NSDL/NSTA Web Seminar:

Earth in Reverse: Magnetic Wiggles on the Ocean Floor

Tuesday, January 29, 2008

Today's NSDL Experts

Dr. Chris Massell Symons, Researcher at the Scripps Institution of Oceanography

Dr. Anthony Koppers, Associate Professor of Marine Geology and Geophysics at Oregon State University

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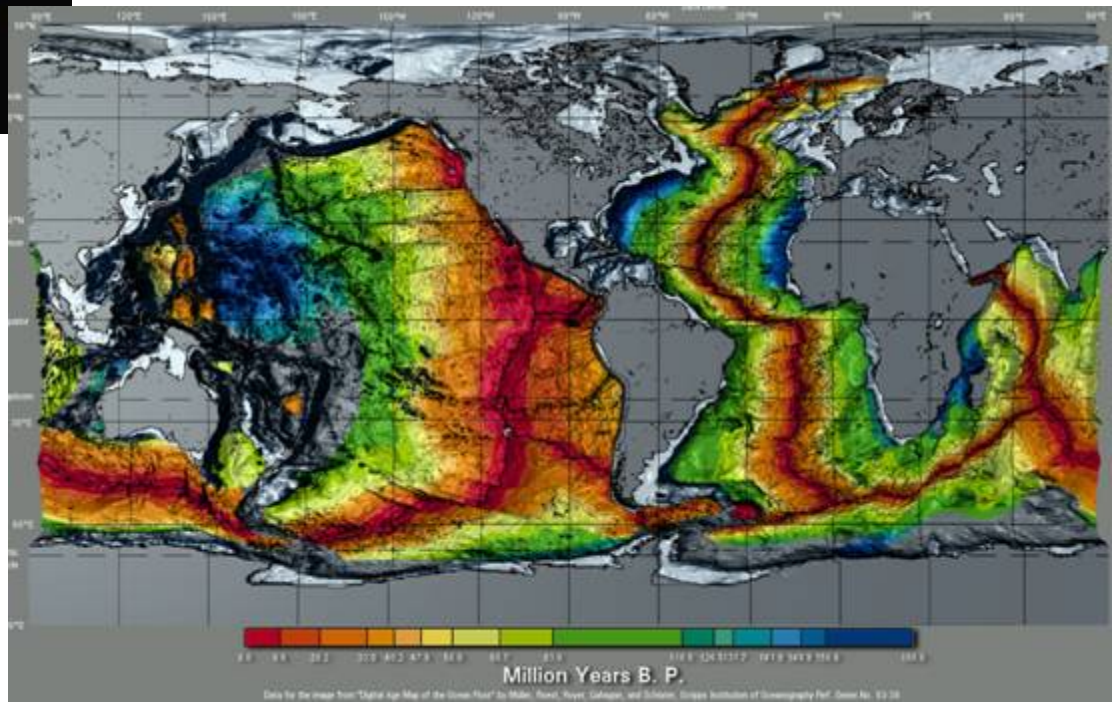
How did we get from “blue” oceans to such great detail?

Magnetic Wiggles!!!



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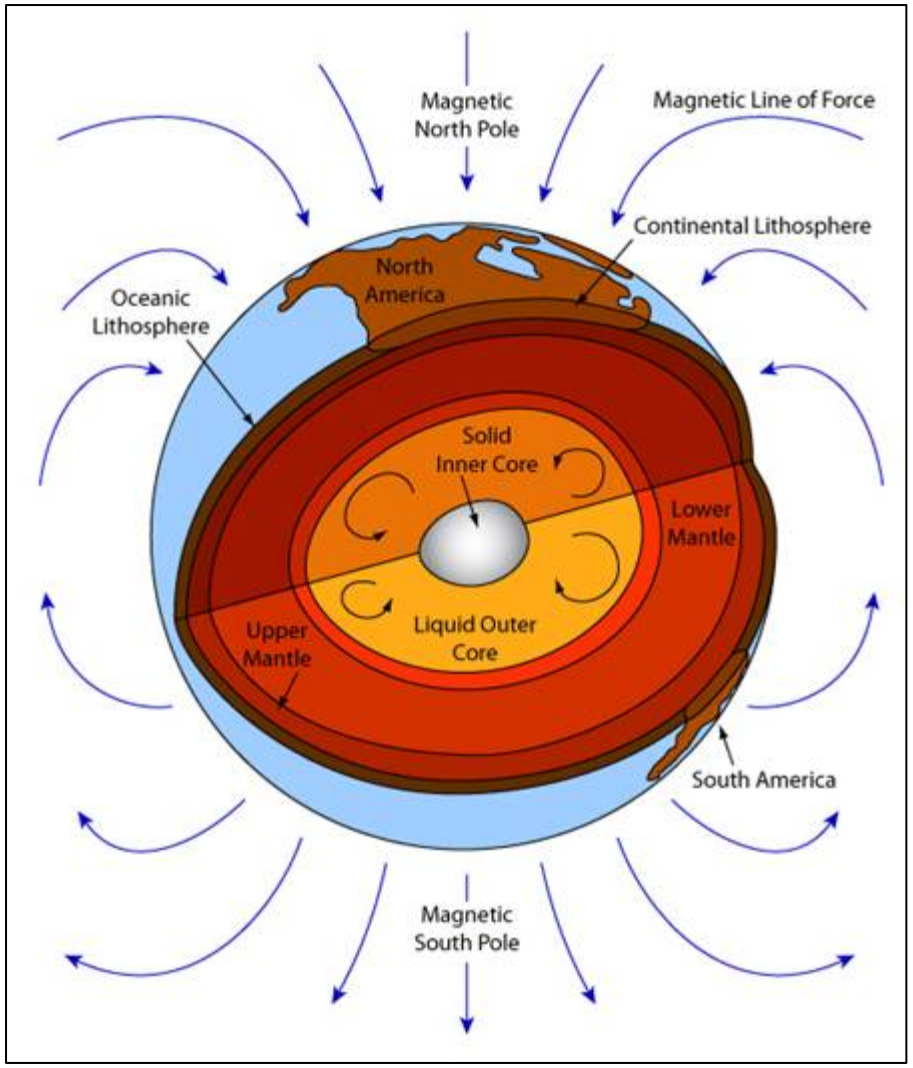
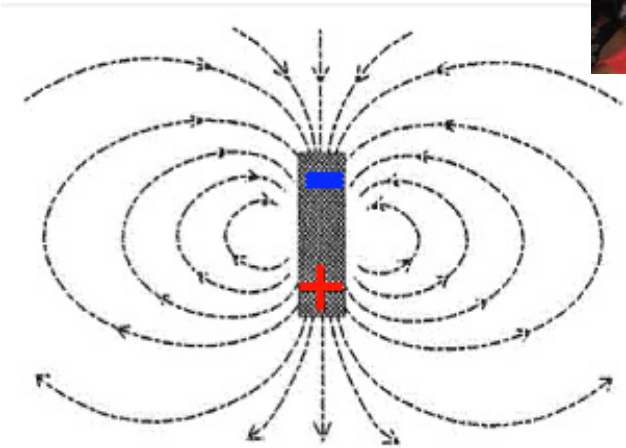
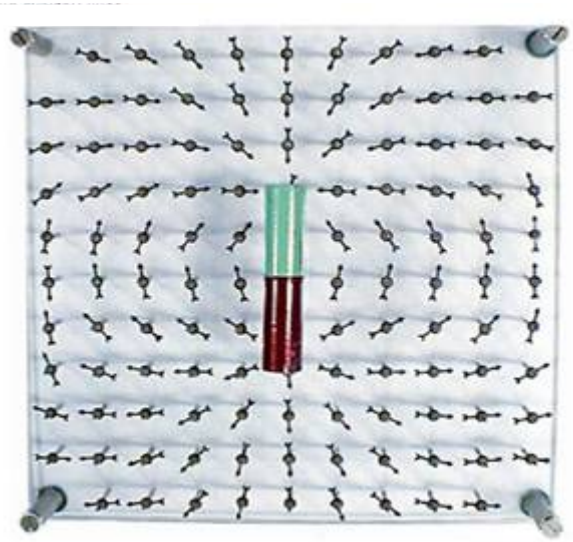
Earth's Magnetic Field





Bar Magnet



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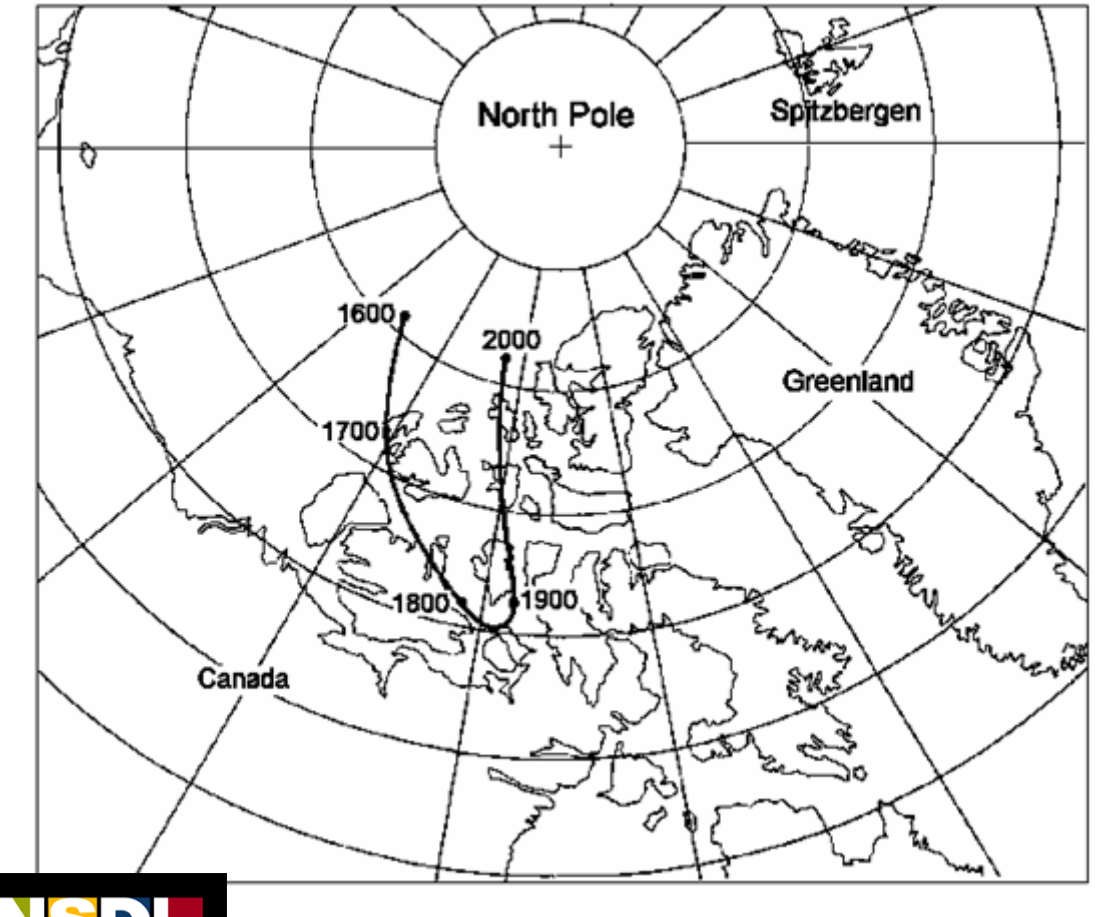
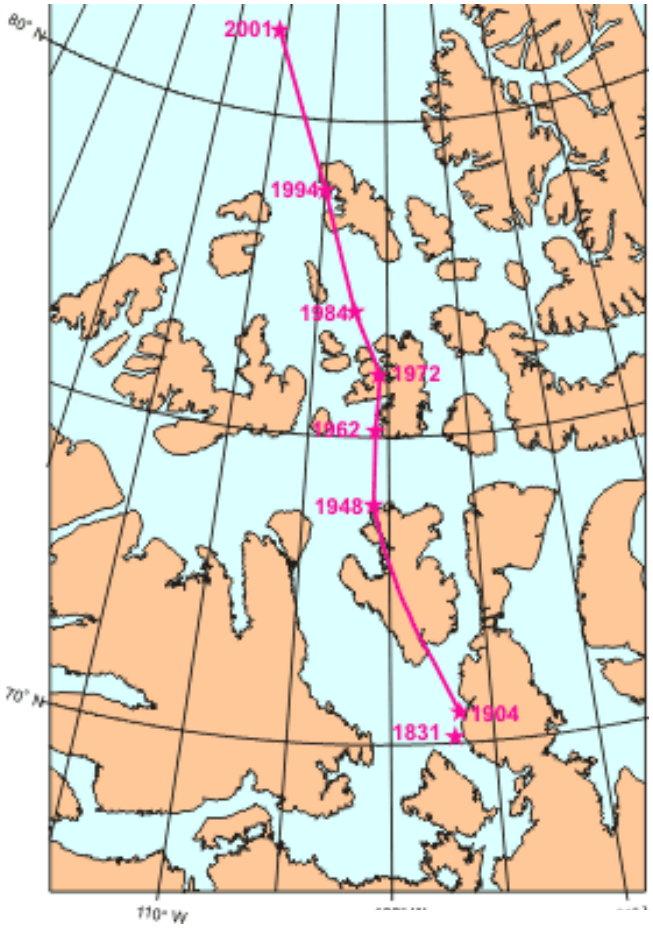
BUT…..Magnetic North is NOT at the North Pole





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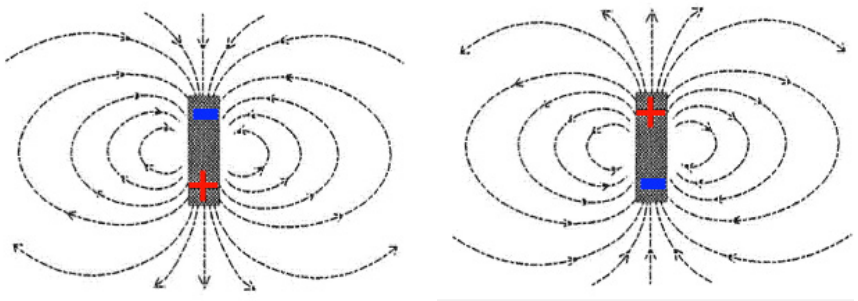
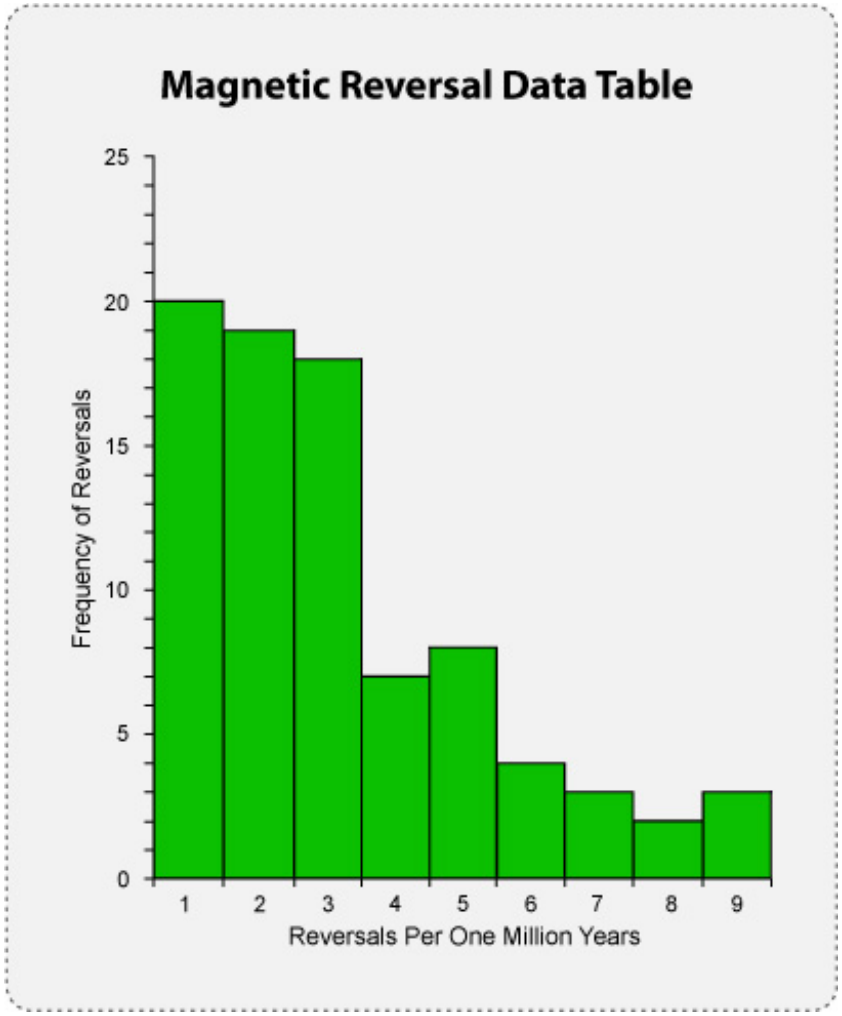
AND…the Magnetic Field Reverses

- Field reverses ~1 time every 200,000 years on average.
- 400 times in last 330 million years.
- Last reversal was 780,000 years ago.

NORMAL REVERSE





Poll Question!

On average, how long does each magnetic reversal take to complete?

A. 10,000 years
B. 5,000 years
C. 1,000 years
D. 100 years

Let’s pause for two questions from the audience….

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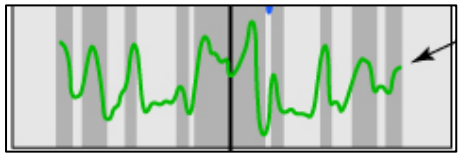
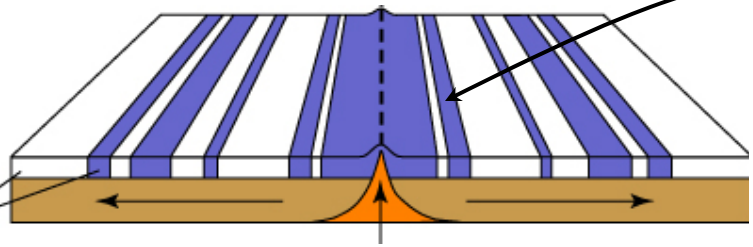


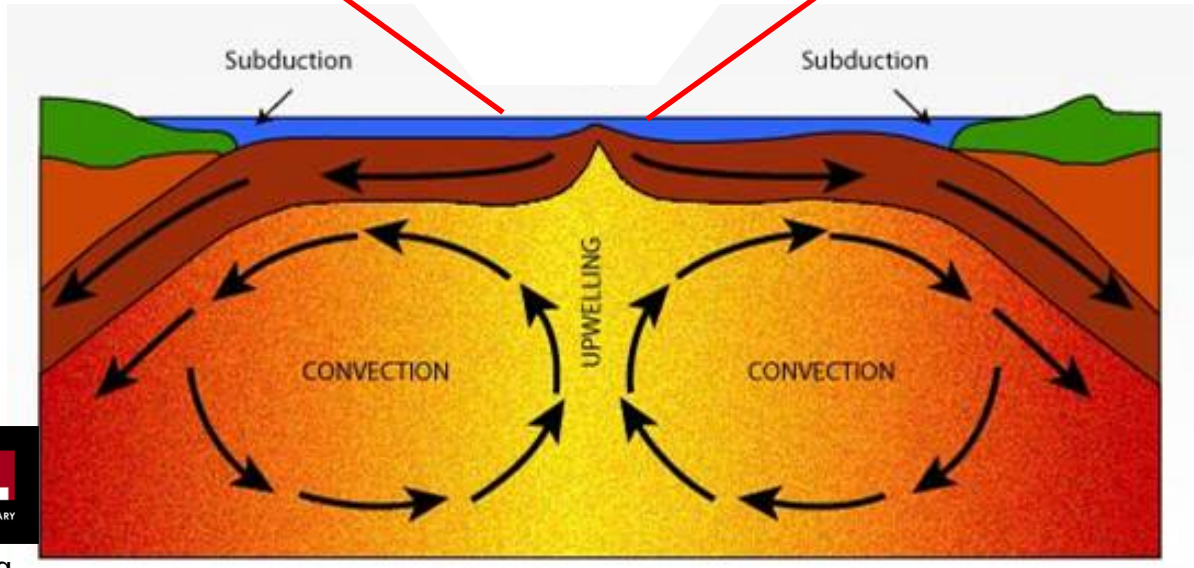
NORMAL

REVERSE



MID-OCEAN RIDGE

http://usgs.gov



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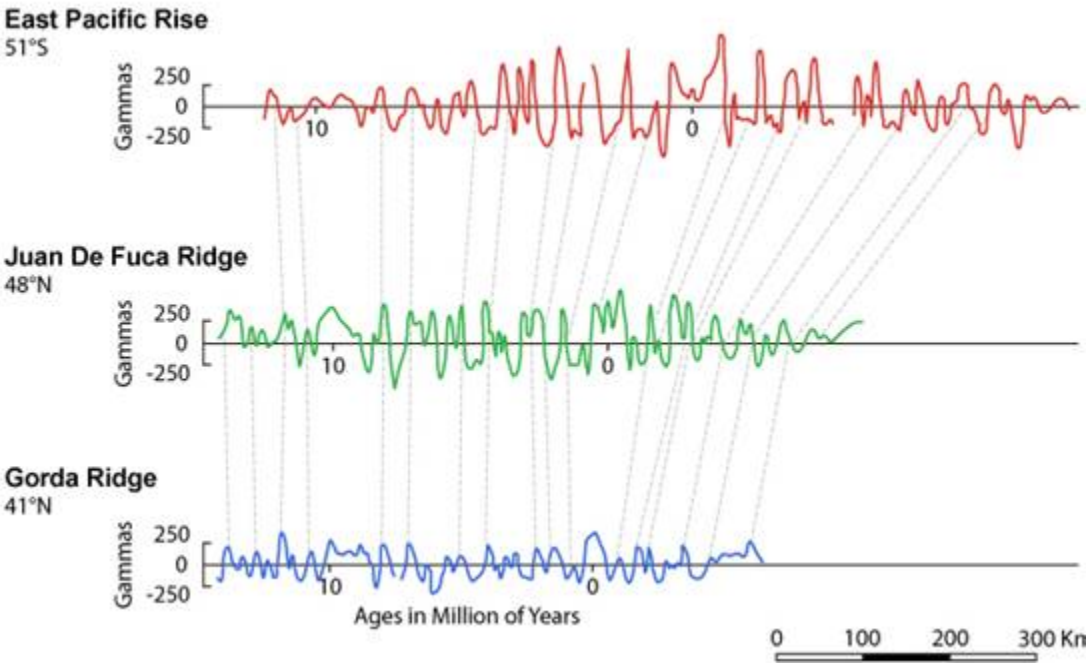
Sampling the Seafloor



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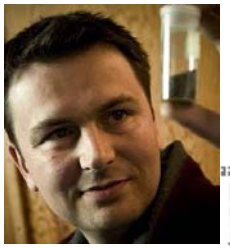
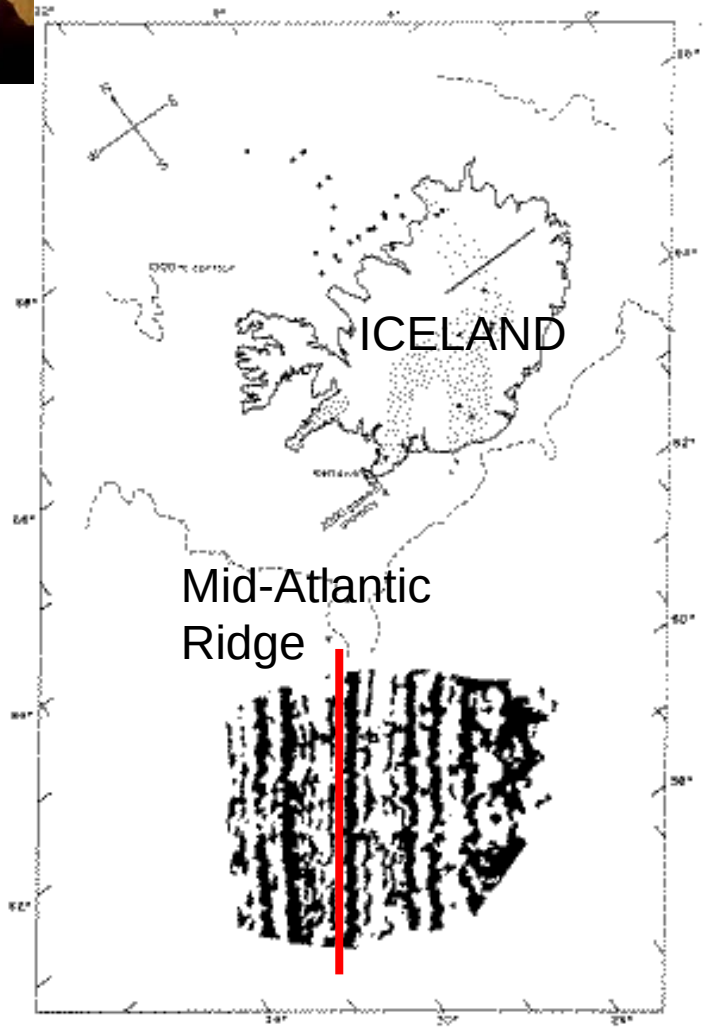
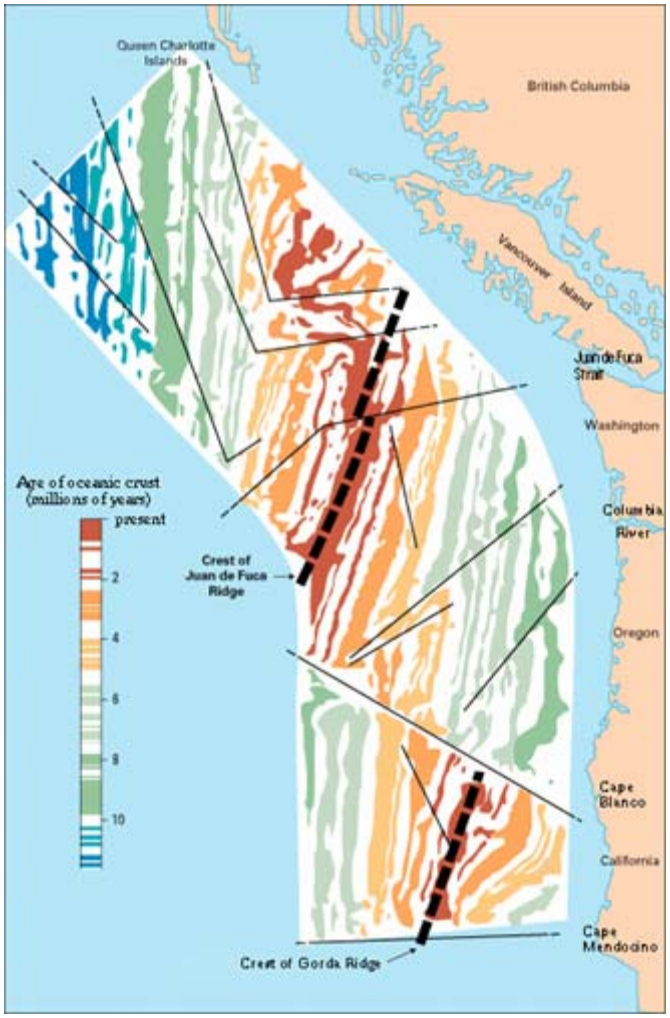


Early Maps of Seafloor Anomalies



Heirtzler et al., 1966



Raff and Mason, 1961

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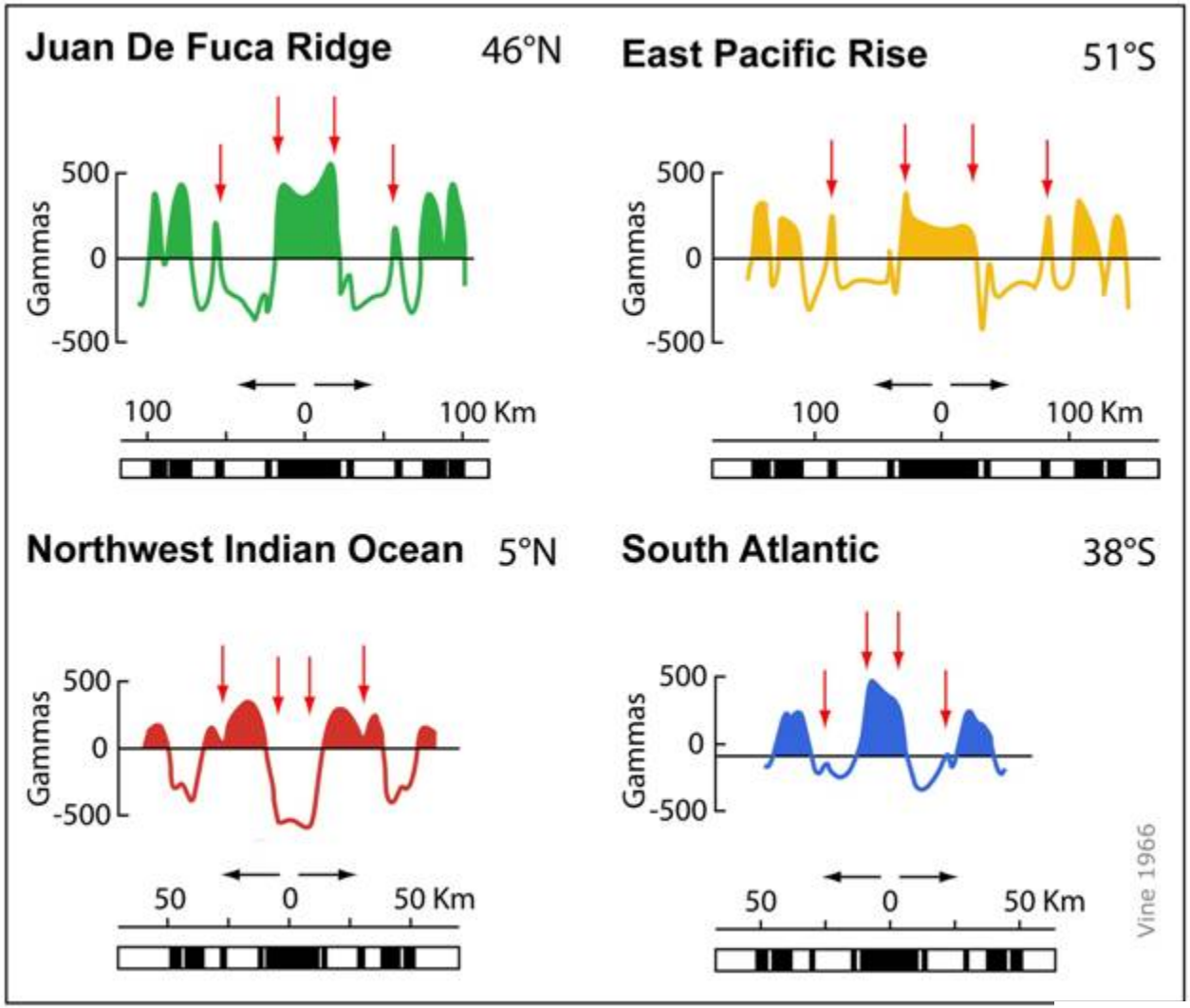
Sample Profiles across Mid-Ocean Ridges



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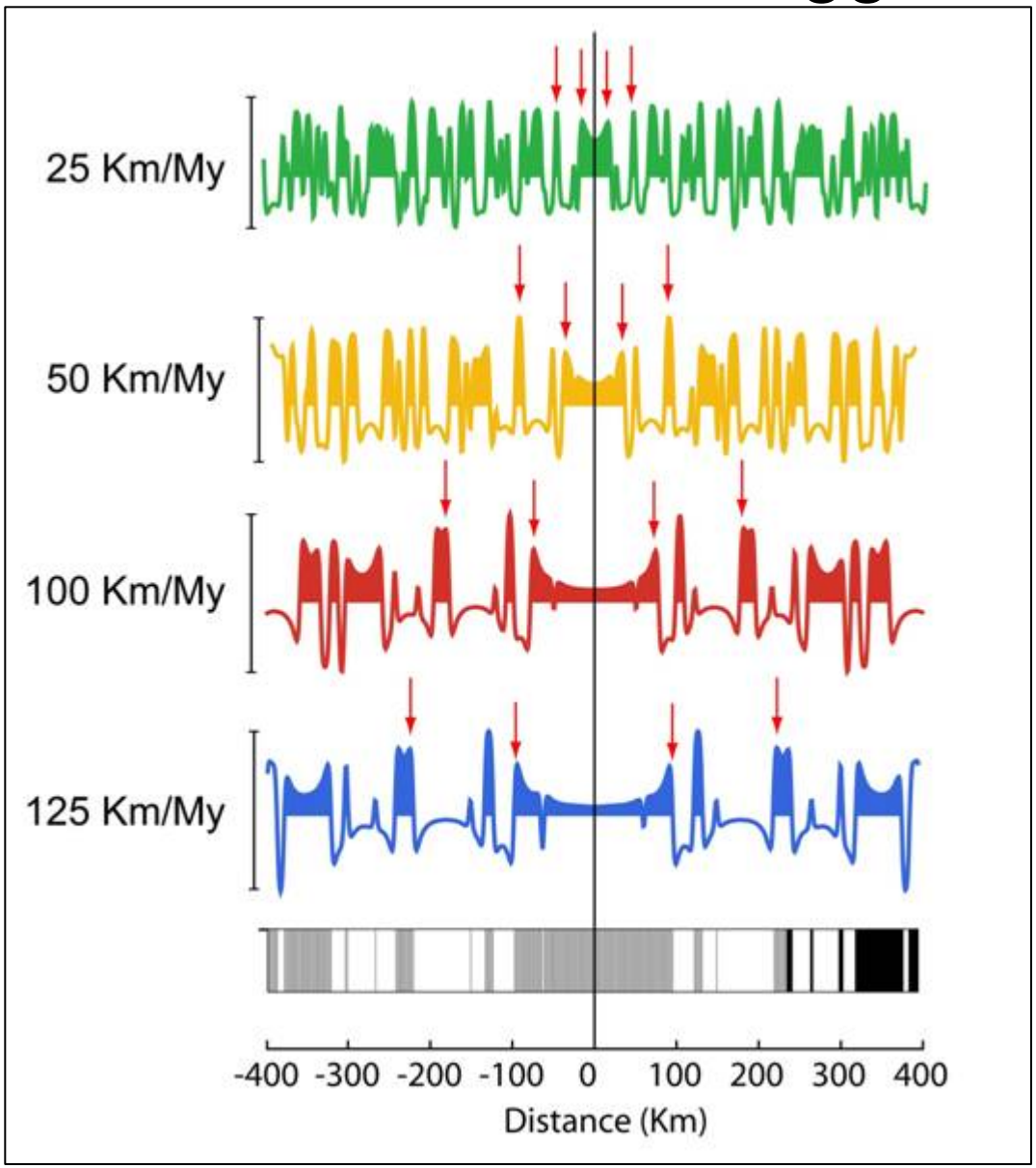
Changing Spreading Rate = Modified Wiggle Pattern



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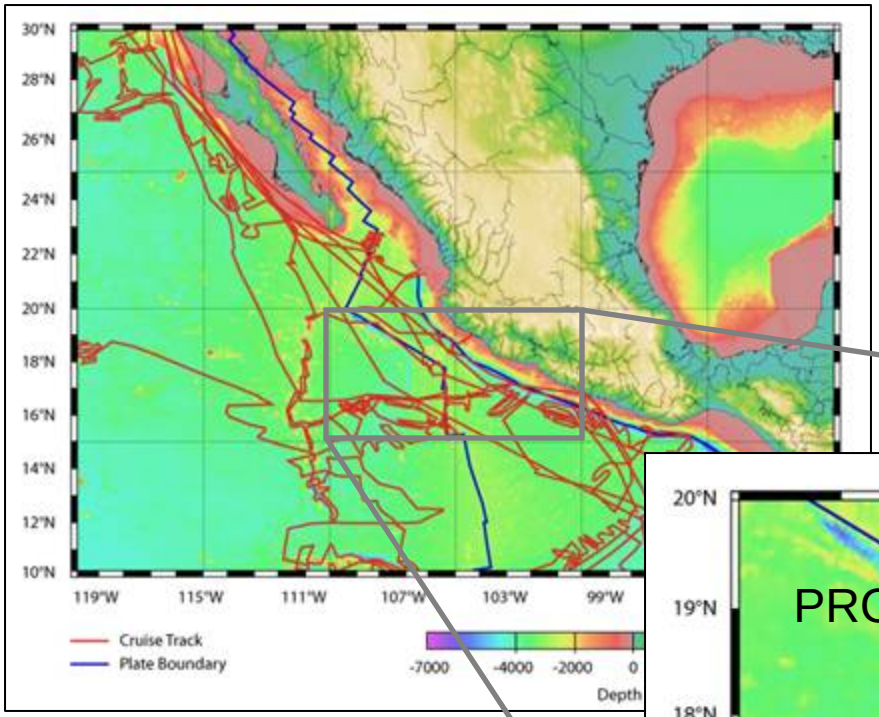
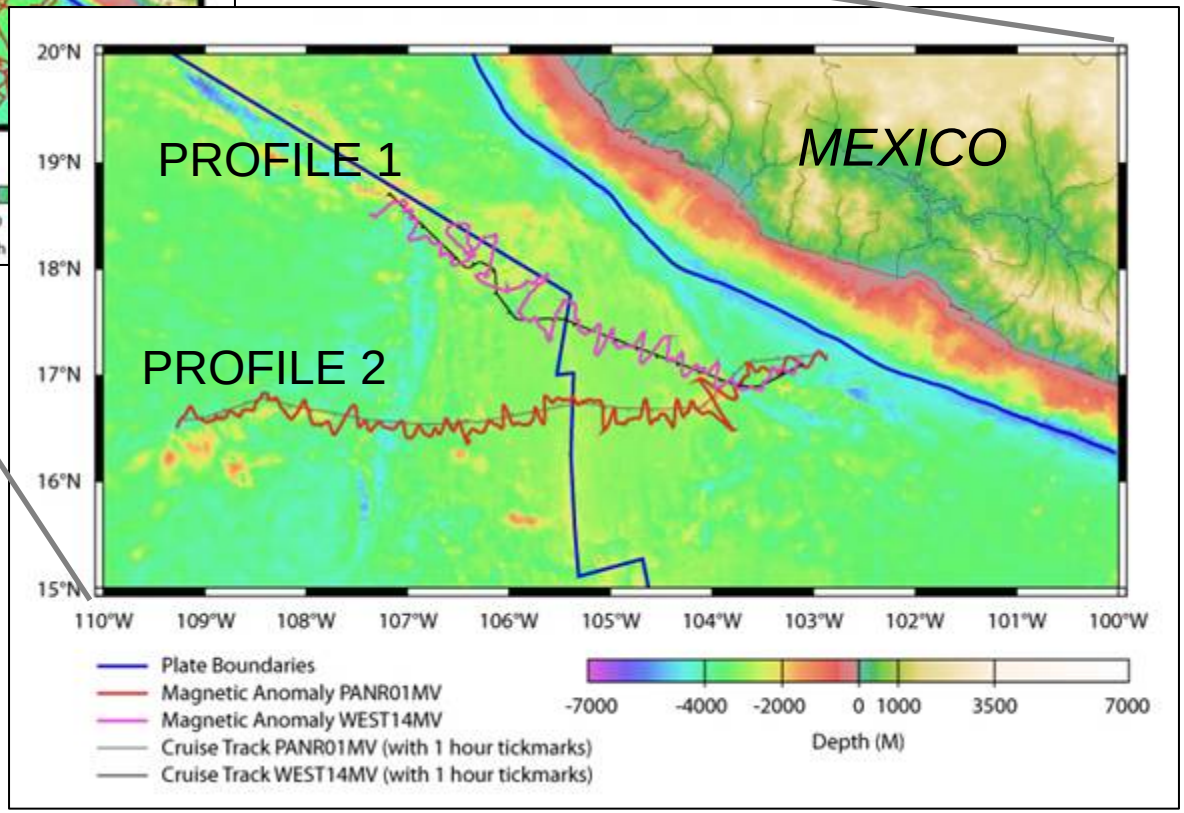
Shipboard Magnetic Data Across the EPR





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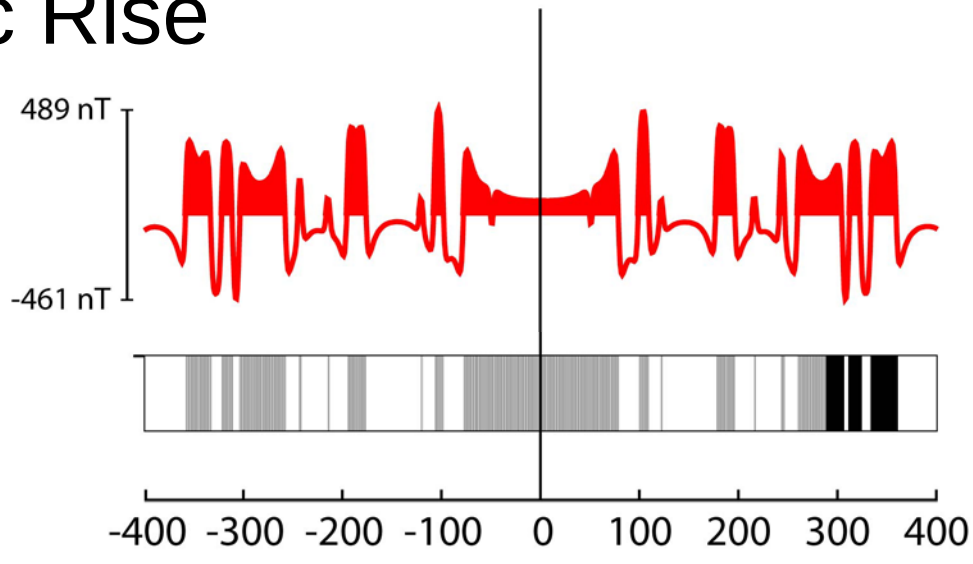
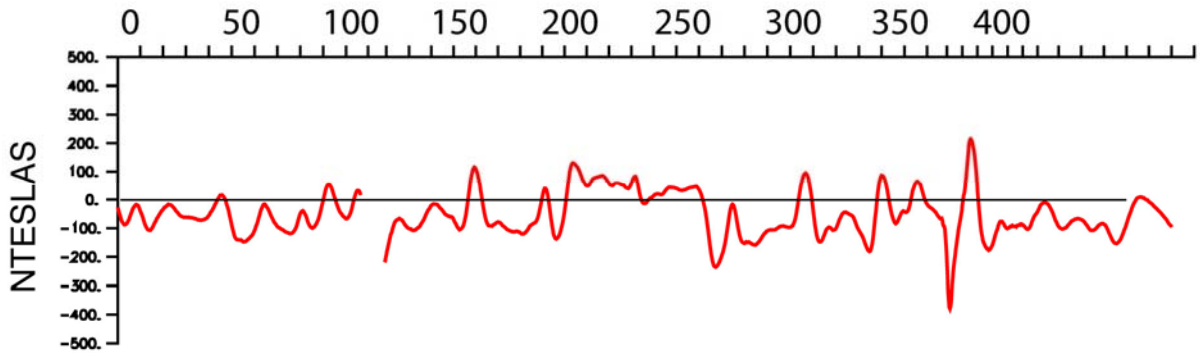
East Pacific Rise

MODEL



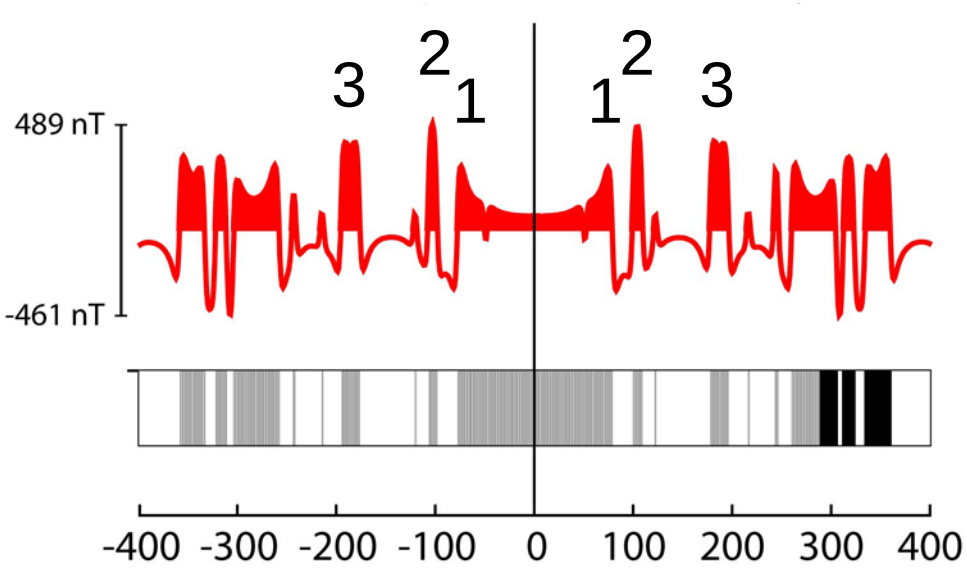
PROFILE 2



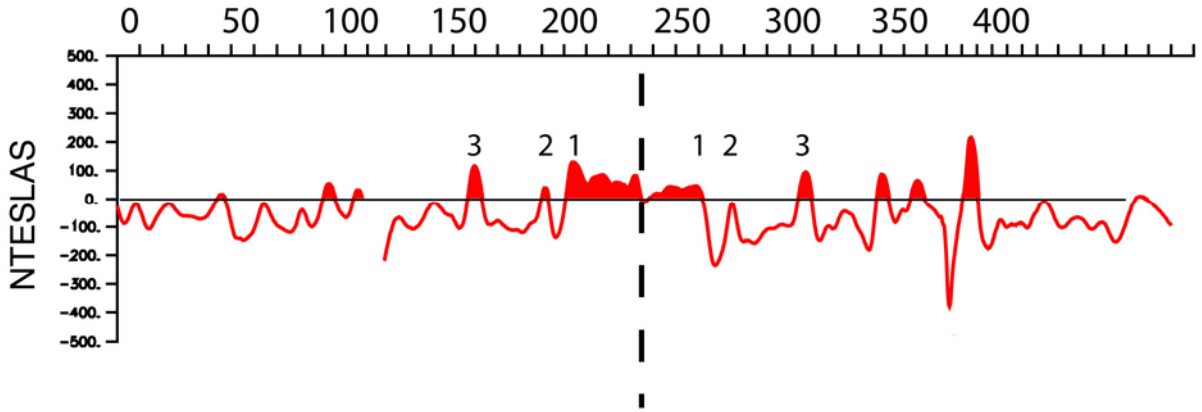
Using the marker, identify the location of the spreading ridge on PROFILE 2.

Solution - Matching Peaks

MODEL



PROFILE 2



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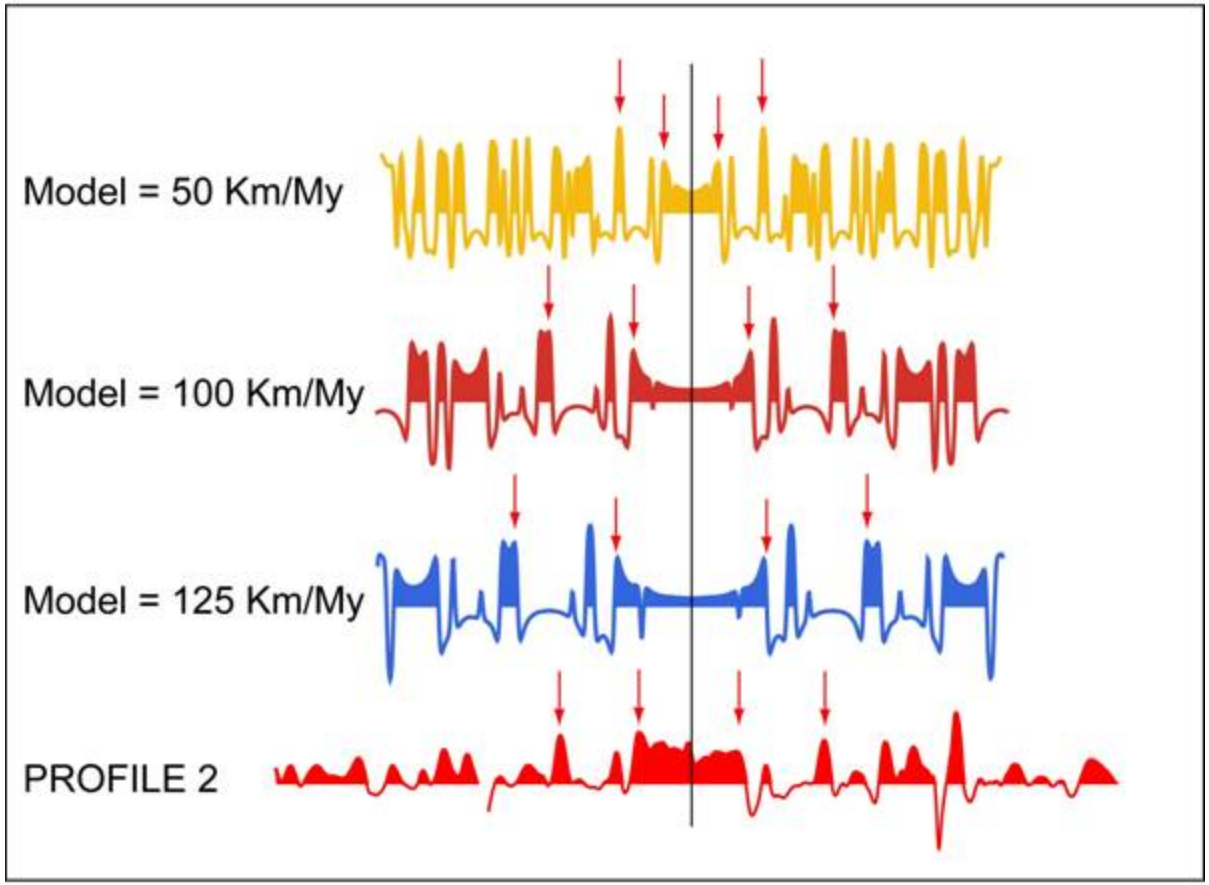
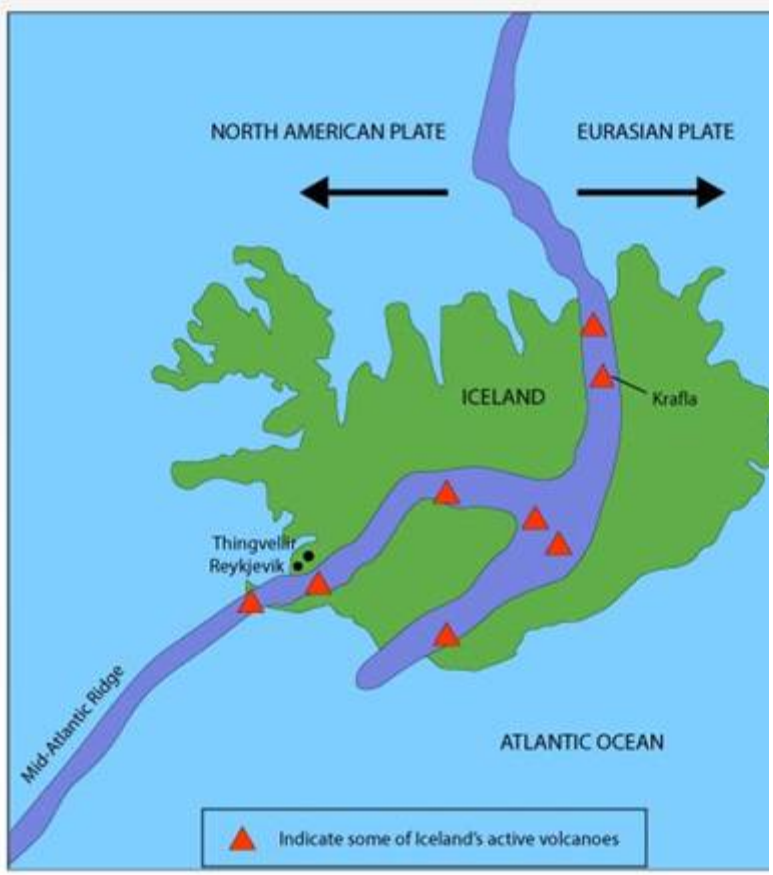
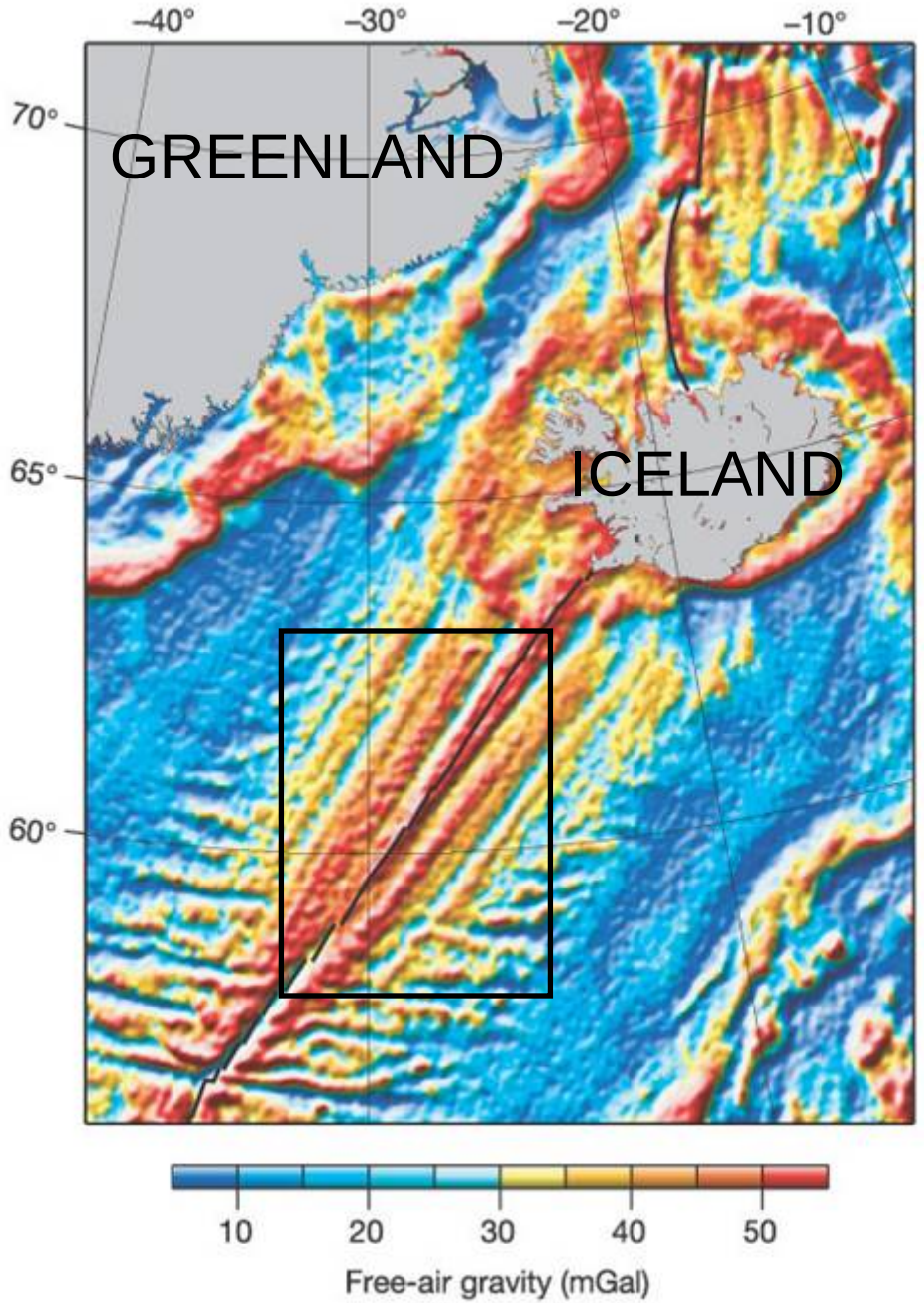
How fast is the East Pacific rise spreading?



50 km/my	100 km/my	125 km/my

Mid-Atlantic Spreading Ridge





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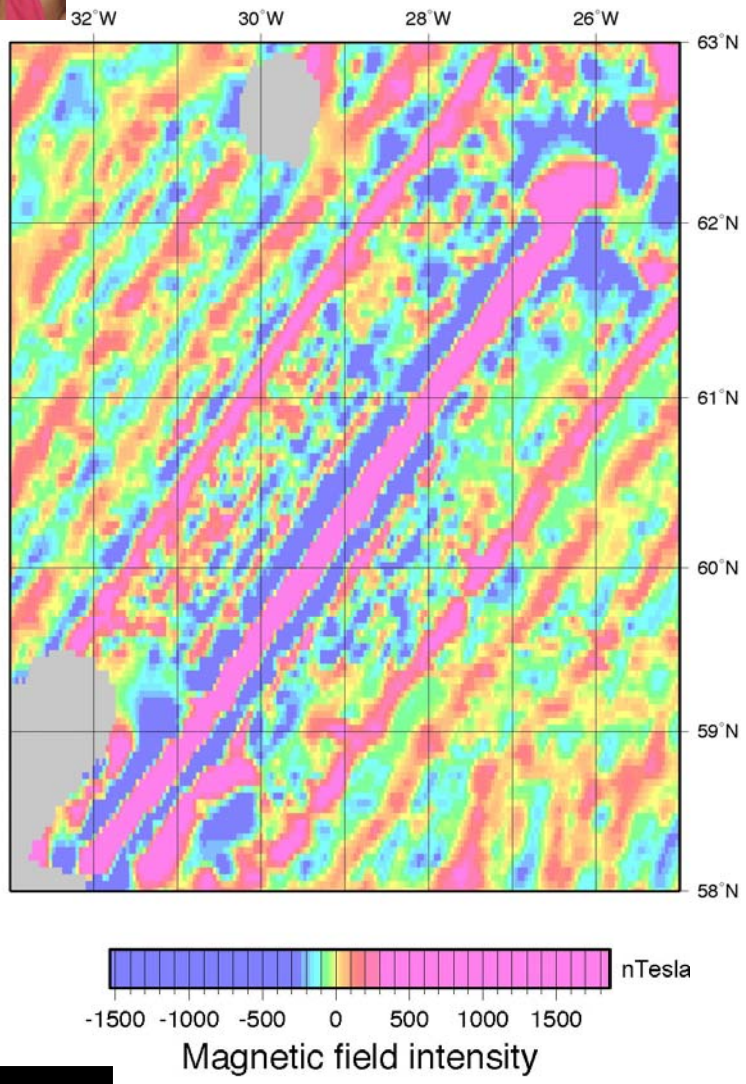
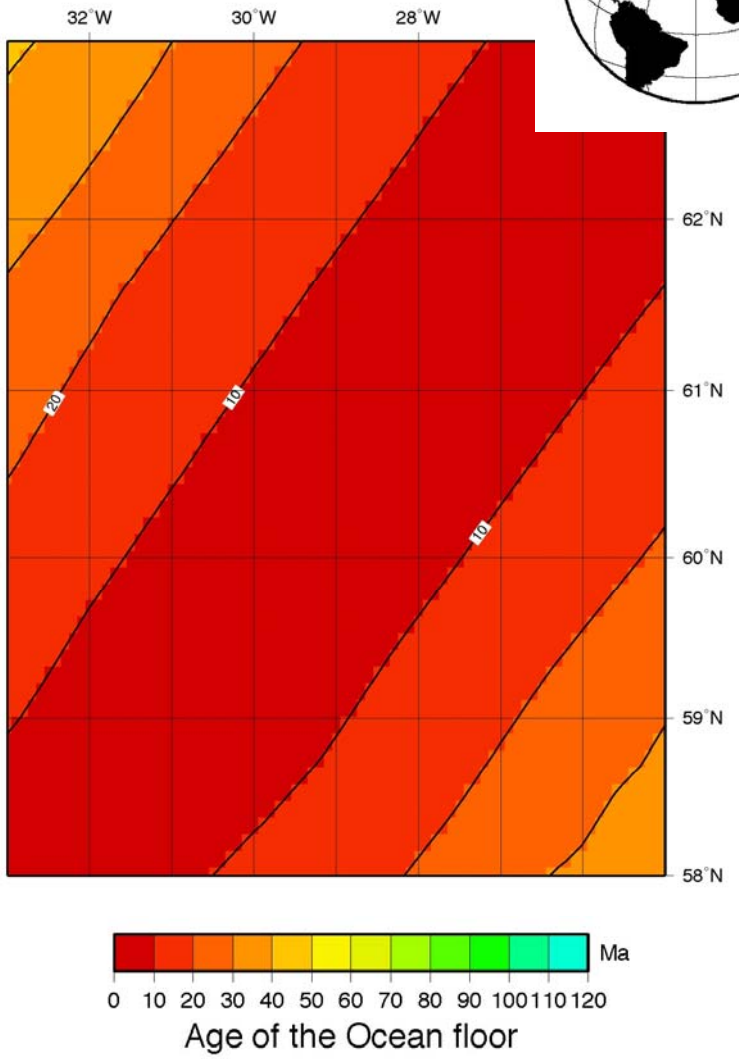
Data across Reykjanes Ridge





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What is the average spreading rate at the Reykjanes Ridge over the last 10 million years?

North American Plate

Longitude (°W)	Latitude (°N)	Distance from Ridge (km)	Depth (m)	Sample Age (Ma)
32.70	60.86	-200	-2600	21.1
32.54	60.82	-190	-2588	19.9
32.37	60.78	-180	-2504	19.0
32.21	60.74	-170	-2465	17.9
32.05	60.70	-160	-2416	16.7
31.88	60.65	-150	-2401	15.7
31.72	60.61	-140	-2401	14.7
31.56	60.57	-130	-2328	13.7
31.40	60.53	-120	-2203	12.7
31.24	60.48	-110	-2103	11.4
31.08	60.44	-100	-1948	10.5
30.92	60.40	-90	-1832	9.4
30.76	60.35	-80	-1770	8.4
30.60	60.31	-70	-1657	7.5
30.44	60.27	-60	-1605	6.4
30.28	60.22	-50	-1599	5.4
30.13	60.18	-40	-1575	4.3
29.97	60.13	-30	-1473	3.2
29.81	60.09	-20	-1390	2.1
29.66	60.04	-10	-1169	1.2
29.50	60.00	0	-1011	0.2

Eurasian Plate

Longitude (°W)	Latitude (°N)	Distance from Ridge (km)	Depth (m)	Sample Age (Ma)
29.50	60.00	0	-1011	0.2
29.34	59.95	10	-1108	0.8
29.19	59.91	20	-1272	2.1
29.04	59.86	30	-1410	3.2
28.88	59.82	40	-1549	4.4
28.73	59.77	50	-1415	5.6
28.57	59.73	60	-1529	6.6
28.42	59.68	70	-1668	7.7
28.27	59.63	80	-1797	8.8
28.12	59.59	90	-1848	9.9
27.96	59.54	100	-2017	10.9
27.81	59.49	110	-2194	11.9
27.66	59.45	120	-2143	12.9
27.51	59.40	130	-2040	13.9
27.36	59.35	140	-2003	14.9
27.21	59.31	150	-2080	16.1
27.06	59.26	160	-2271	17.0
26.91	59.21	170	-2389	17.9
26.77	59.16	180	-2320	19.1
26.62	59.11	190	-2213	20.1
26.47	59.07	200	-2235	21.3

Stamp One:

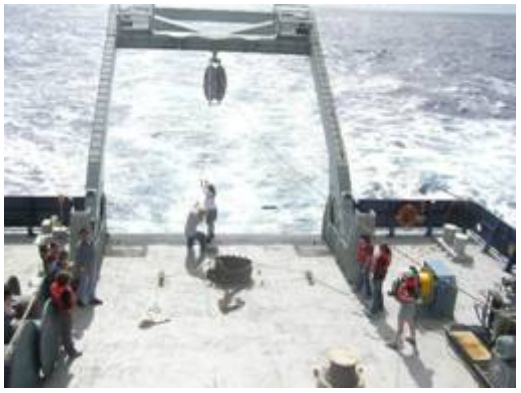
1 km/my

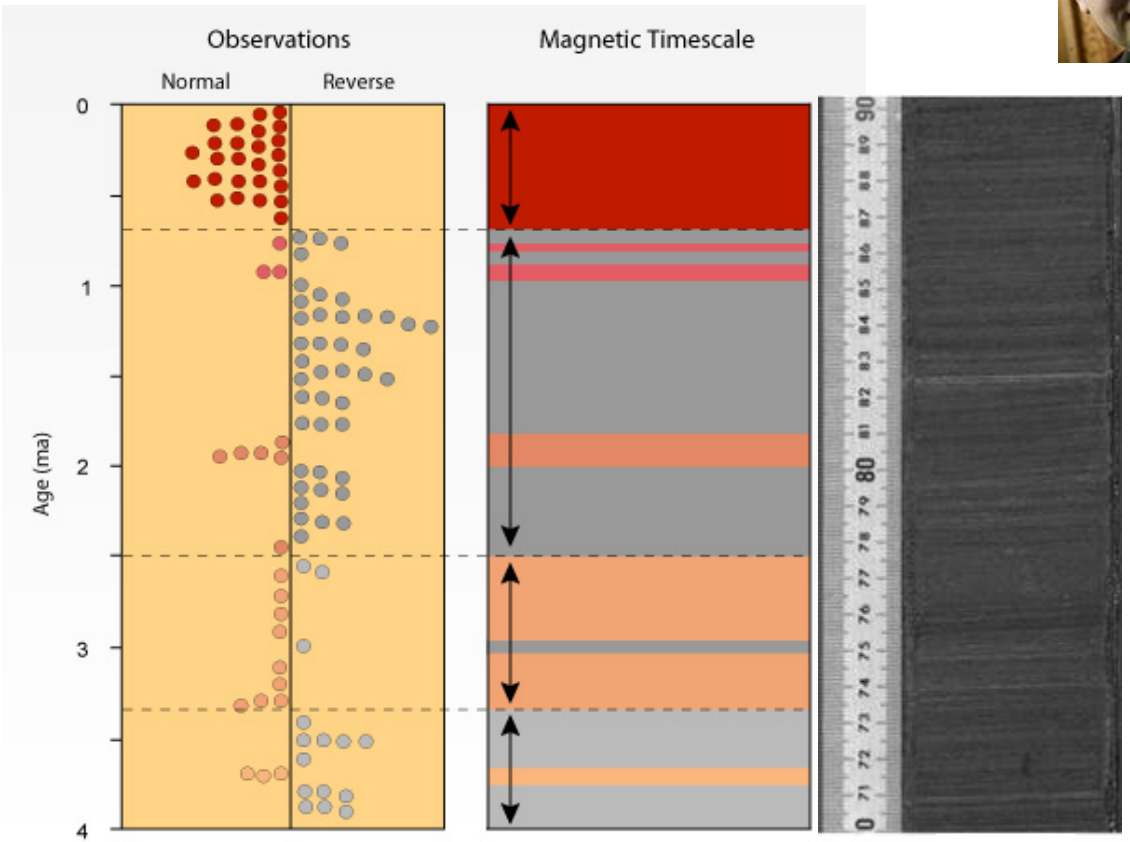
5 km/my

10 km/my

Let’s pause for two questions from the audience….

How old are the wiggles?





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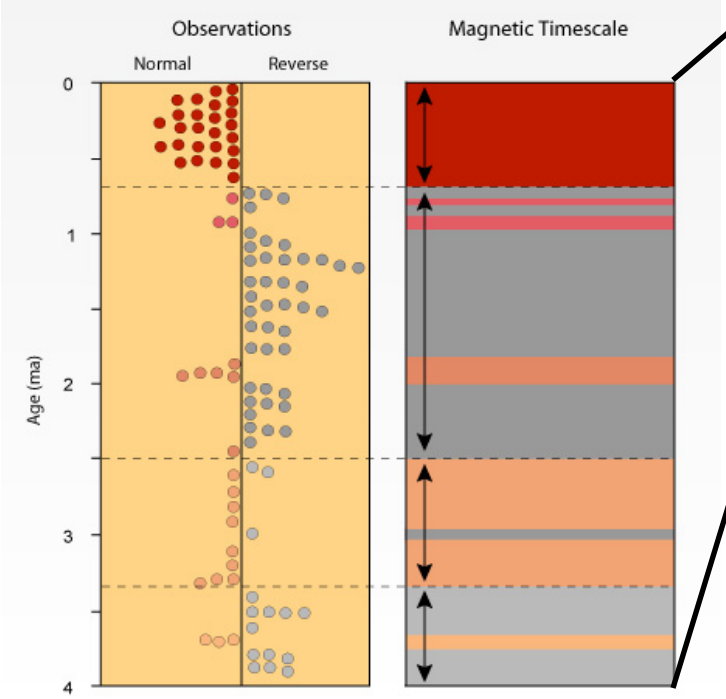
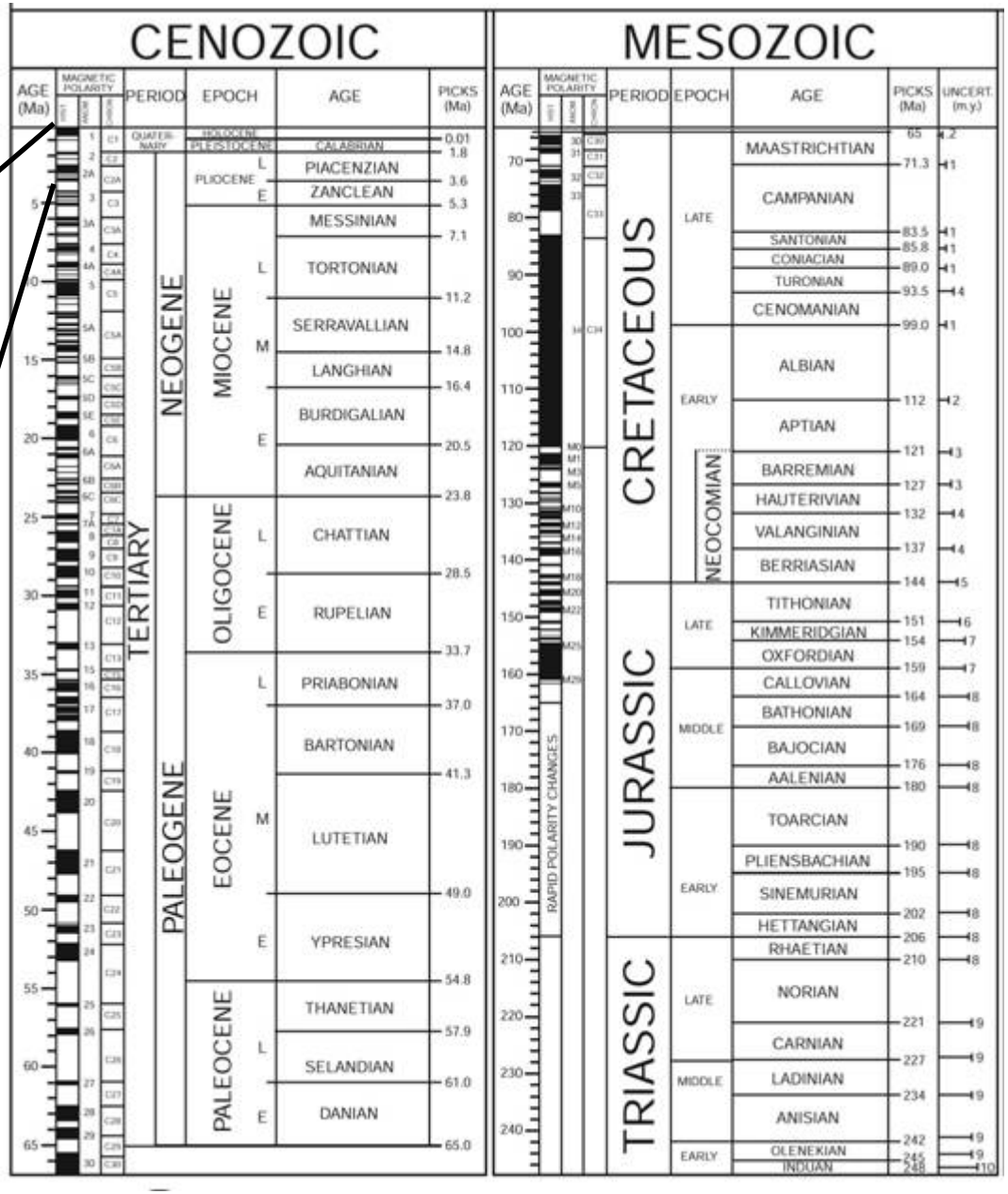
Time Scale





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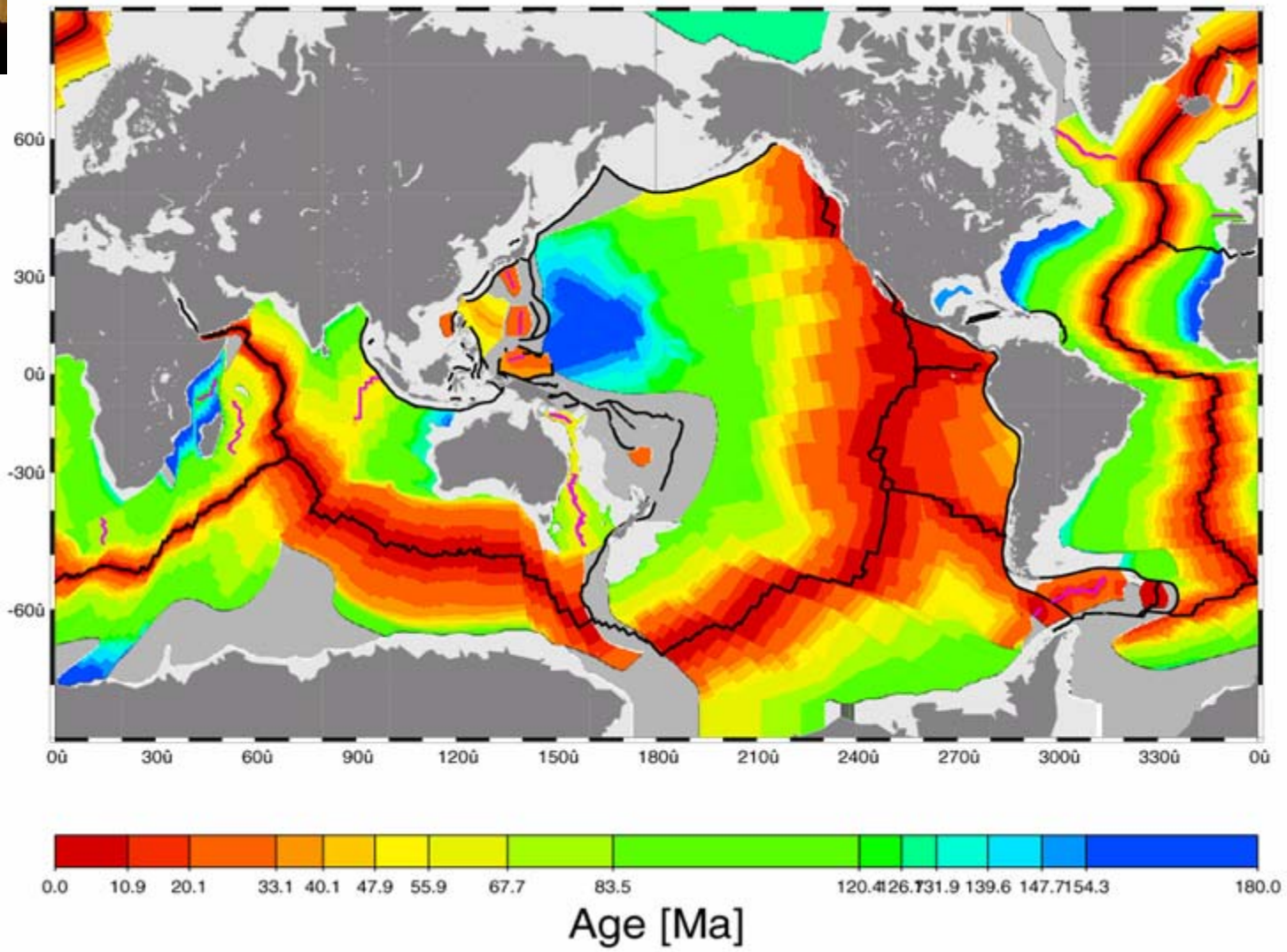
EXTREME AGES

- Age of the Earth ~ 4.6 Billion Years
- Oldest Rock ~ 3.5 Billion Years
- Oldest Mineral ~ 3.0 Billions Years
- Oldest Seafloor ~ xxx ???

Seafloor Age Map



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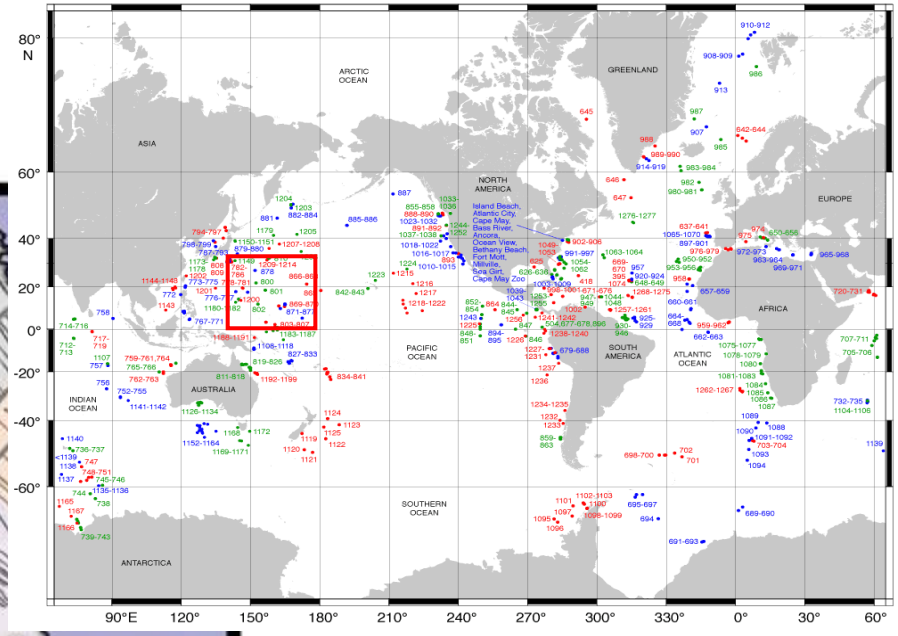

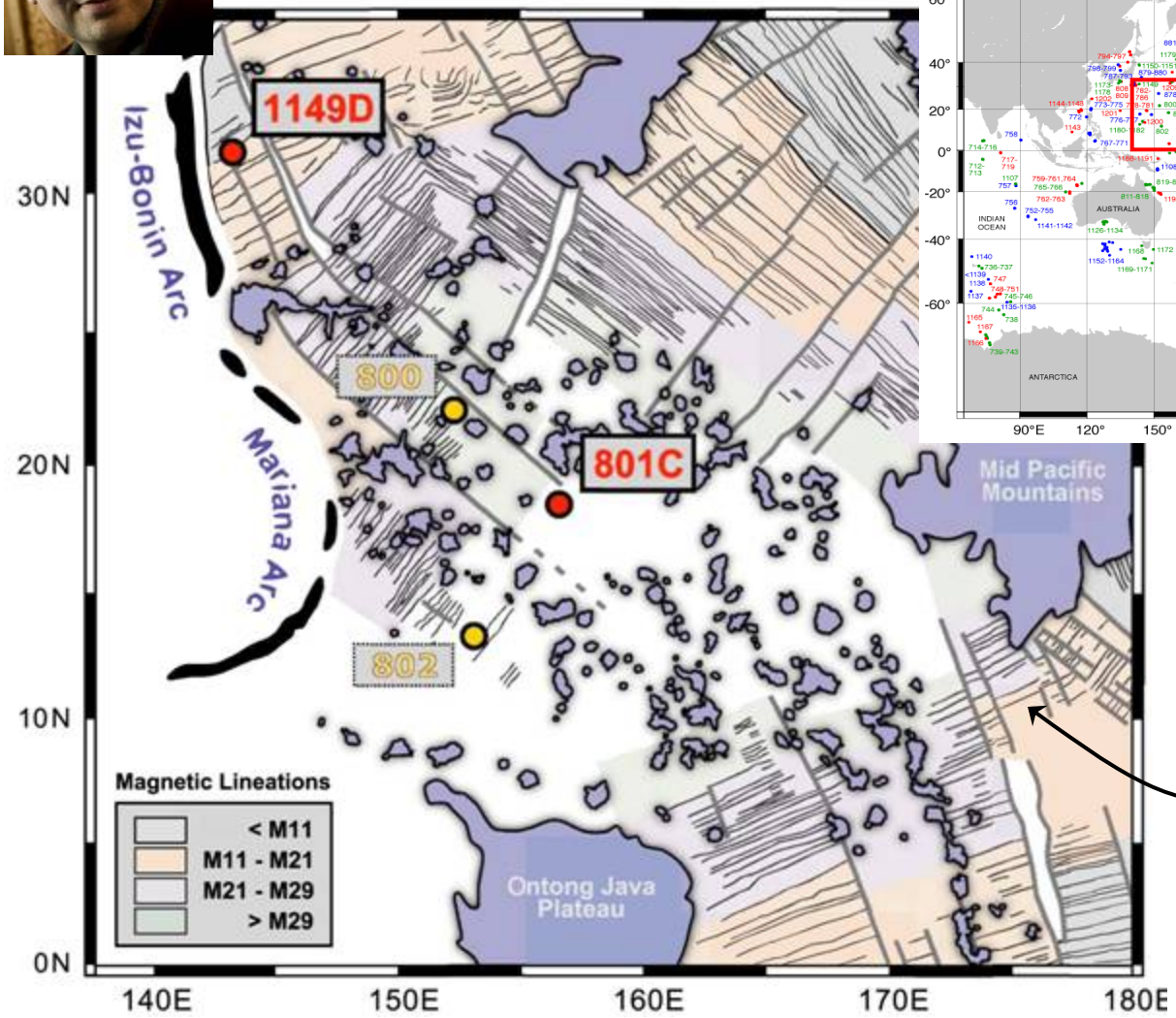

Dating OLDEST Seafloor

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Ocean Drilling Program
1983-2003

http://www.odplegacy.org/

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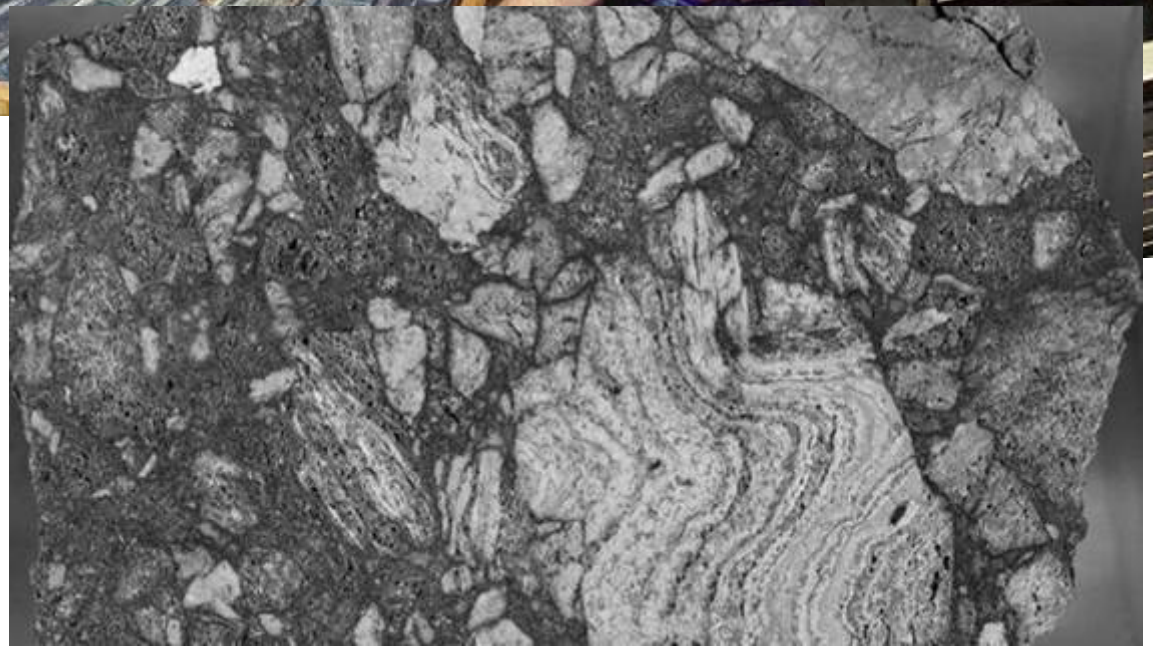
From seafloor to analysis to storage…..



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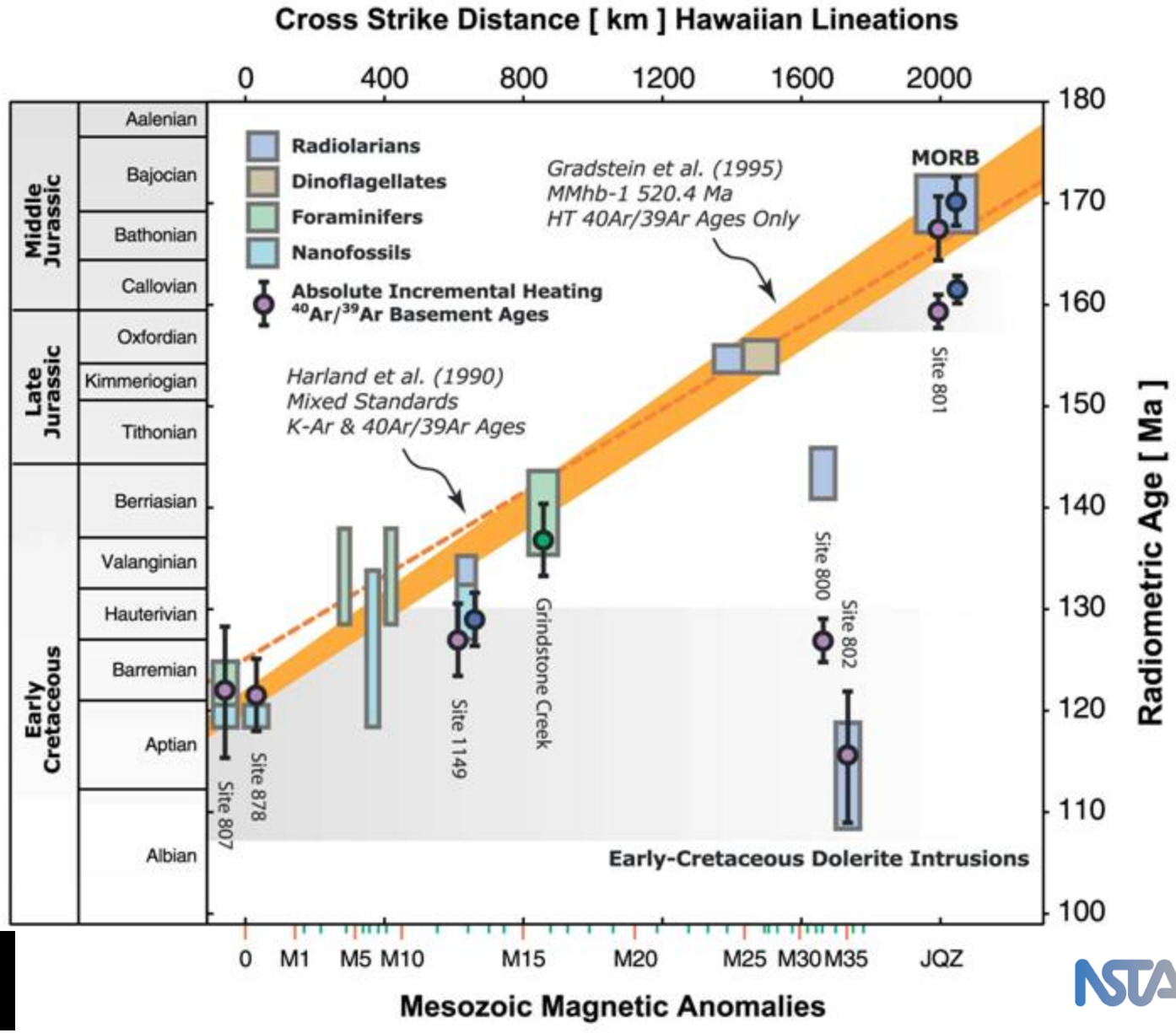
Argon-40/Argon-39 Dating



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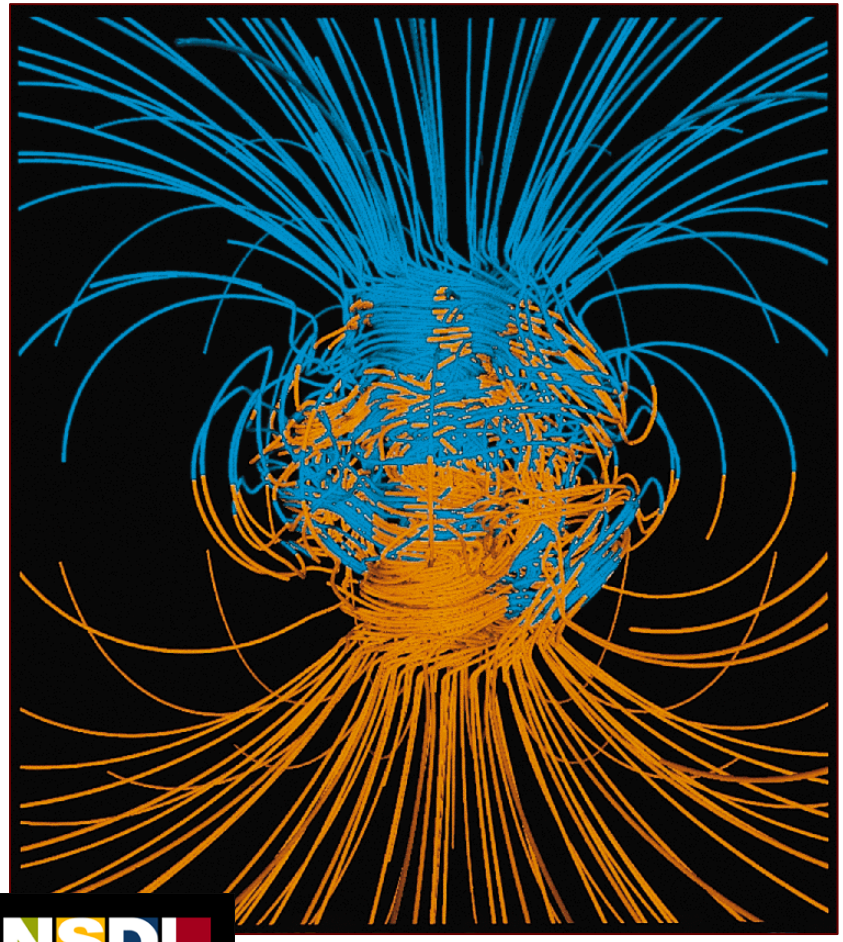
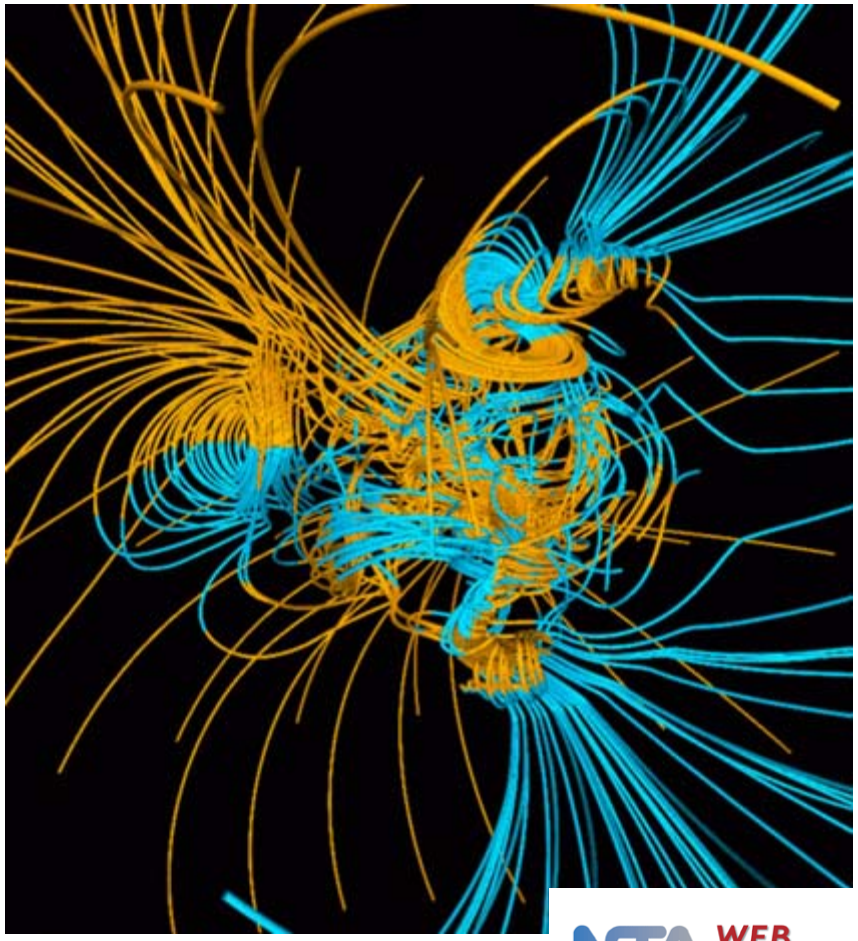
Unsolved Mysteries

- Why does the Earth's magnetic field reverse?
- WHEN will be the next reversal?





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Blue = North **Orange = South**

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THANK YOU!

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