.2
40	3500.0	2871.0	5.55	13.71	7.26	312	57822	826	117.64	6537	2933	0.304	1345.6	1.64	1.00	1065.3
41	3600.0	2771.0	5.50	13.68	7.26	312	57822	823	116.96	6440	2907	0.303	1287.0	1.64	1.01	1052.0
42	3630.0	2741.0	5.49	13.68	7.26	312	57822	822	116.76	6412	2899	0.303	1269.7	1.64	1.01	1048.4
43	3630.0	2741.0	5.49	13.68	7.26	312	57822	822	116.76	6412	2899	0.303	1269.7	3.33	1.01	1048.4
44	3700.0	2671.0	5.45	13.59	7.23	312	57822	819	115.08	6279	2855	0.302	1229.7	3.29	1.01	1040.6
45	3800.0	2571.0	5.40	13.47	7.18	312	57822	815	112.73	6095	2794	0.301	1173.4	3.24	1.01	1030.9
46	3900.0	2471.0	5.35	13.36	7.14	312	57822	811	110.46	5917	2734	0.299	1118.2	3.20	1.00	1022.7
47	4000.0	2371.0	5.30	13.24	7.09	312	57822	807	108.23	5744	2675	0.298	1063.8	3.17	1.00	1015.8
48	4100.0	2271.0	5.25	13.13	7.05	312	57822	803	106.04	5575	2617	0.297	1010.3	3.15	1.00	1010.0
49	4200.0	2171.0	5.20	13.01	7.01	312	57822	799	103.88	5409	2559	0.295	957.6	3.13	1.00	1005.3
50	4300.0	2071.0	5.15	12.90	6.96	312	57822	795	101.73	5246	2502	0.294	905.6	3.13	1.00	1001.5
51	4400.0	1971.0	5.10	12.78	6.91	312	57822	792	99.59	5085	2445	0.292	854.3	3.14	1.00	998.5
52	4500.0	1871.0	5.05	12.66	6.87	312	57822	788	97.43	4925	2388	0.291	803.6	3.16	1.00	996.3
53	4600.0	1771.0	5.00	12.54	6.82	312	57822	784	95.26	4766	2331	0.289	753.5	3.19	0.99	994.7
54	4700.0	1671.0	4.95	12.42	6.77	312	57822	779	93.06	4607	2273	0.288	704.1	3.23	0.99	993.6
55	4800.0	1571.0	4.89	12.29	6.72	312	57822	775	90.81	4448	2215	0.286	655.2	3.27	0.99	993.1
56	4900.0	1471.0	4.84	12.16	6.67	312	57822	770	88.52	4288	2157	0.284	606.8	3.32	0.99	993.0
57	5000.0	1371.0	4.78	12.02	6.61	312	57822	766	86.17	4128	2098	0.282	558.9	3.38	0.99	993.2
58	5100.0	1271.0	4.73	11.88	6.56	312	57822	761	83.76	3966	2039	0.280	511.6	3.45	0.99	993.8
59	5200.0	1171.0	4.67	11.73	6.50	312	57822	755	81.28	3803	1979	0.278	464.8	3.52	0.99	994.6
60	5300.0	1071.0	4.62	11.57	6.44	312	57822	750	78.72	3638	1918	0.275	418.6	3.59	0.99	995.7