Secular variation of

Center of Gravity

of **Stas** and **Rickard**

Presented by Yama

motivation

With age, people approach to **Heaven** or **Hell**.

(Space scientist must approach to the Heaven?)

Can't we examine it from the average location?

$\Rightarrow$ Calculate the average location

& Calculate its secular variation

method

(1) Get past business trip record.

(2) Input location (Earth fixed XYZ).

Greenwich's XYZ = (0, cos λ, sin λ)

(3) Take average over 200 days.

(working days without semester)

(4) Examine its depth under the ground.

data : Stas

Stas	Lat	Long	2001	2002	2003	2004	2005
Bern	46.95	7.44		6			
Bryssel	50.5	4.41	2				
Darmstadt	49.87	8.5	2	3	22	4	
Dublin	53.33	-6.25	4				
ESTEC	52.1	4.3	6	6	19	1	12
Göteborg	57.3	12					1
Graz	47.06	15.45				3	
Helsingfors	60.1	24.56	2	3			
Bangalore	12.96	77.56					9
Italy	43	12				6	
Montreal	45.51	-73.55				7	
Nice	43.41	7.15	7	2		6	
Paris	48.52	2.22				3	3
Pekin	39.55	116.24				6	
Rom	41.89	12.5					5
S.F.	37.74	-122.42				8	10
Singapore	1.17	103.51				6	
Stockholm	59.33	18.07	3.4	0.4	3.2		0.4
Tokyo	35.69	139.75	13				18
Toulouse	43.37	1.27	3	4	11		2
Trivandum	8.48	76.95				12	
Turin	45.07	7.67				4	
Umeå	63.82	20.31	2			2	
Wien	48.12	16.22					10

data : Rickard

Rickard			2001	2002	2003	2004	2005
Bern	46.95	7.44			14		10
Biarritz	43.48	-1.57	3				
Darmstadt	49.87	8.5				2	
ESTEC	52.1	4.3	10	16	10	1	17
Finland	60	25		5			
Frankrike	45	2		3			3
Göteborg	57.3	12	0.4				
Houston	29.76	-95.36		18			
Irkutsk	52.3	104			4		
Kiruna	67.9	20			10	52	39
Köpenhamn	55.42	12.38					2
Kourou	5.15	-52.55		31			
Les Houches	45.89	6.79			10		
London	51.5	-0.13		4			2
Luleå	65.34	22.1	4.4	1			
Lund	55.71	13.2	1	17	25.8	13	12.4
Malmö	55.58	13.3		1	1		
Moskva	55.44	37.42				1	
München	48.08	11.35		2			
Neapel	41.9	12.34			5		
Nice	43.41	7.15	6			9	
Oslo	59.91	10.75		13			
Östersund	63.18	14.65					0.4
Oxford	51.47	-1.25		4			
Paris	48.52	2.22		2	2	12	3
Rom	41.89	12.5		6			
San Antonio	29.42	-98.49				6	
Sapporo	43.1	141.35			6		
Colorado	40	-105				7	
Stockholm	59.33	18.07	15.2	29.9	20.6	12.6	9.2
Strasbourgh	48.36	7.45			2		
Sverige	57	16	9				
Tenerife	28.3	-16.51			8		
Tokyo-Kyoto	35.3	137.7	6				
Toulouse	43.37	1.27		12	14	6	29
Umeå	63.82	20.31	24.8	32	5		
Venedig	45.45	12.2	7				
Vienna	48.12	16.22					14

cf. : Yama

Yama	Lat	Long	1995	1996	1997	1998	1999	2000
Bern	46.95	7.44			4	4		
ESTEC	52.1	4.3						3
Haag	52.07	4.17		5			6	
Hamburg	53.3	10	4				6	
Denver	39.8	-104.9	18					
Washington	38.54	-77.2				7		
Hawai	19.65	-156					11	
Banyuls	42.47	3.12		6				
Nice	43.41	7.15						6
London	51.5	0			5			
MPAe	51.6	10		6				5
Longyearbyen	78.2	15.6			10			
Sapporo	43.1	141.35				4		
Stockholm	59.33	18.07					7	4
Sendai	39	141						6
Tokyo-Osaka	35.69	139.75	28	19	16	73	20	9
Kagoshima	30.5	131				11		
Göteborg	57.3	12			2			
Umeå	63.82	20.31					1	18
Uppsala	59.53	17.36	3				2	
Wien	48.12	16.22			7			

Result : Stas

Stas	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
<Z>	0.88	0.91	0.88	0.8	0.82	0.85
<X>	0.15	0.12	0.11	0.16	0.16	0.1
<Y>	0.33	0.39	0.43	0.32	0.27	0.37
<R>	**0.95**	**0.99**	**0.99**	**0.87**	**0.88**	**0.94**
<Lat>	67.7	65.8	63.2	66.1	69.1	65.6
<Long>	23.7	17.6	14.5	26.6	30.3	15.0

- R $\Rightarrow$ Discontinuity at 2004
- Lat/Long $\Rightarrow$ Stay within Lappland

Result : Rickard

Rickard	**2001**	**2002**	**2004**	**2003**	**2005**	**2006**
<Z>	0.88	0.68		0.85	0.83	0.8
<X>	0.14	-0.12		0.07	0.11	0.07
<Y>	0.39	0.49		0.42	0.52	0.27
<R>	**0.97**	**0.85**		**0.95**	**0.99**	**0.85**
<Lat>	64.6	53.7		63.7	57.6	70.9
<Long>	19.7	-13.3		9.4	12.2	14.5

- R ⇒ Large Variation
- Lat/Long ⇒ Scandinavia & North Sea

cf. : Yama

Yama	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
<Z>	0.85	0.88	0.89	0.76	0.85	0.89
<X>	0.11	0.16	0.16	0.28	0.14	0.16
<Y>	0.17	0.29	0.29	-0.07	0.21	0.31
<R>	**0.87**	**0.94**	**0.95**	**0.81**	**0.89**	**0.95**
<Lat>	76.5	69.5	69.5	69.4	73.5	68.6
<Long>	31.2	29.3	27.8	-75.7	33.3	26.9

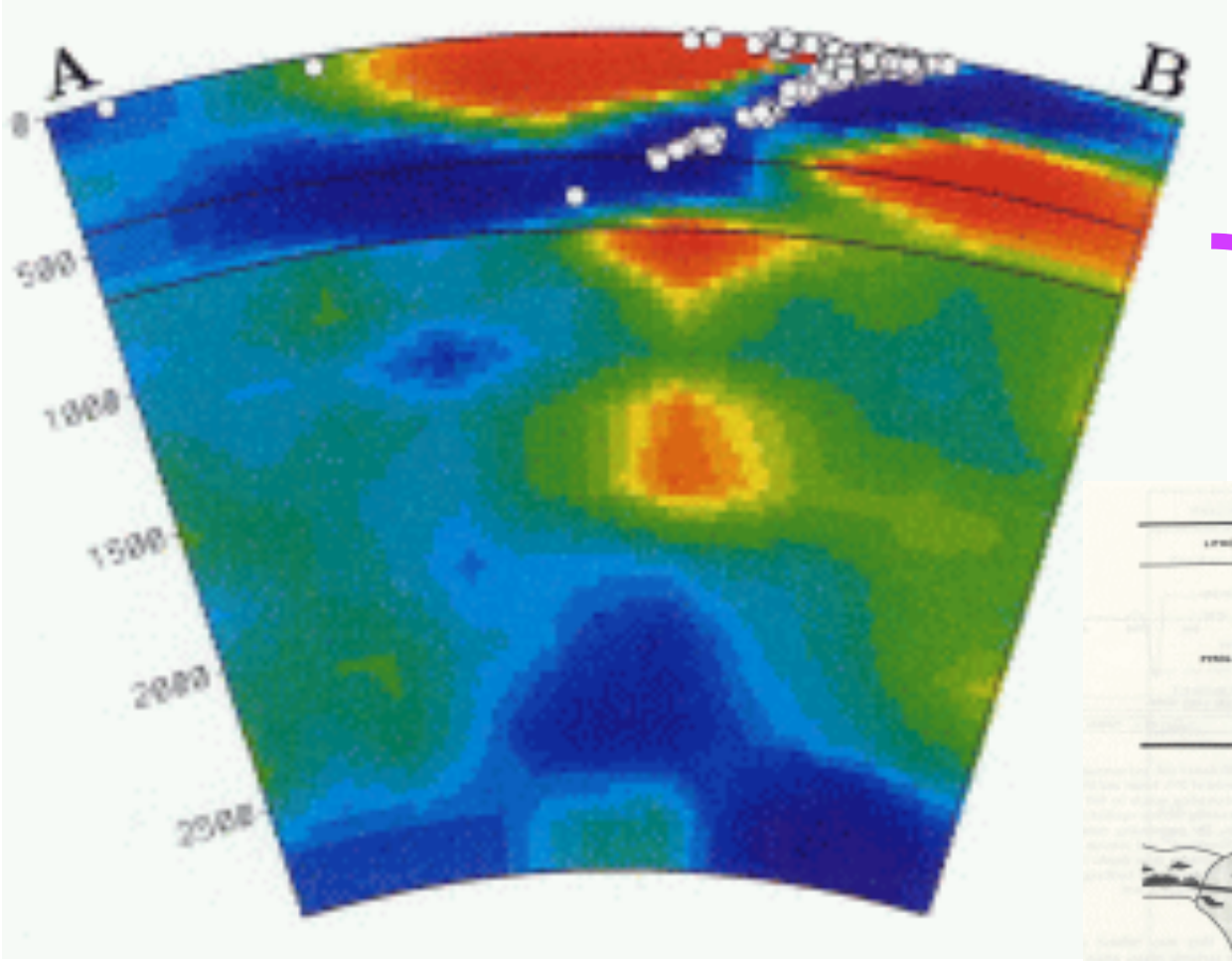
- R ⇒ Singularity at 1998 (Nozomi Launch)
- Lat/Long ⇒ Under the Arctic Sea

discussion

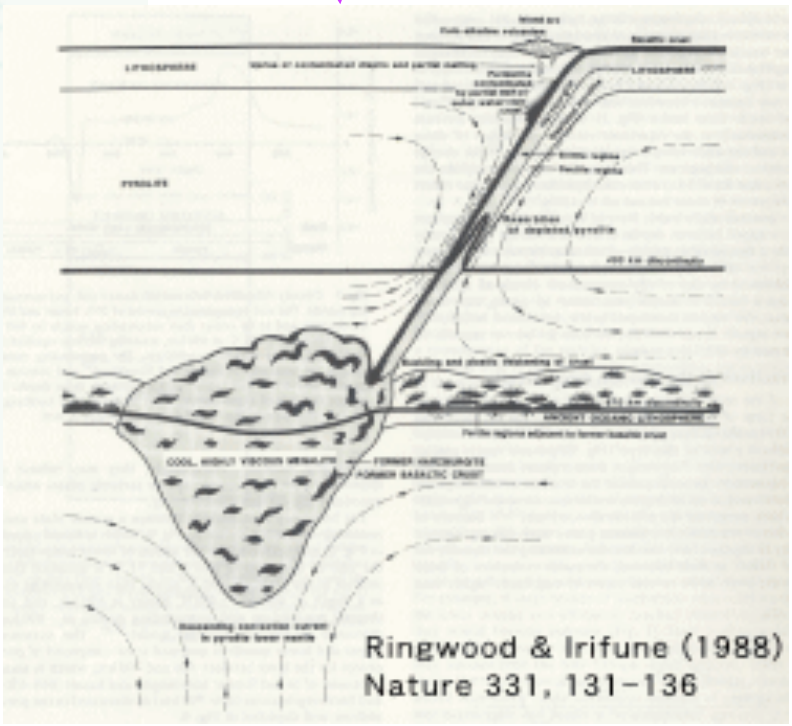
They are certainly under the sea level.

But, how much are they close to the Hell boundary?

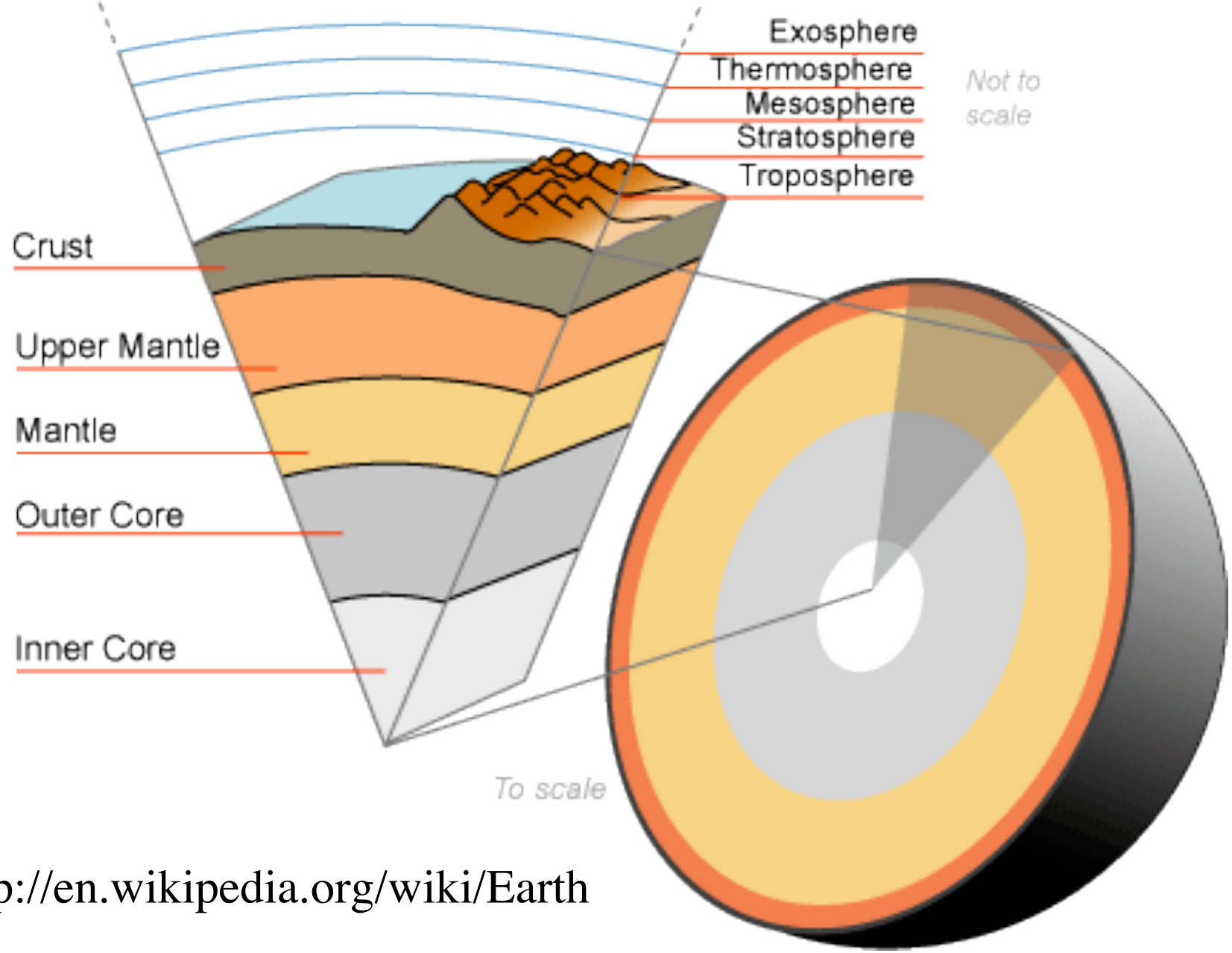
Searching the Hell : Seismology



Velocity map of seismic wave.



Earth's Interior



http://en.wikipedia.org/wiki/Earth

Where is the Hell?

Candidates :

Moho. discon. (~ 5-75 km) : R/R_E = **0.995**

Lehman discon. (~ 220 km) : R/R_E = **0.97**

Upper/lower mantle (~ 700 km) : R/R_E = **0.89**

Gutenberg discon. (~ 2900 km) : R/R_E = **0.55**

Note: If the trips stay within > 45°N,

$\Rightarrow$ Automatically $\mathbf{R/R_E > 0.7}$

Condition for Hell

(1)Nearly "melting-hot" :

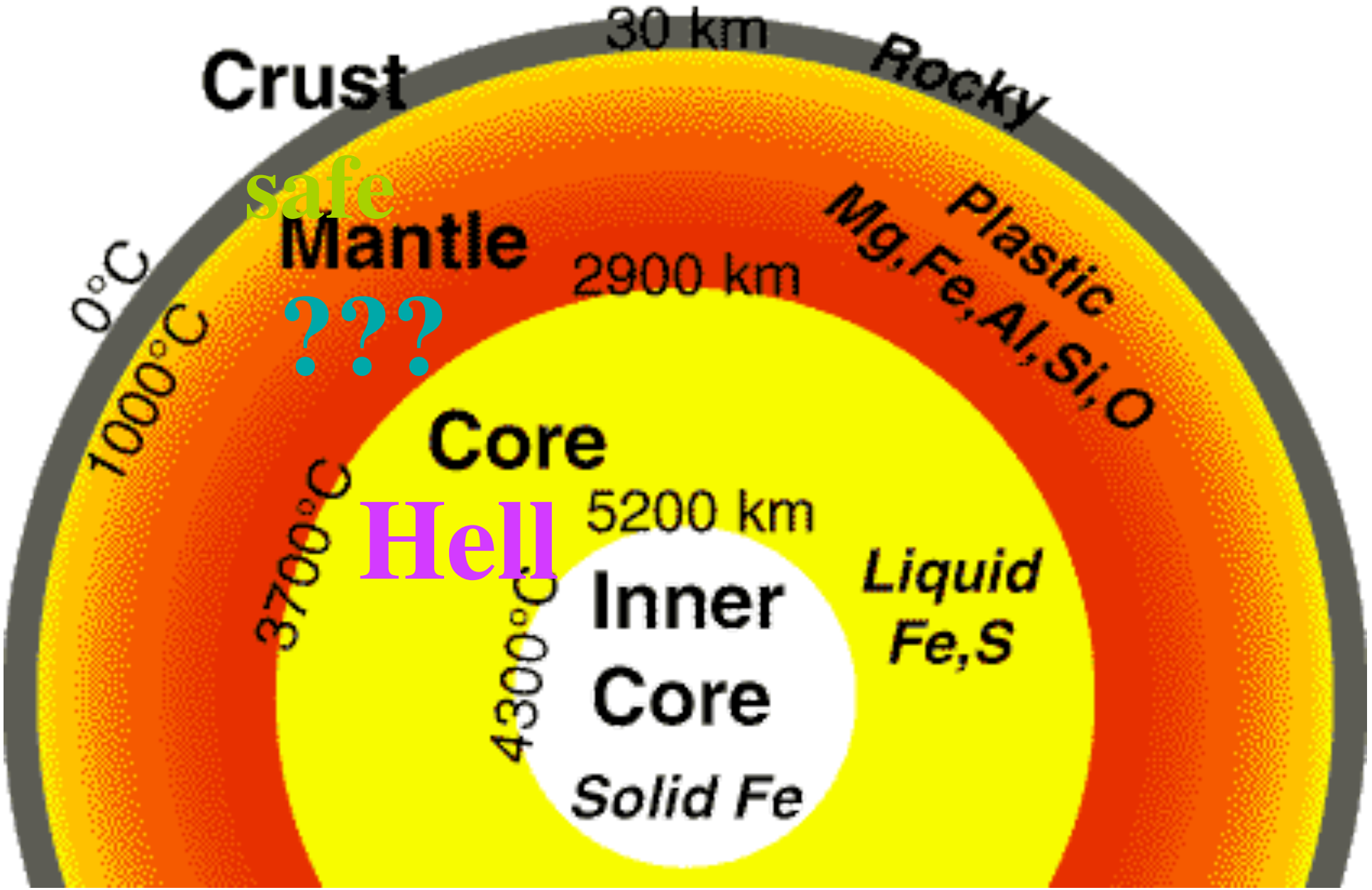
$\Rightarrow$ Outer core = Hell

Crust = Safe

Mantle = ???

(2) I actually felt "**nearly-Hell**" at 1998, when I was located at $\mathbf{R/R_E = 0.81}$

Hell boundary must be $\mathbf{R/R_E \approx 0.8}$



http://www.seismo.unr.edu/ftp/pub/louie/class/100/interior.html

Conclusions

- **All are consistently located within Mantle.**
- **Stas is quickly approaching to the Hell after his professorship.**
- **Rickard had some near-miss years.**
- **For myself, Nozomi launch year was the Hell.**
- **There must be unknown discontinuity in the lower Mantle at around $R/R_E \approx 0.8$.**