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A global isochron chart

by
J.-Y. Royer, R.D. Müller, L.M. Gahagan,
L.A. Lawver, C.L. Mayes, D. Nürnberg and J.G. Sclater

Reference as:

Royer, J.-Y., R.D. Müller, L.M. Gahagan, L.A. Lawver, C.L. Mayes, D. Nürnberg and J.G. Sclater, A global isochron chart, University of Texas Institute for Geophysics Technical Report No. 117, pp. 38, 1992.

The Paleoceanographic Mapping Project (POMP) began in 1984 as a global, plate reconstruction project at the University of Texas at Austin Institute for Geophysics (UTIG). Sponsored by a consortium of oil companies, the original goals of POMP were to:

* build a digital, global data base of coastlines, plate boundaries, and marine magnetic and tectonic data,
* develop software for digitizing, manipulating, and reconstructing the data,
* develop a global model of plate motions through time based on the data base.

By the end of the project in April, 1991, POMP had succeeded in achieving these goals. POMP had provided its sponsors with both the data base and a comprehensive, self-consistent plate motion model which described the Mesozoic and Cenozoic evolution of the world's major ocean basins. The data base included tectonic lineations interpreted from Seasat and Geosat altimeter data, which permitted greatly improved reconstructions. The accuracy of the reconstructions exceeded original expectations, and a well-constrained plate model of the major ocean basins was developed.

In July of 1989, members of the POMP research team presented the POMP database and plate model at the 28th International Geological Congress in Washington, D.C. Included in their presentation was a series of isochrons constructed using the data base and plate model. This report is meant to serve as documentation of that presentation and of some of the results of POMP itself.

Figure 1 presents some of the ship-track data in the POMP database (data sources are listed by region in Table 1). For this report, some of the data from the POMP data base in the northwest Pacific Ocean have been replaced by more recent data from Nakanishi et al. (1989 and 1992). Figure 2 presents the Seasat and Geosat satellite altimetry lineations (or interpretations). Figure 3 is a present-day map of isochrons and the current plate boundaries dividing the tectonic plates. The chrons were constructed for the following anomaly times: 5 (10.4 Ma), 6 (20.5 Ma), 13 (35.5 Ma), 18 (42.7 Ma), 21 (50.3 Ma), 25 (58.6 Ma), 31 (68.5 Ma), 34 (84.0 Ma), M0 (118.7 Ma), M4 (126.5 Ma), M10N (131.7 Ma), M16 (141.9 Ma), M21 (149.9 Ma), M25 (156.6 Ma), and M29 (168.0 Ma). The isochrons in the northwest Pacific Ocean were recently constructed (by R.D. Müller) using the more recent data from Nakanishi et al. (1989 and 1992) and rotation poles for the Izanagi plate in Table 2. Table 2 lists the relative poles of rotation (with references) for plates with isochrons. Figures 4 through 18 present a series of plate reconstructions using the isochrons and rotation poles. Figure 19 is a 'fit' reconstruction at 180 Ma.

Contents Page

Table 1
Data Sources

Coastlines, sutures, continental margins

Barker and Lawver, 1986
Bott, 1987
Buffler et al., 1981
Case and Holcombe, 1980
Dunbar and Sawyer, 1986
Eldholm and Thiede, 1987
Emery and Uchupi, 1984
Fischer et al., 1971
General Bathymetric Chart of the Oceans, 1981
Hayes and Taylor, 1978
Johnson and Holmes, 1989
Kroenke et al., 1983
Ladd, 1974
Larsen, 1984
New Zealand Geological Survey, 1972
Nuernberg and Mueller, 1991
Otsuki and Ehiro, 1979
Piccirillo et al., 1988
Roest and Srivastava, 1989
Royer, 1987
Royer and Sandwell, 1989
Srivastava and Roest, 1989
Veevers, 1986
Veevers et al., 1985
World Data Bank #2 (CIA), 19??
Ziegler, 1982

plate boundaries
Plate boundaries

Barker, 1982
Cande et al., 1982
Cande et al., 1988
Cochran, 1981
Curray et al., 1979
Fischer et al., 1971
Guennoc et al., 1988
Hayes and Taylor, 1978
Hamilton, 1978
Hill and Hayward, 1988
Jennings, 1961
Johnson and Holmes, 1989
Klitgord and Schouten, 1986
Klitgord and Mammerickx, 1983
Larson et al., 1985
Mejorada, 1976
New Zealand Geological Survey, 1972
Otsuki and Ehiro, 1979
Packhorn, 1982
Rosencrantz et al., 1988
Ross and Scotese, 1988
Royer et al., 1988
Searle, 1980

References for satellite interpretations

Gahagan et al., 1988
Mayes et al., 1990
Nürnberg & Müller , 1991
Royer et al., 1989

References for ship-track data by region

Arctic Ocean
Canadian Hydrographic Service, 1981
Klitgord and Schouten, 1986
Ohta, 1982
Perry et al., 1985

North Atlantic Ocean
Barker and Lawver, 1986
Bott, 1987
Canadian Hydrographic Service, 1981
Eldholm and Thiede, 1987
Emery and Uchupi, 1984
Hill and Hayward, 1988
Klitgord and Schouten, 1986
Larsen, 1984
Perry et al., 1985
Roest and Srivastava, 1989
Ziegler, P.A., 1982

Caribbean
Buffler et al., 1981
Case and Holcombe, 1980
Mejorada, P., 1976
Rosencrantz et al., 1988

South Atlantic Ocean
Barker and Lawver, 1986
Cande et al., 1988
Emery and Uchupi, 1984
LaBrecque and Cande, 1986
LaBrecque and Hayes, 1979
Ladd, 1974
Martin et al., 1982
Nürnberg and Müller,1991
Rabinowitz and LaBrecque, 1979

Indian Ocean
Barker and Lawver, 1986
Barker and Lawver, 1986
Bergh, pers. comm.
Bergh, 1987
Cochran, 1988
Cochran, 1981
Davies et al., 1974
Fisher et al., 1971
General Bathymetric Chart of the Oceans, 1981
Goodlad et al., 1982
Guennoc et al., 1988
Karasik et al., 1986
LaBrecque and Hayes, 1979
Larson et al., 1978
Liu et al., 1982
Markl, 1974
Markl, 1978
McKenzie and Sclater, 1971
Mohr and Zannettin, 1988
Norton and Sclater, 1979
Patriat, 1987
Patriat, 1987
Rabinowitz and LaBrecque, 1979
Royer et al., 1988
Royer and Sandwell, 1989
Schlich, 1982
Schlich et al., 1987
Sclater et al., 1976
Segoufin, 1981
Segoufin and Patriat, 1981
Tapscott et al., 1980
Veevers, 1986
Veevers et al., 1985
Vogt et al., 1983
Weissel and Hayes, 1972
Whitmarsh, 1974
Whitmarsh et al., 1974

North Pacific Ocean
Cande et al., 1978
Caress et al., 1988
Currie et al., 1982
Elvers et al., 1967
Elvers et al., 1972
Hilde et al., 1976
Klitgord and Mammerickx, 1982
Lonsdale, 1988
Mammerickx et al., 1976
Mammerickx et al., 1988
Mammerickx and Sharman, 1988
Nakanishi et al., 1989
Nakanishi et al., 1992
Raff and Mason, 1961
Sharman and Risch, 1988
Tamaki et al., 1979
Tamaki et al., 1979
Theberge, 1971

Central Pacific Ocean
Handschumacher, 1976
Handschumacher et al.,1981
Herron,1972
Klitgord and Mammerickx, 1983
Mammerickx et al., 1980
Pardo-Casas and Molnar, 1987

South Pacific Ocean
Cande et al., 1982
Christofel and Falconer, 1972
Molnar et al., 1975
Weissel et al., 1977

Southeast Asia
Burns et al., 1973
Hamilton, 1978
Hayes and Taylor, 1978
Mammerickx et al., 1976

Southwest Pacific marginal basins

Table 2

Finite poles of rotation used to reconstruct isochrons

Time	Latitude	Longitude	Angle	Reference
North America to Northwest Africa				
0.0	0.0	0.0	0.0	
10.0	80.12	50.80	2.52	Mueller et al. 1990
20.0	79.57	37.84	5.29	Klitgord & Schouten 1986
35.5	75.37	1.12	10.04	Mueller et al. 1990
49.5	75.30	-3.88	15.25	Mueller et al. 1990
59.0	79.68	-0.46	18.16	Mueller et al. 1990
67.5	82.90	4.94	20.76	Mueller et al. 1990
72.5	81.35	-9.15	22.87	Klitgord & Schouten 1986
74.3	80.76	-11.76	23.91	Klitgord & Schouten 1986
80.2	78.30	-18.35	27.06	Klitgord & Schouten 1986
84.0	76.55	-20.73	29.60	Klitgord & Schouten 1986
118.0	66.30	-19.90	54.25	Klitgord & Schouten 1986
126.0	66.13	-19.0	56.39	Klitgord & Schouten 1986
131.5	65.95	-18.50	57.40	Klitgord & Schouten 1986
141.5	66.10	-18.40	59.79	Klitgord & Schouten 1986
149.5	66.50	-18.10	61.92	Klitgord & Schouten 1986
156.5	67.15	-16.0	64.70	Klitgord & Schouten 1986
170.0	67.02	-13.17	72.10	Klitgord & Schouten 1986
175.0	66.95	-12.02	75.55	Klitgord & Schouten 1986
Greenland to North America				
0.0	0.00	0.00	0.00	
35.5	0.00	0.00	0.00	
49.0	59.50	-92.00	-2.81	This paper
56.0	54.91	-110.01	-4.00	Roest & Srivastava 1989
59.0	24.48	-137.25	-3.12	Roest & Srivastava 1989
61.0	20.61	-148.20	-3.27	Roest & Srivastava 1989
63.0	27.63	-149.41	-3.72	Roest & Srivastava 1989
69.0	43.94	-145.31	-4.92	Roest & Srivastava 1989
84.0	65.30	-122.45	-11.00	Roest & Srivastava 1989
92.0	66.60	-119.48	-12.20	Roest & Srivastava 1989
105.0	67.08	-118.96	-12.99	Roest & Srivastava 1989
118.0	67.50	-118.48	-13.78	Roest & Srivastava 1989

South America to Central Africa

0.0	0.0	0.0	0.00	
1.9	60.00	-39.00	0.51	Cande et al. 1988
2.5	60.00	-39.00	0.77	Cande et al. 1988
3.9	60.00	-39.00	1.21	Cande et al. 1988
5.3	60.00	-39.00	1.78	Cande et al. 1988
6.7	60.00	-39.00	2.27	Cande et al. 1988
7.9	60.00	-39.00	2.76	Cande et al. 1988
8.9	60.00	-39.00	3.15	Cande et al. 1988
11.6	59.50	-38.00	4.05	Cande et al. 1988
14.9	59.50	-38.00	5.25	Cande et al. 1988
16.2	59.50	-38.00	5.75	Cande et al. 1988
17.6	59.50	-38.00	6.30	Cande et al. 1988
18.6	59.50	-38.00	6.70	Cande et al. 1988
19.4	59.50	-38.00	7.05	Cande et al. 1988
20.9	59.50	-37.75	7.60	Nuernberg & Mueller 1991
22.6	59.50	-36.50	8.45	Cande et al. 1988
23.3	59.50	-37.00	8.80	Nuernberg & Mueller 1991
25.5	59.00	-36.00	9.50	Cande et al. 1988
26.9	59.00	-36.00	10.00	Cande et al. 1988
28.2	58.00	-35.00	10.55	Cande et al. 1988
29.7	57.00	-35.00	11.05	Cande et al. 1988
31.2	57.00	-34.50	11.60	Nuernberg & Mueller 1991
32.5	57.50	-35.00	12.15	Cande et al. 1988
35.3	57.50	-34.00	13.38	Cande et al. 1988
37.2	57.00	-33.50	14.10	Cande et al. 1988
38.1	57.00	-33.25	14.40	Nuernberg & Mueller 1991
39.5	57.00	-33.00	15.05	Cande et al. 1988
41.3	57.50	-32.50	15.80	Cande et al. 1988
43.6	58.00	-32.00	17.00	Cande et al. 1988
44.7	57.50	-31.75	17.60	Cande et al. 1988
48.7	58.50	-31.50	19.07	Cande et al. 1988
51.9	59.00	-31.50	20.10	Cande et al. 1988
53.9	60.00	-32.00	20.75	Cande et al. 1988
55.1	60.00	-32.00	21.20	Cande et al. 1988
58.6	61.50	-32.50	22.30	Nuernberg & Mueller 1991
60.2	61.50	-32.50	22.70	Cande et al. 1988
63.0	62.50	-33.00	23.55	Cande et al. 1988
64.3	63.00	-33.30	24.00	Cande et al. 1988
65.5	63.00	-33.30	24.30	Cande et al. 1988
66.7	63.00	-33.30	24.70	Cande et al. 1988
68.5	63.00	-33.50	25.40	Cande et al. 1988
71.4	63.00	-33.50	26.60	Cande et al. 1988
74.3	63.00	-33.50	27.90	Cande et al. 1988
80.2	63.00	-34.00	31.00	Cande et al. 1988
84.0	61.75	-34.00	33.50	Cande et al. 1988
118.7	50.10	-34.60	52.78	This paper
121.0	50.00	-34.20	53.64	This paper
126.5	49.30	-33.80	54.29	This paper
131.5	49.10	-33.70	55.17	This paper
245.0	49.10	-33.70	55.17	This paper

Eurasia to North America

0.0	0.00	0.00	0.00	
10.0	65.38	133.58	-2.44	Lawver et al. 1990
20.0	68.92	136.74	-4.97	Lawver et al. 1990
36.0	65.64	136.95	-7.51	Lawver et al. 1990
49.0	67.19	137.74	-10.91	Srivastava & Roest 1989
56.0	62.60	140.81	-12.75	Srivastava & Roest 1989
59.0	63.14	141.66	-14.22	Srivastava & Roest 1989
69.0	64.84	143.96	-16.95	Srivastava & Roest 1989
80.0	66.17	147.74	-19.00	Srivastava & Roest 1989
84.0	66.54	148.91	-19.70	Srivastava & Roest 1989
92.0	66.67	150.26	-20.37	Srivastava & Roest 1989
105.0	66.85	152.34	-21.49	Srivastava & Roest 1989
118.0	68.99	154.75	-23.05	Srivastava & Roest 1989
145.0	68.99	154.75	-23.05	Srivastava & Roest 1989
170.0	69.10	156.70	-23.64	This paper

Iberia to Eurasia

0.0	0.00	0.00	0.00
30.0	90.00	0.00	0.00

Iberia to Northwest Africa

30.0	31.4	-18.60	7.87	Srivastava & Tapscott 1986 fit
133.2	31.4	-18.60	7.87	Srivastava & Tapscott 1986

Iberia to North America

133.2	70.30	-11.00	-51.50	calculated from Srivastava & Tapscott 1986

Porcupine plate to North America

0.0	0.00	0.00	0.00	
10.0	65.38	133.58	-2.44	Lawver et al. 1990
20.0	68.92	136.74	-4.97	Lawver et al. 1990
36.0	65.64	136.95	-7.51	Lawver et al. 1990
49.0	58.75	142.49	-10.01	Srivastava & Roest 1989
56.0	59.21	143.14	-12.29	Srivastava & Roest 1989
59.0	60.10	143.68	-13.76	Srivastava & Roest 1989
69.0	62.31	145.52	-16.47	Srivastava & Roest 1989
80.0	63.90	148.92	-18.51	Srivastava & Roest 1989
84.0	64.35	149.97	-19.21	Srivastava & Roest 1989
92.0	64.55	151.19	-19.88	Srivastava & Roest 1989
105.0	64.82	153.08	-21.00	Srivastava & Roest 1989
118.0	67.13	155.32	-22.54	Srivastava & Roest 1989

Rockall to North America

0.0	0.00	0.00	0.00	
10.0	65.38	133.58	-2.44	Lawver et al. 1990
20.0	68.92	136.74	-4.97	Lawver et al. 1990
36.0	65.64	136.95	-7.51	Lawver et al. 1990
49.0	63.62	141.96	-10.52	Srivastava & Roest 1989
56.0	54.86	143.39	-11.99	Srivastava & Roest 1989
59.0	56.24	143.78	-13.44	Srivastava & Roest 1989
69.0	59.05	147.21	-15.56	Srivastava & Roest 1989
80.0	69.31	152.06	-19.31	Srivastava & Roest 1989
84.0	72.29	154.49	-20.94	Srivastava & Roest 1989
92.0	73.95	156.24	-22.00	Srivastava & Roest 1989
118.0	75.32	159.61	-23.47	Srivastava & Roest 1989

India to Central Indian Basin

0.0	90.00	0.00	0.00	This paper
10.5	-8.70	76.90	2.75	This paper
20.5	-0.90	74.60	6.77	This paper
70.0	-0.90	74.60	6.77	This paper

India to East Antarctica

70.0	13.00	7.20	-50.08	This paper
80.2	8.20	11.00	-62.18	Royer & Sandwell 1989
84.0	7.80	10.90	-65.10	Royer & Sandwell 1989

India to Madagascar

84.0	17.50	22.60	-55.41	Royer & Sandwell 1989
100.0	18.20	24.60	-61.92	This paper
115.0	19.40	27.10	-59.74	This paper
140.0	19.10	31.20	-61.99	calculated from Lawver & Scotese 1987

India to East Antarctica

140.0	-4.40	16.70	-92.77	Lawver & Scotese 1987

Arabia to Central Africa

0.0	0.00	0.00	0.00	
4.7	32.80	22.60	-1.89	LePichon & Gaullier 1988
13.0	32.20	22.60	-5.36	LePichon & Gaullier 1988
30.0	32.10	22.60	-6.36	LePichon & Gaullier 1988

Central Indian Basin to Australia

0.0	90.00	0.00	0.00
42.7	90.00	0.00	0.00

Central Indian Basin to East Antarctica

42.7	16.60	29.90	-23.62	This paper
46.2	16.30	28.50	-25.24	Royer & Sandwell 1989
50.4	14.90	26.00	-27.77	This paper
56.1	12.30	21.50	-34.40	Royer & Sandwell 1989
64.3	9.70	17.40	-45.12	Royer & Sandwell 1989
68.5	9.40	13.70	-51.59	Royer & Sandwell 1989
80.2	8.20	11.00	-62.18	Royer & Sandwell 1989
84.0	7.80	10.90	-65.10	Royer & Sandwell 1989

Central Africa paleomagnetic reference frame

0.0	0.00	0.00	0.00	
14.0	0.00	92.00	5.00	Ziegler et al. 1983
44.0	0.00	113.00	12.00	Ziegler et al. 1983
60.0	0.00	126.00	10.00	Ziegler et al. 1983
75.0	0.00	129.00	17.00	Ziegler et al. 1983
93.0	0.00	151.00	20.00	Ziegler et al. 1983
131.0	0.00	156.00	35.00	Ziegler et al. 1983
175.0	0.00	166.00	36.00	Ziegler et al. 1983
192.0	0.00	172.00	31.00	Ziegler et al. 1983

Madigascar to Central Africa

0.0	0.00	0.00	0.00	
115.0	90.00	0.00	0.00	
118.7	5.40	-76.20	0.90	This paper
123.0	5.40	-76.20	1.96	This paper
126.5	5.40	-76.20	3.19	This paper
129.4	5.40	-76.20	4.20	This paper
141.9	5.40	-76.20	8.32	This paper
149.9	4.00	-71.40	11.32	This paper
165.0	-3.41	-81.70	19.73	Lawver and Scotese 1987

Mascarene Plateau to Madigascar

0.0	90.00	0.00	0.00	
63.0	90.00	0.00	0.00	
64.3	-15.10	49.90	-10.48	Patriat unpublished manuscript
68.5	5.90	30.00	-12.74	Patriat unpublished manuscript
73.4	4.30	32.80	-20.01	Patriat unpublished manuscript
84.0	-4.50	46.00	-45.16	This paper
96.0	-2.90	44.80	-50.00	This paper

Northwest Africa to Central Africa

0.0	0.00	0.00	0.00	
84.0	0.00	0.00	0.00	
118.7	8.80	98.70	0.37	This paper (fit)

Northwest Africa to South America

118.7	50.00	-35.20	-52.90	This paper

Australia to East Antarctica

0.0	90.00	0.00	0.00	
10.5	13.10	36.10	-6.61	Royer & Chang 1991
20.5	15.40	32.70	-11.97	Royer & Chang 1991
35.5	13.80	33.40	-20.41	Royer & Chang 1991
42.7	16.60	29.90	-23.62	Royer & Sandwell 1989
46.2	15.10	31.30	-24.50	Royer & Sandwell 1989
56.1	12.50	31.70	-25.24	Royer & Sandwell 1989
68.5	8.70	33.20	-25.83	Royer & Sandwell 1989
80.2	6.20	35.10	-26.37	Royer & Sandwell 1989
84.0	4.90	35.80	-26.81	Royer & Sandwell 1989
96.0	1.00	38.00	-28.30	Royer & Sandwell 1989
130.0	-2.00	38.90	-31.50	Royer & Sandwell 1989

East Antarctica to Central Africa

0.0	0.00	0.00	0.00	
10.5	8.20	-49.40	1.53	Royer & Chang 1991
20.5	10.70	-47.90	2.78	Royer & Chang 1991
35.5	12.00	-48.40	5.46	Royer & Chang 1991
46.2	11.40	-43.70	7.81	Royer et al. 1988
50.3	10.30	-42.90	8.77	Royer et al. 1988
56.1	6.70	-40.60	9.97	Royer et al. 1988
60.8	3.80	-39.70	10.63	Royer et al. 1988
64.3	0.60	-39.20	11.32	Royer et al. 1988
66.2	-0.40	-39.40	11.59	Royer et al. 1988
68.5	1.10	-41.60	11.84	Royer et al. 1988
73.6	-1.80	-41.40	13.47	Royer et al. 1988
80.2	-4.70	-39.70	16.04	Royer et al. 1988
84.0	-2.00	-39.20	17.85	Royer et al. 1988
118.7	-4.20	-29.10	42.80	This paper
123.0	-4.60	-29.10	44.17	This paper
141.9	-7.00	-26.90	50.70	This paper
149.9	-4.70	-29.00	52.84	This paper
165.0	-7.78	-31.42	58.00	Lawver & Scotese 1987

Marie Byrdland to East Antarctica

0.0	0.00	0.00	0.00	
95.0	0.00	0.00	0.00	
130.0	62.27	21.84	13.27	Lawver & Scotese 1987
245.0	62.27	21.84	13.27	Lawver & Scotese 1987

Bellinghausen plate to Pacific

0.0	0.00	0.00	0.00	
4.7	66.20	-83.50 -	4.13	Mayes et al. 1990
10.6	70.44	-78.84	-9.12	Mayes et al. 1990
25.8	73.13	-72.44	-19.52	Mayes et al. 1990
30.0	73.73	-69.54	-22.52	Mayes et al. 1990
35.9	73.67	-65.98	-26.68	Mayes et al. 1990
42.7	72.78	-64.61	-29.89	Mayes et al. 1990
49.6	72.09	-63.44	-33.93	Mayes et al. 1990
59.2	71.81	-60.67	-39.39	Mayes et al. 1990
65.1	70.77	-58.37	-45.52	Mayes et al. 1990
69.4	70.31	-56.34	-50.92	Mayes et al. 1990
74.0	69.92	-54.75	-56.33	Mayes et al. 1990

Kerguelen to East Antarctica

0.0	90.00	0.00	0.00	
50.0	90.00	0.00	0.00	
50.0	15.10	31.30	24.60	This paper
155.0	15.10	31.30	24.60	This paper

Lord Howe Rise to Australia

0.0	0.00	0.00	0.00	
55.7	0.00	0.00	0.00	Weissel & Hayes 1977
60.5	-1.50	138.50	-2.55	Weissel & Hayes 1977
65.8	-5.50	140.50	-6.60	Weissel & Hayes 1977
72.7	-11.40 1	41.50	-12.75	Weissel & Hayes 1977
77.2	-14.00	142.00	-19.00	Weissel & Hayes 1977
84.0	-14.00	148.00	-23.34	This paper (fit)
245.0	-14.00	148.00	-23.34	This paper

Pacific to Marie Byrdland

0.0	0.00	0.00	0.00	
4.8	66.20	-83.50	4.13	Mayes et al. 1990
10.6	70.44	-78.84	9.12	Mayes et al. 1990
26.0	73.13	-72.44	19.52	Mayes et al. 1990
30.3	73.73	-69.54	22.52	Mayes et al. 1990
35.9	73.67	-65.98	26.68	Mayes et al. 1990
42.7	72.78	-64.61	29.89	Mayes et al. 1990
49.5	-73.42	122.78	-35.15	Stock & Molnar 1987
50.3	72.09	-63.44	33.93	Mayes et al. 1990
59.2	70.32	-63.45	36.77	Mayes et al. 1990
65.1	68.69	-63.47	39.88	Mayes et al. 1990
69.4	67.12	-63.02	4.53	Mayes et al. 1990
84.0	64.94	-62.49	53.09	Mayes et al. 1990
90.0	64.03	-56.96	57.65	Mayes et al. 1990

For times older than 90 Ma, the Pacific plate is fixed to the global reference frame

90.0	64.00	-73.30	54.47	calculated from Mayes et al. 1990

Nazca to Pacific

0.0	0.00	0.00	0.00	
4.8	58.86	-89.43	-6.60	Mayes et al. 1990
10.6	60.13	-89.76	-15.18	Mayes et al. 1990
20.5	64.50	-91.50	-30.70	calculated from Mayes et al. 1990
26.0	65.41	-92.00	-39.35	Mayes et al. 1990
26.0	38.80	-84.30	-20.79	This paper

Vancouver to Pacific

0.0	0.00	0.00	0.00	
10.4	72.00	6.40	-14.76	This paper
20.5	82.60	4.60	-15.65	This paper
35.3	88.50	-134.00	-34.99	This paper
41.3	87.50	-161.00	-43.34	This paper
48.8	86.50	-168.90	-51.80	This paper
61.0	85.20	125.80	-59.54	This paper
69.0	82.50	108.40	-66.24	This paper
84.0	77.10	93.60	-75.91	This paper
133.5	63.80	78.60	-108.58	This paper
158.0	57.10	81.10	-121.36	This paper

Jan Mayen to Eurasia

0.	0.00	0.00	0.00	
36.0	0.00	0.00	0.00	
42.7	64.90	-12.20	-22.60	This paper
46.2	64.90	-12.30	-31.60	This paper
49.0	64.30	-12.70	-37.30	Lawver et al. 1990
52.6	64.00	-12.90	-41.70	This paper
54.7	63.10	-13.50	-40.90	This paper
56.0	63.10	-13.50	-50.00	Lawver et al. 1990

Jan Mayen to Greenland

56.0	73.40	-10.80	-55.45	calculated from Lawver et al. 1990 (fit)
245.0	73.40	-10.80	-55.45	calculated from Lawver et al. 1990 (fit)

Cocos to Pacific

0.0	90.00	0.00	0.00	
4.8	36.80	-108.60	-10.03	DeMets et al. 1990
10.4	34.00	-106.80	-22.73	This paper
20.5	37.30	-113.30	-31.62	This paper
20.5	55.40	-117.70	-42.28	This paper

Izanagi to Pacific

0.0	0.0	0.0	0.0	
84.0	0.0	0.0	0.0	Engebretson 1983
131.7	54.5	6.6	64.15	This paper
141.9	64.7	15.7	68.33	This paper
149.9	57.5	96.3	87.76	This paper
156.6	60.5	80.8	79.43	This paper

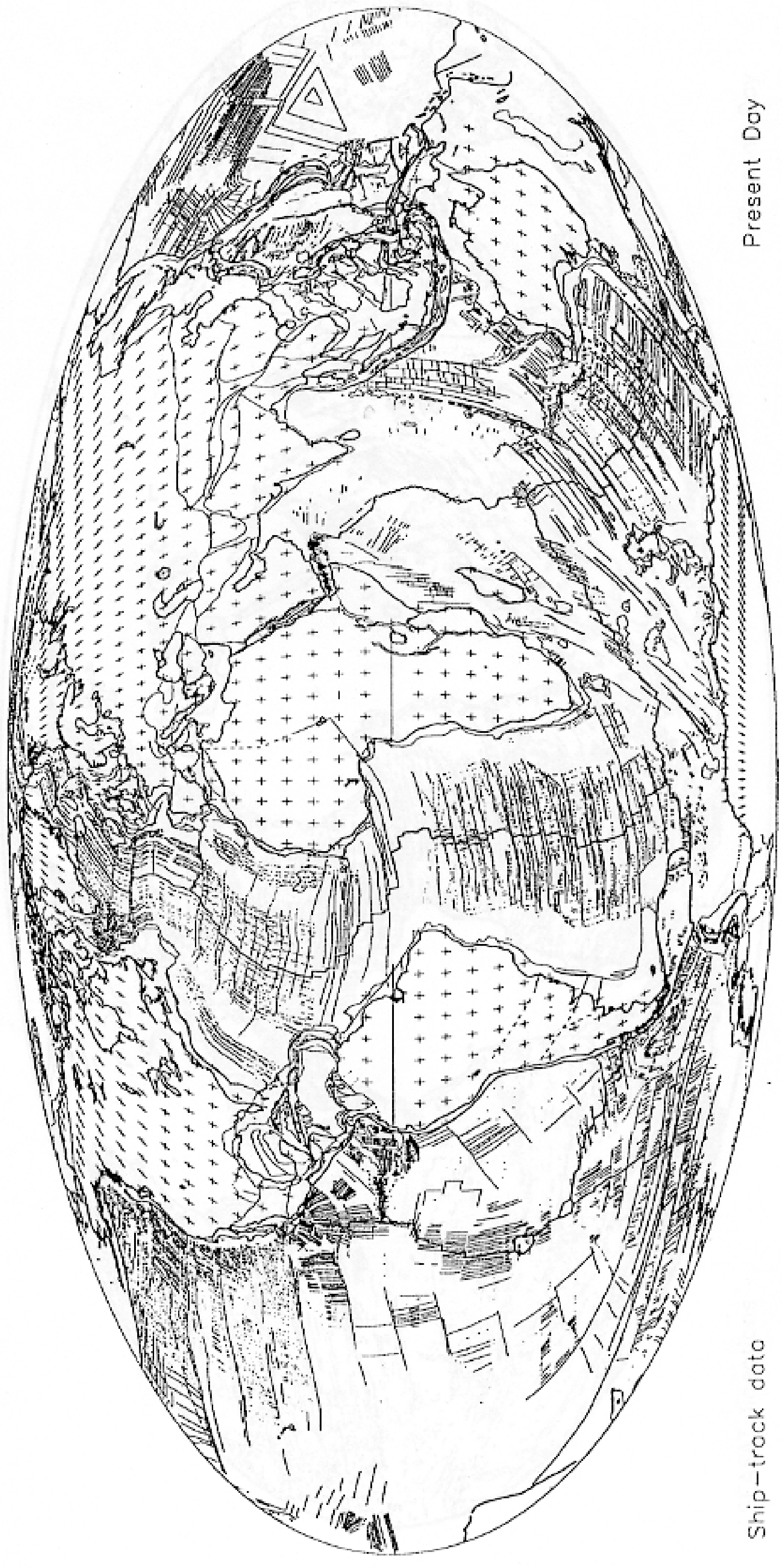


Figure 1

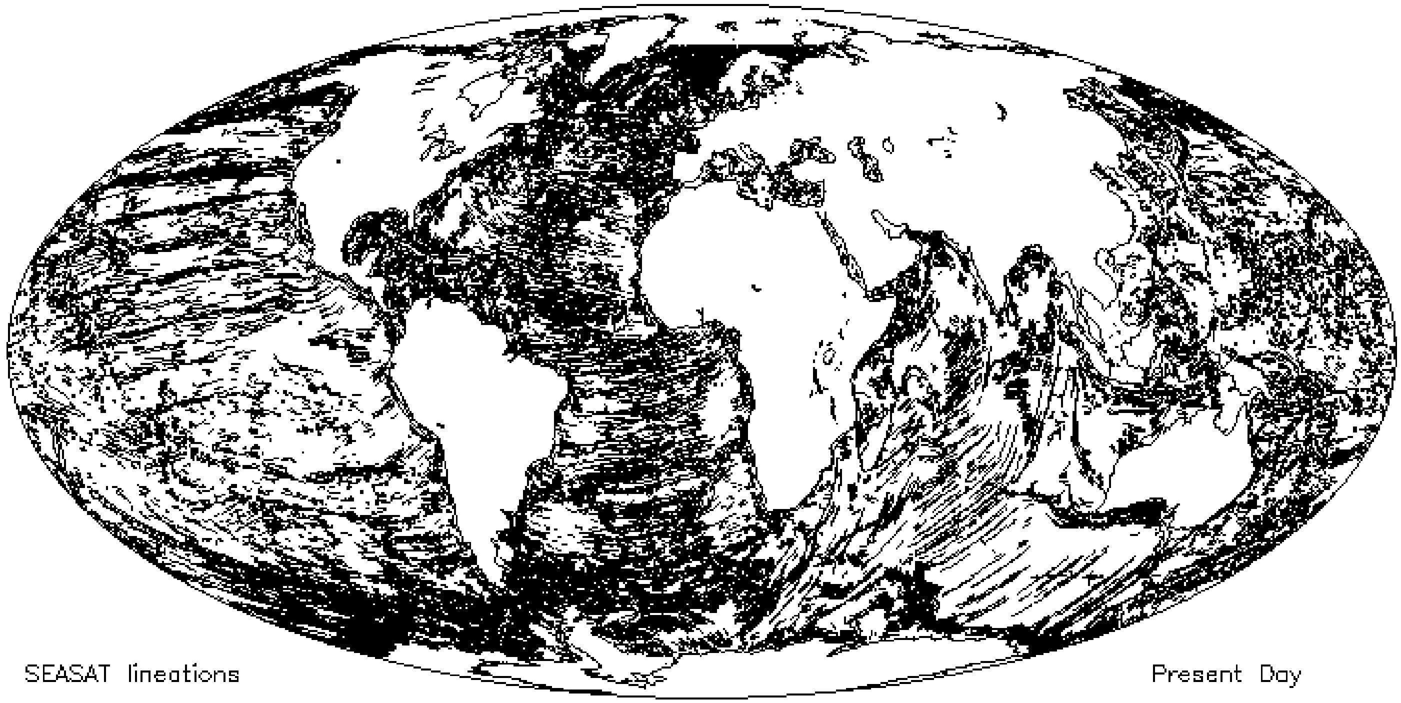


Figure 2a

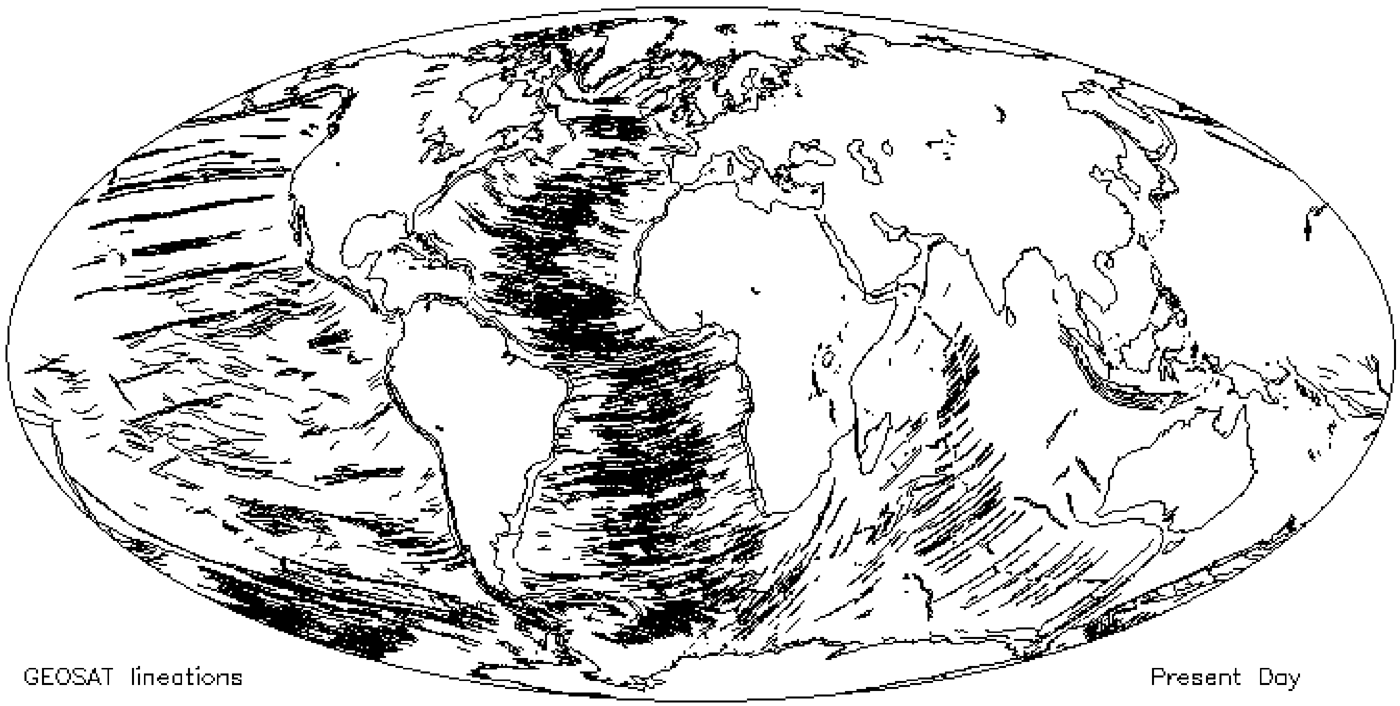


Figure 2b

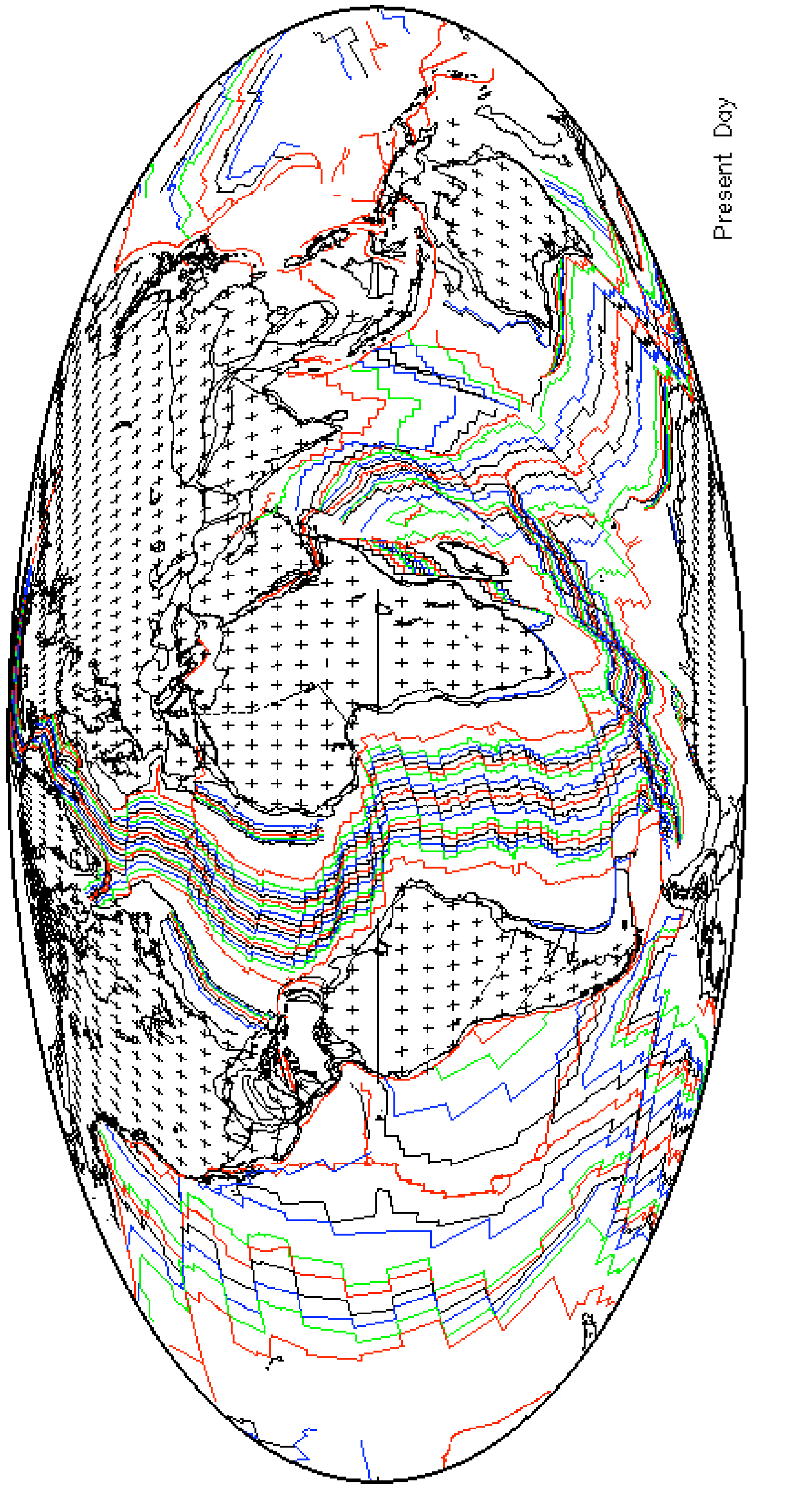
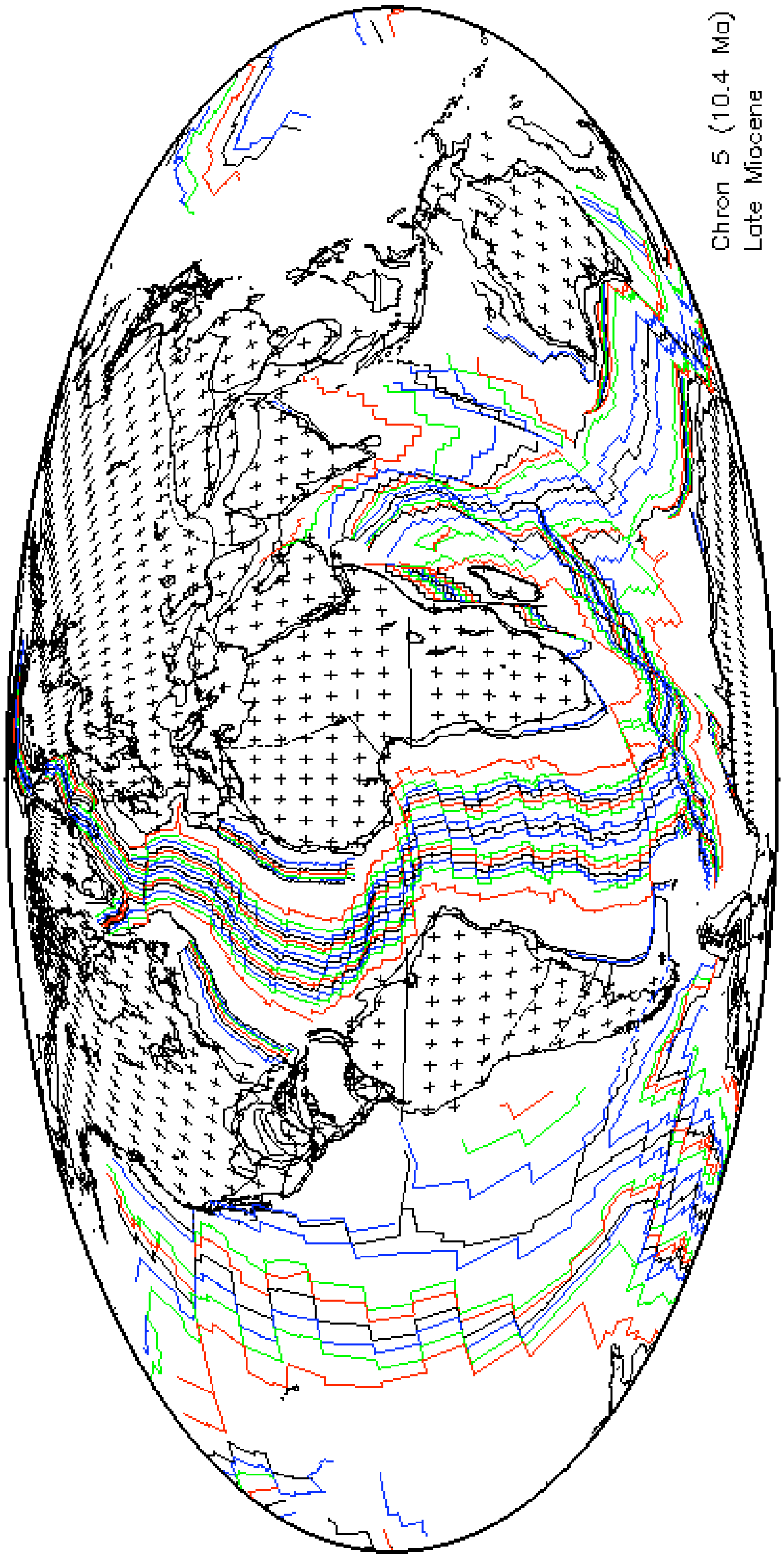


Fig. 3



Chron 5 (10.4 Ma)
Late Miocene

FIG. 4

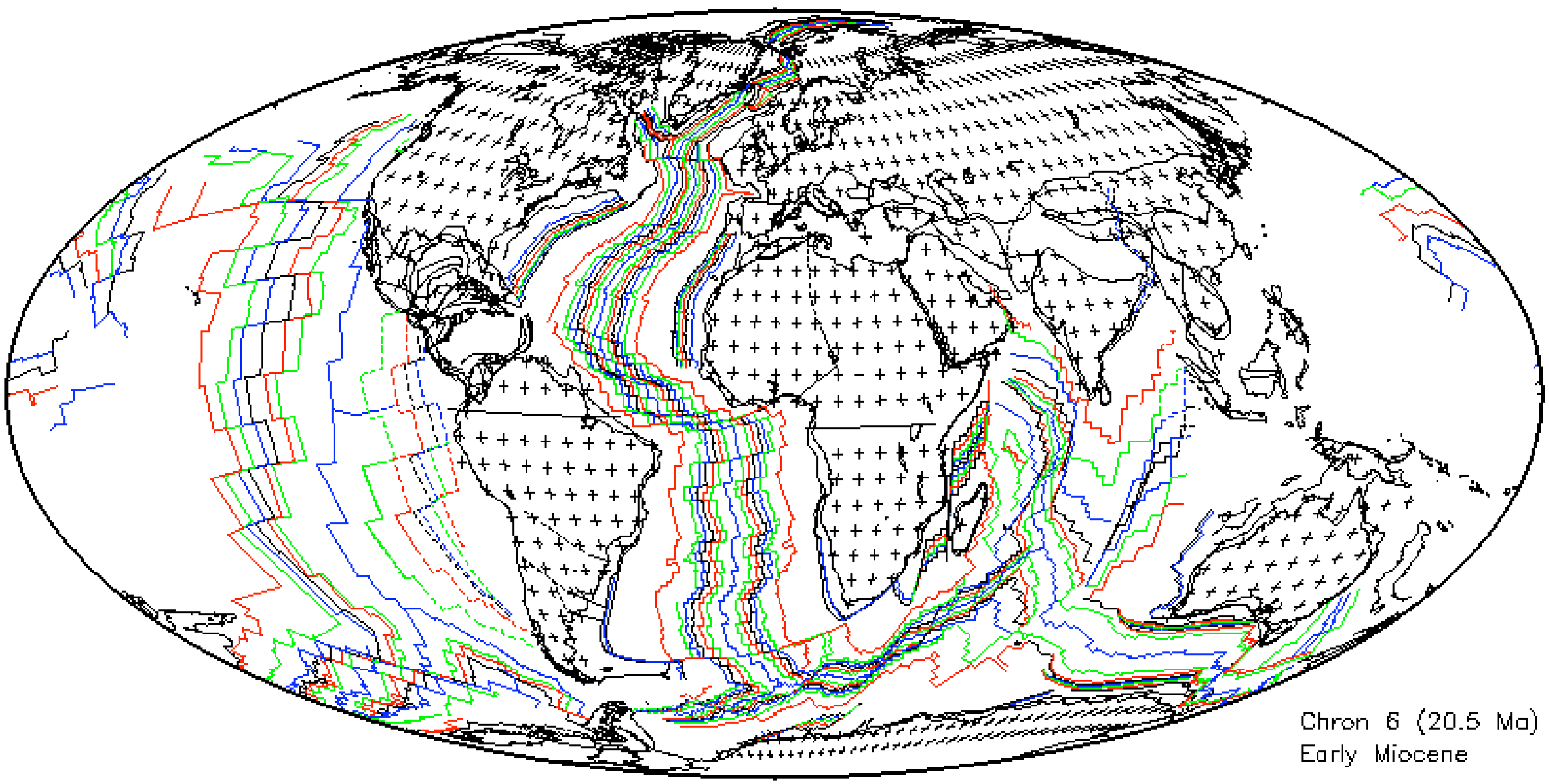
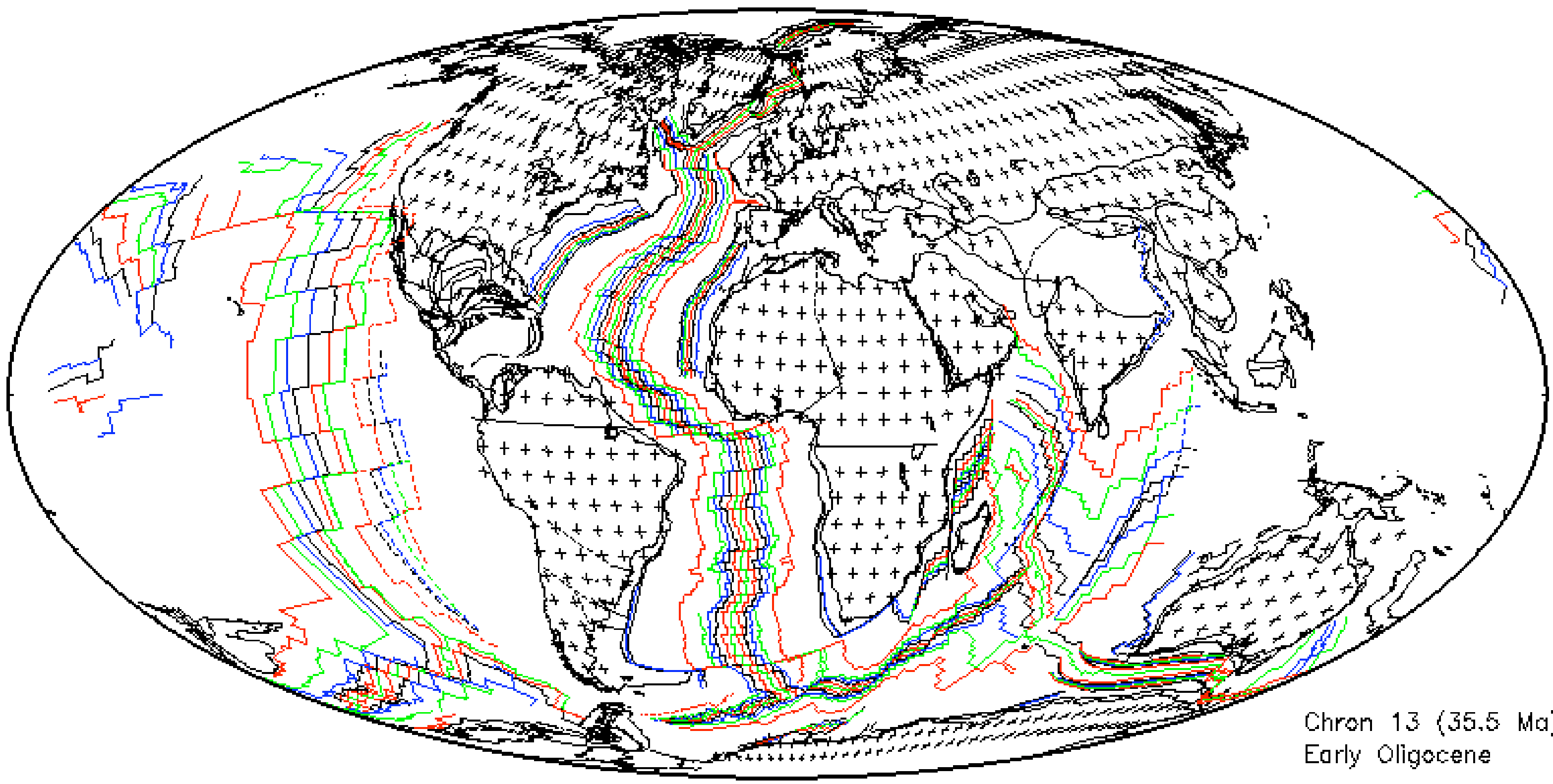
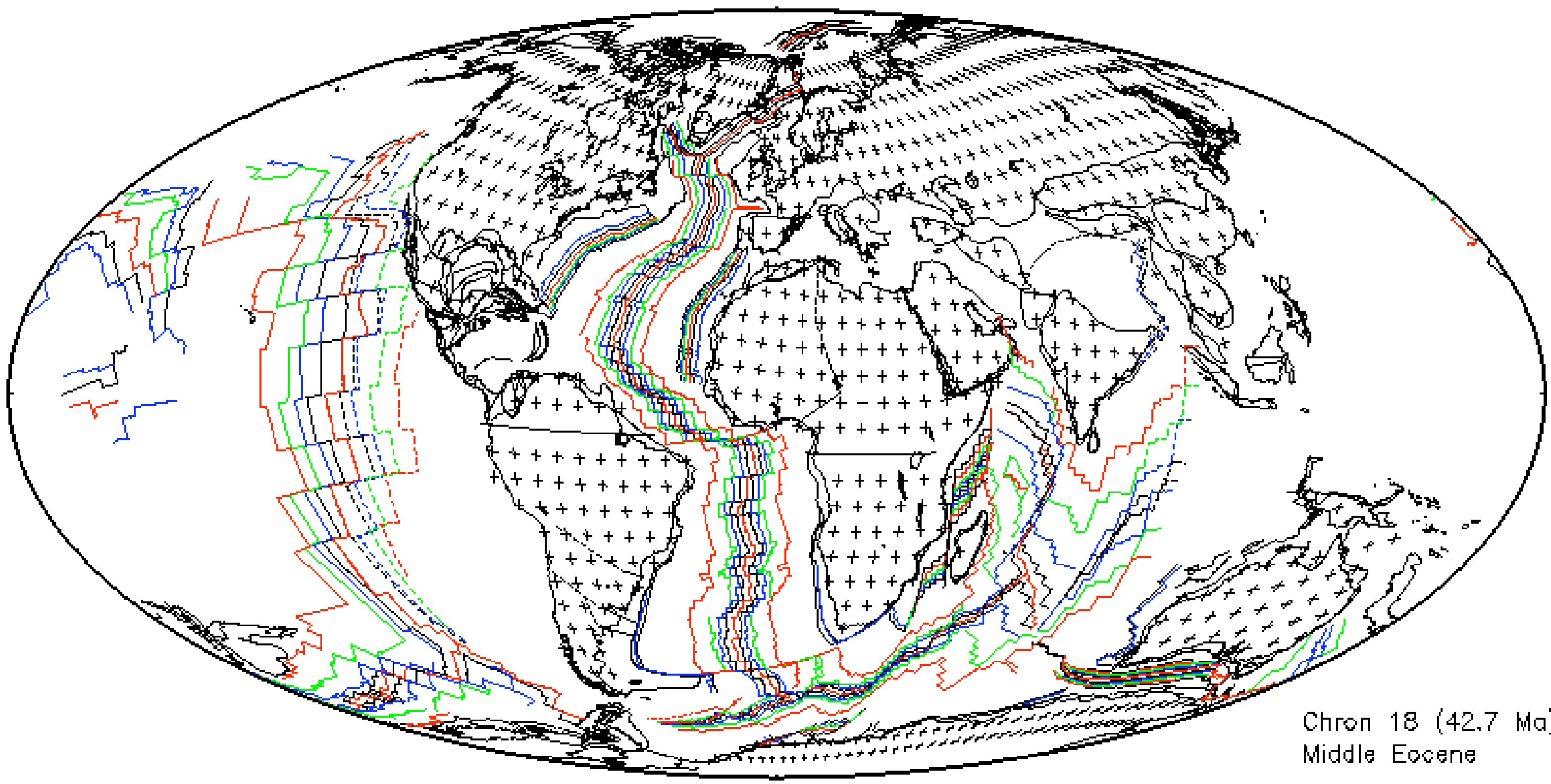


FIG. 5



Chron 13 (35.5 Ma)
Early Oligocene

FIG. 6



Chron 18 (42.7 Ma)
Middle Eocene

FIG. 7

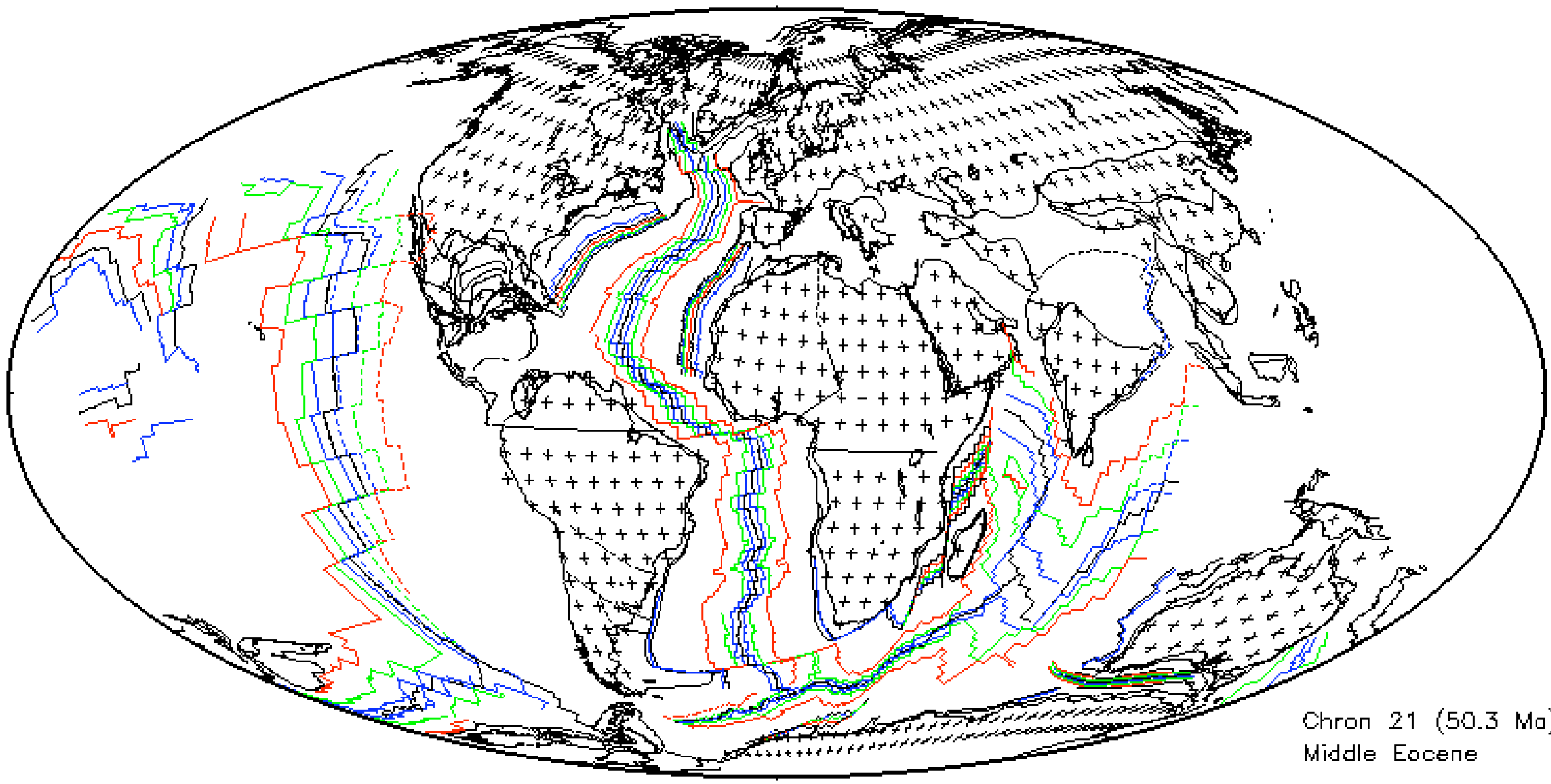
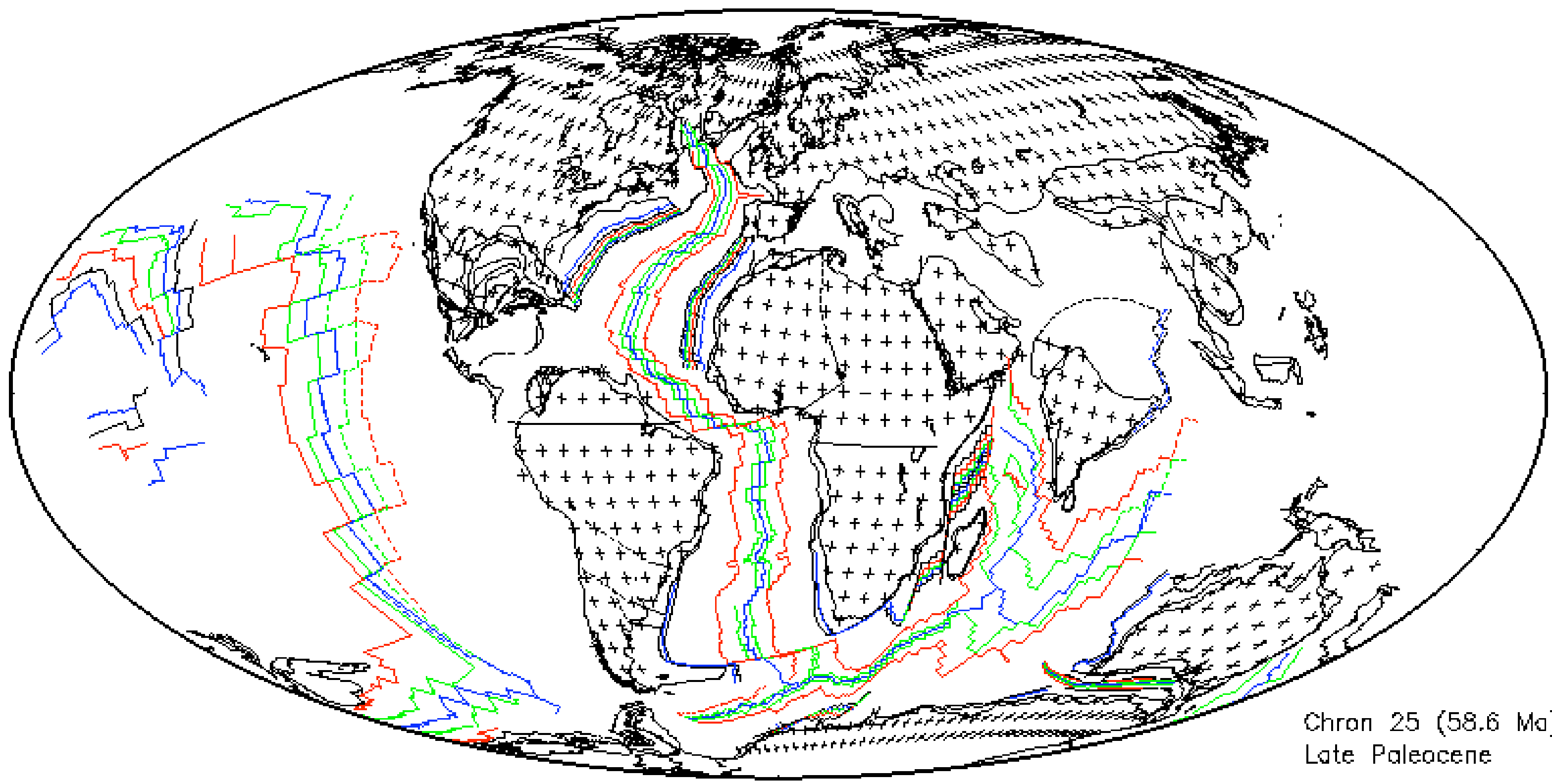
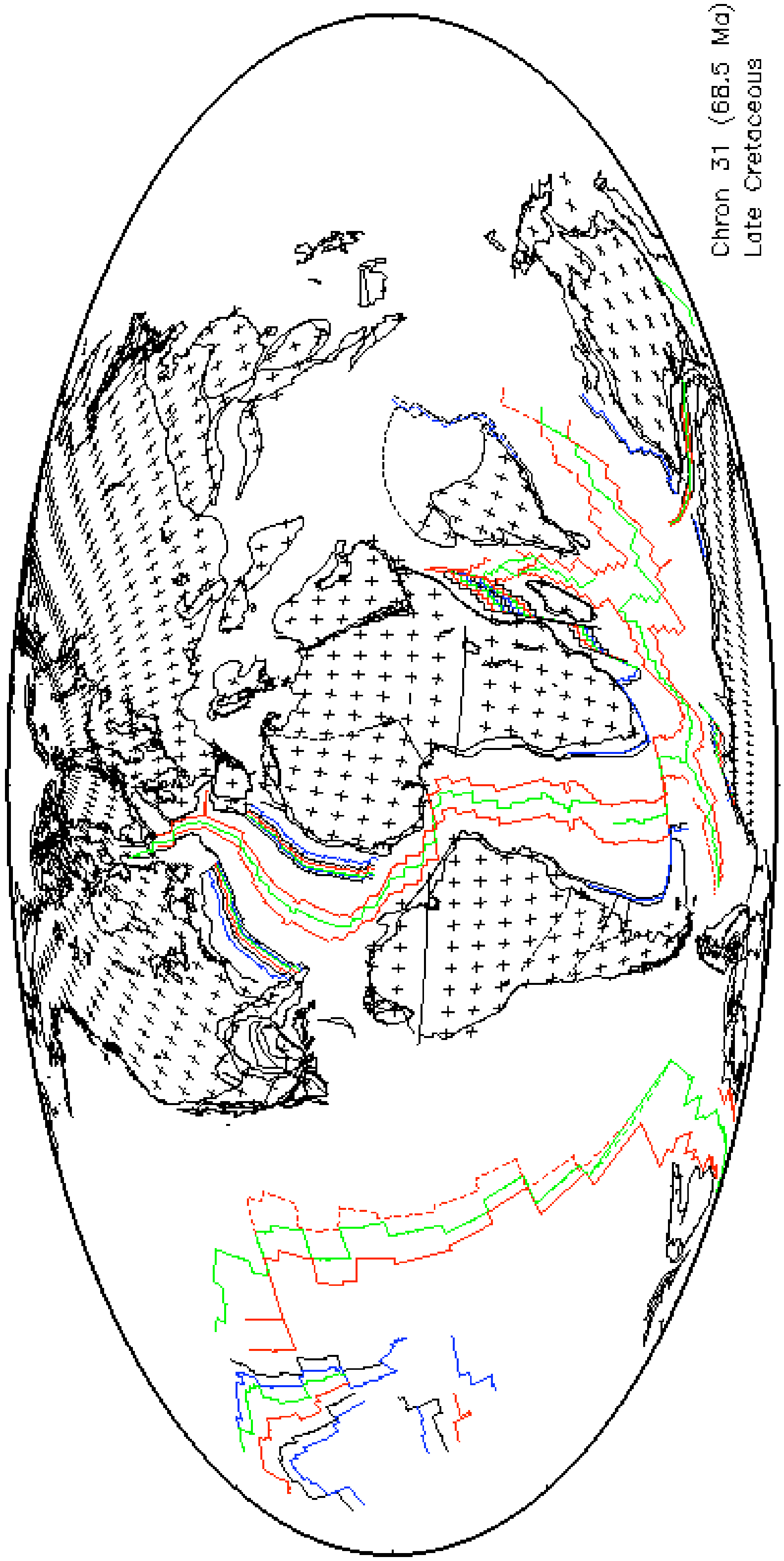


FIG. 8



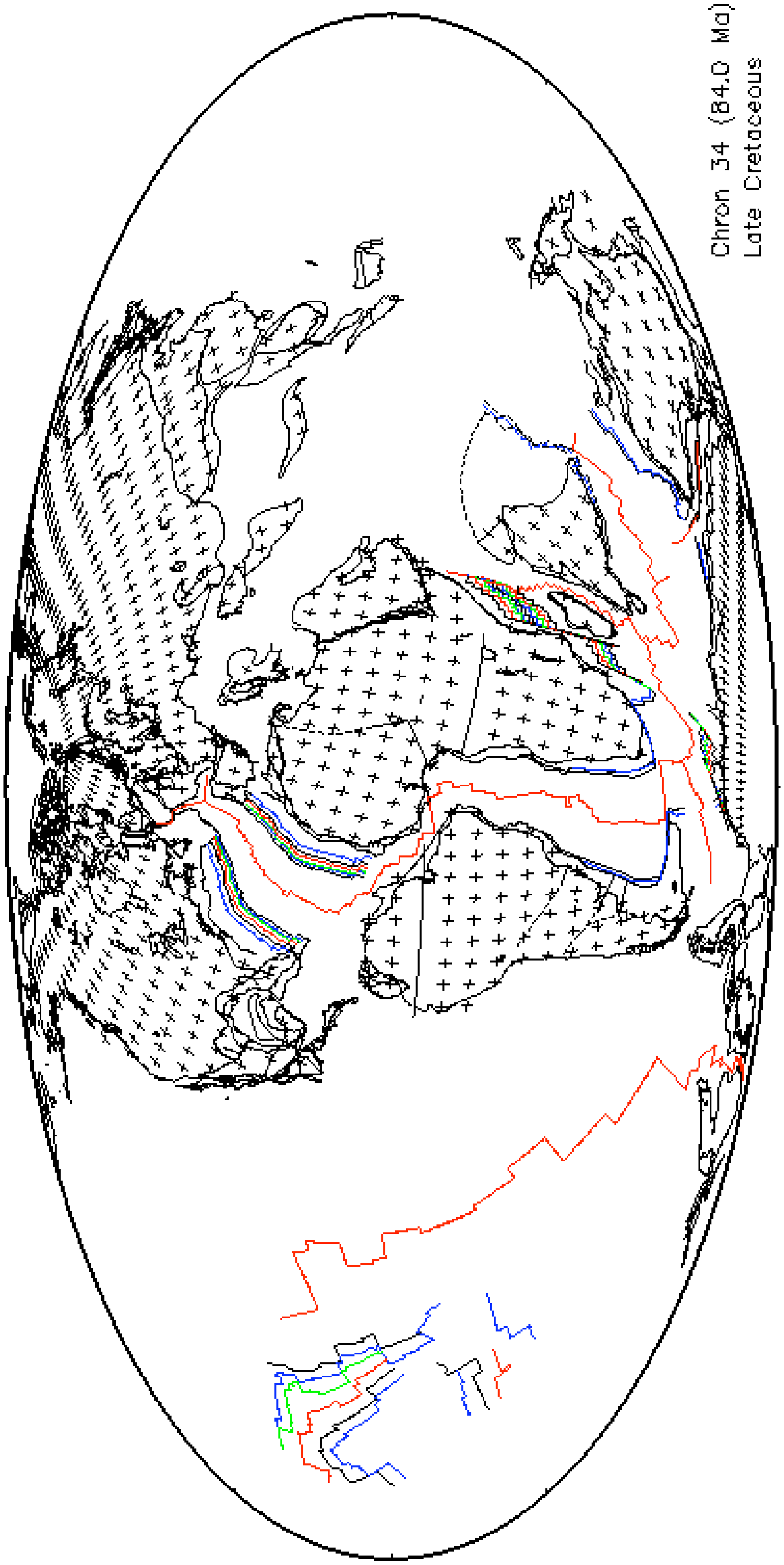
Chron 25 (58.6 Ma)
Late Paleocene

FIG. 9



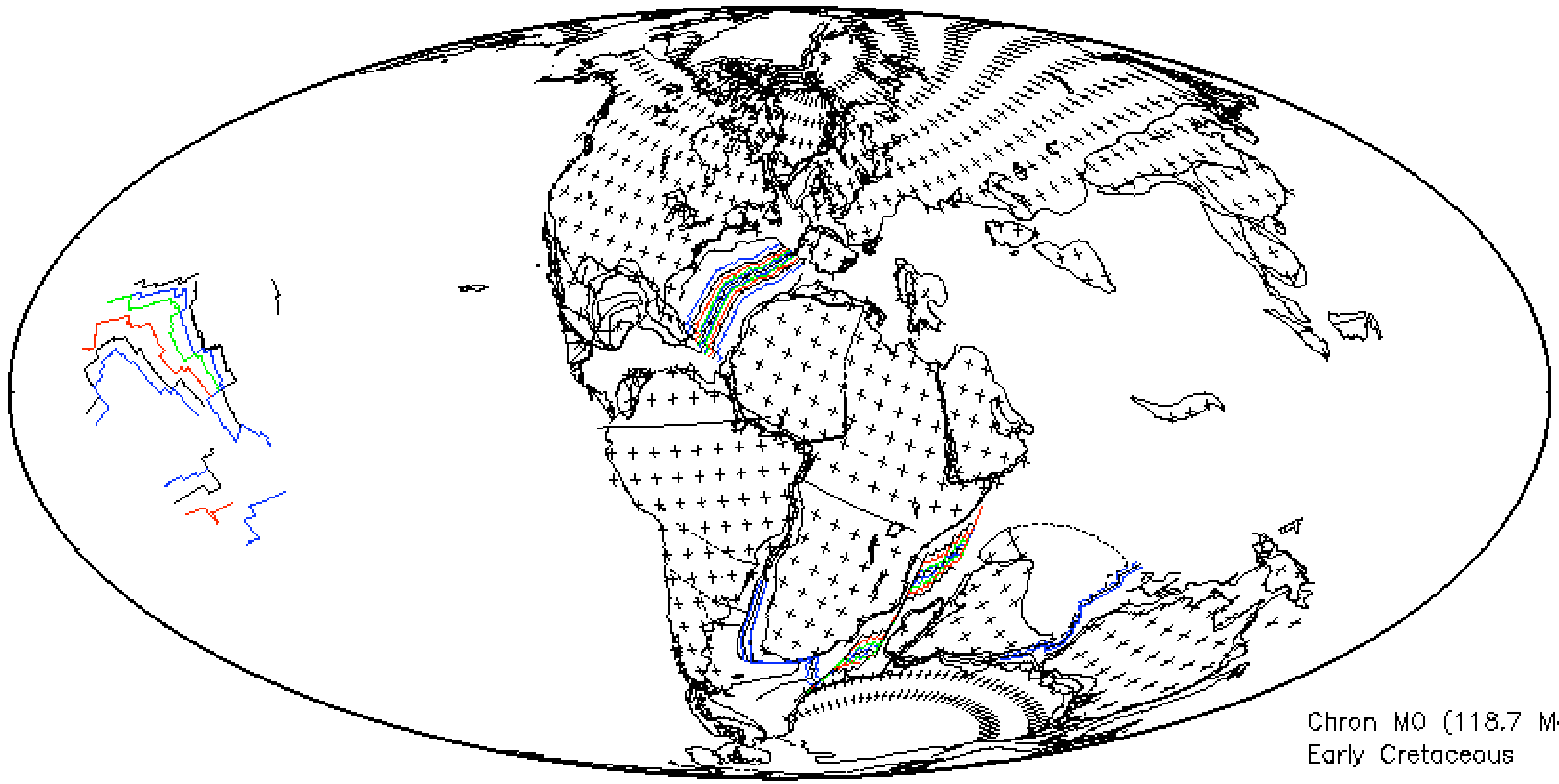
Chron 31 (68.5 Ma)
Late Cretaceous

FIG. 10



Chron 34 (84.0 Ma)
Late Cretaceous

FIG. 11



Chron M0 (118.7 Ma)
Early Cretaceous

FIG. 12

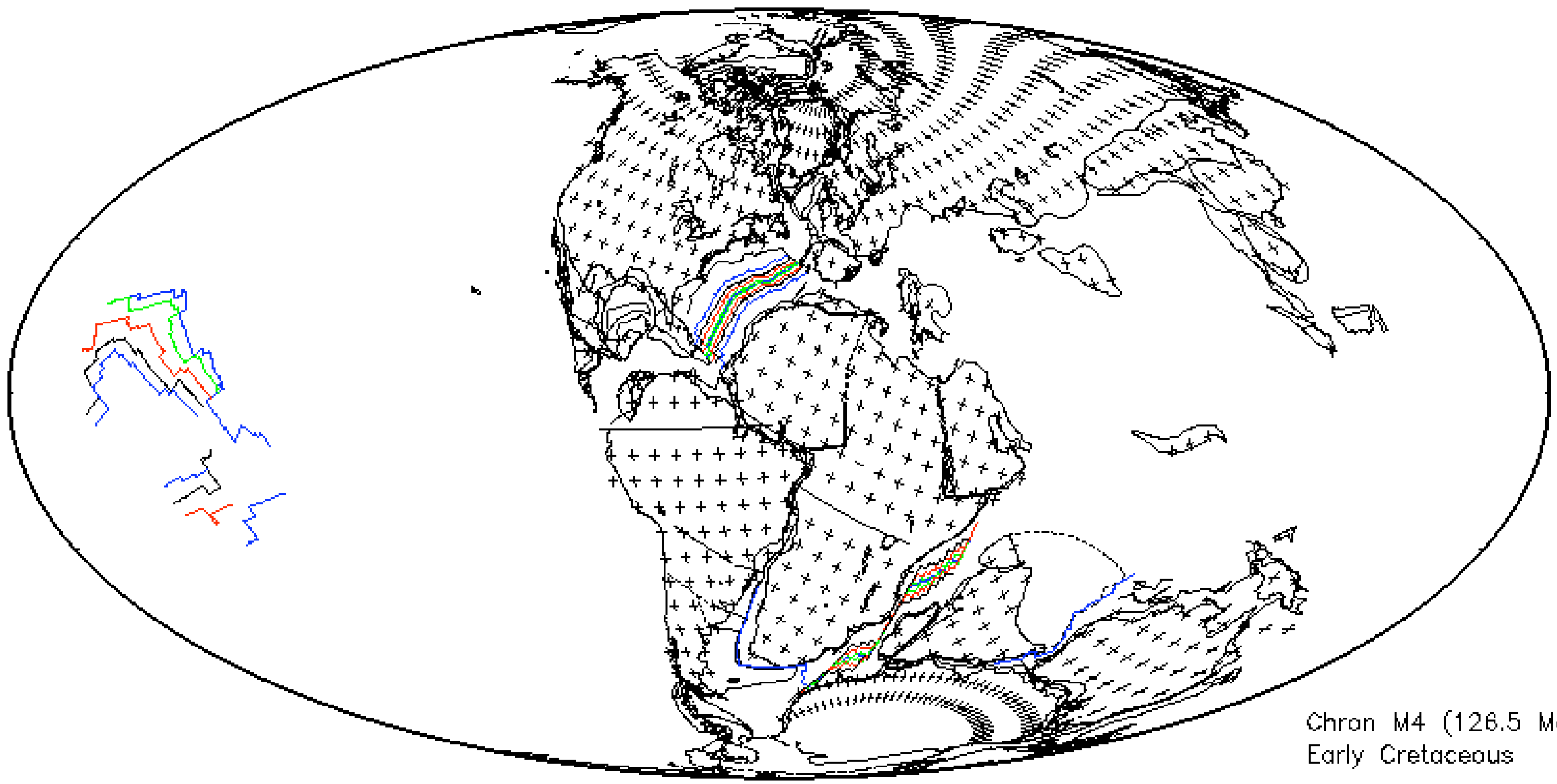
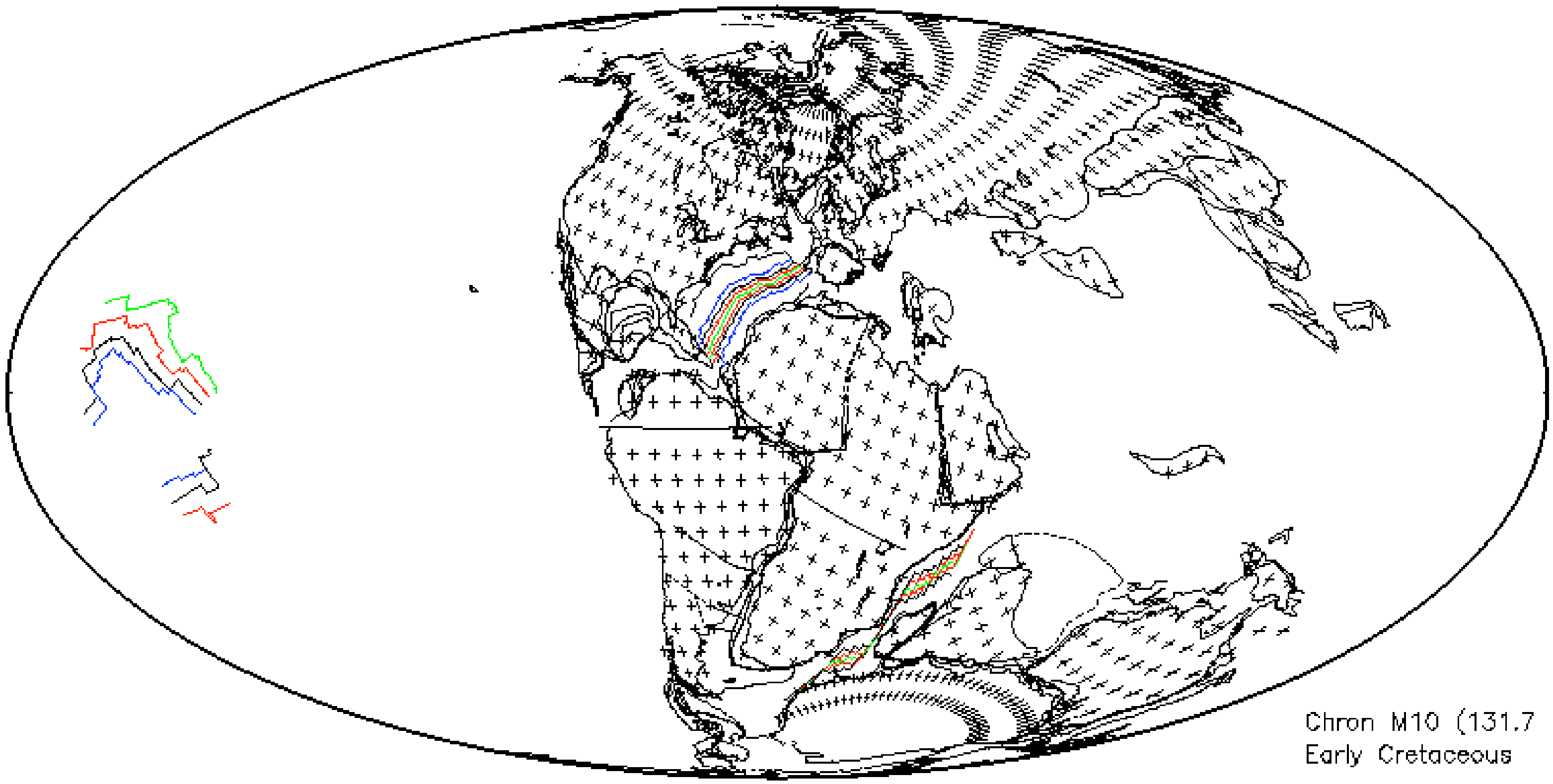
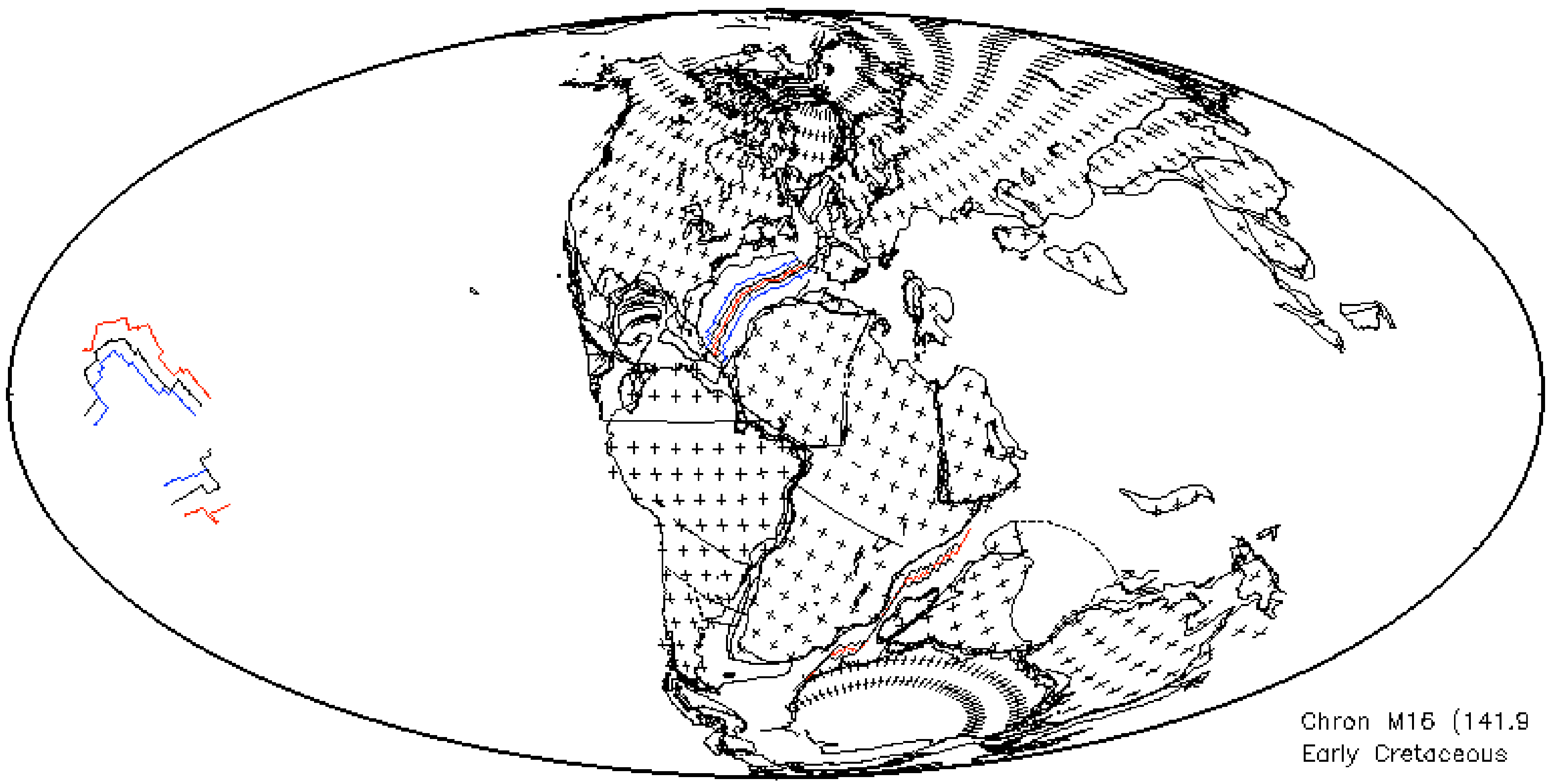


FIG. 13



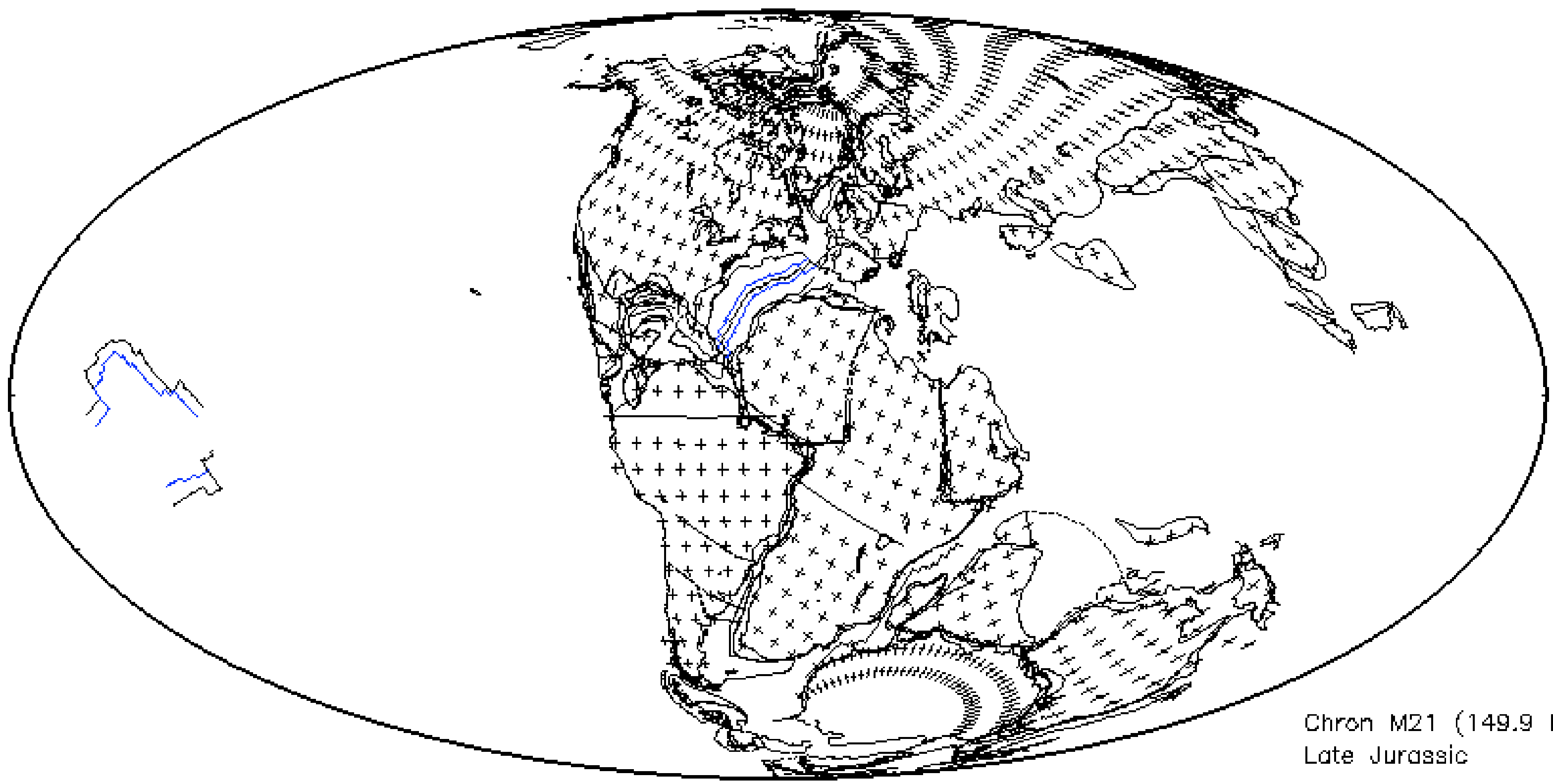
Chron M10 (131.7 Ma)
Early Cretaceous

FIG. 14



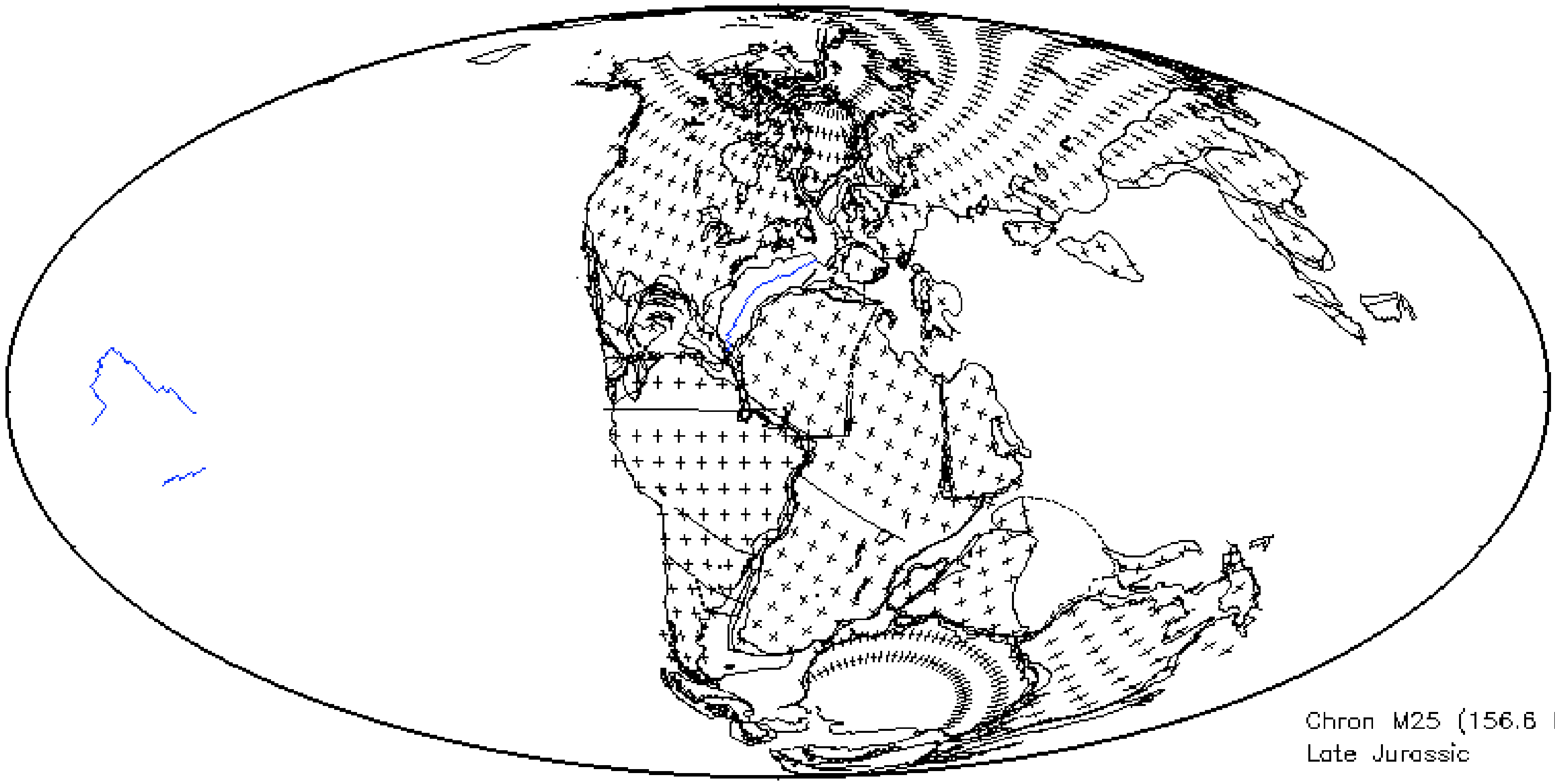
Chron M16 (141.9 Ma)
Early Cretaceous

FIG. 153



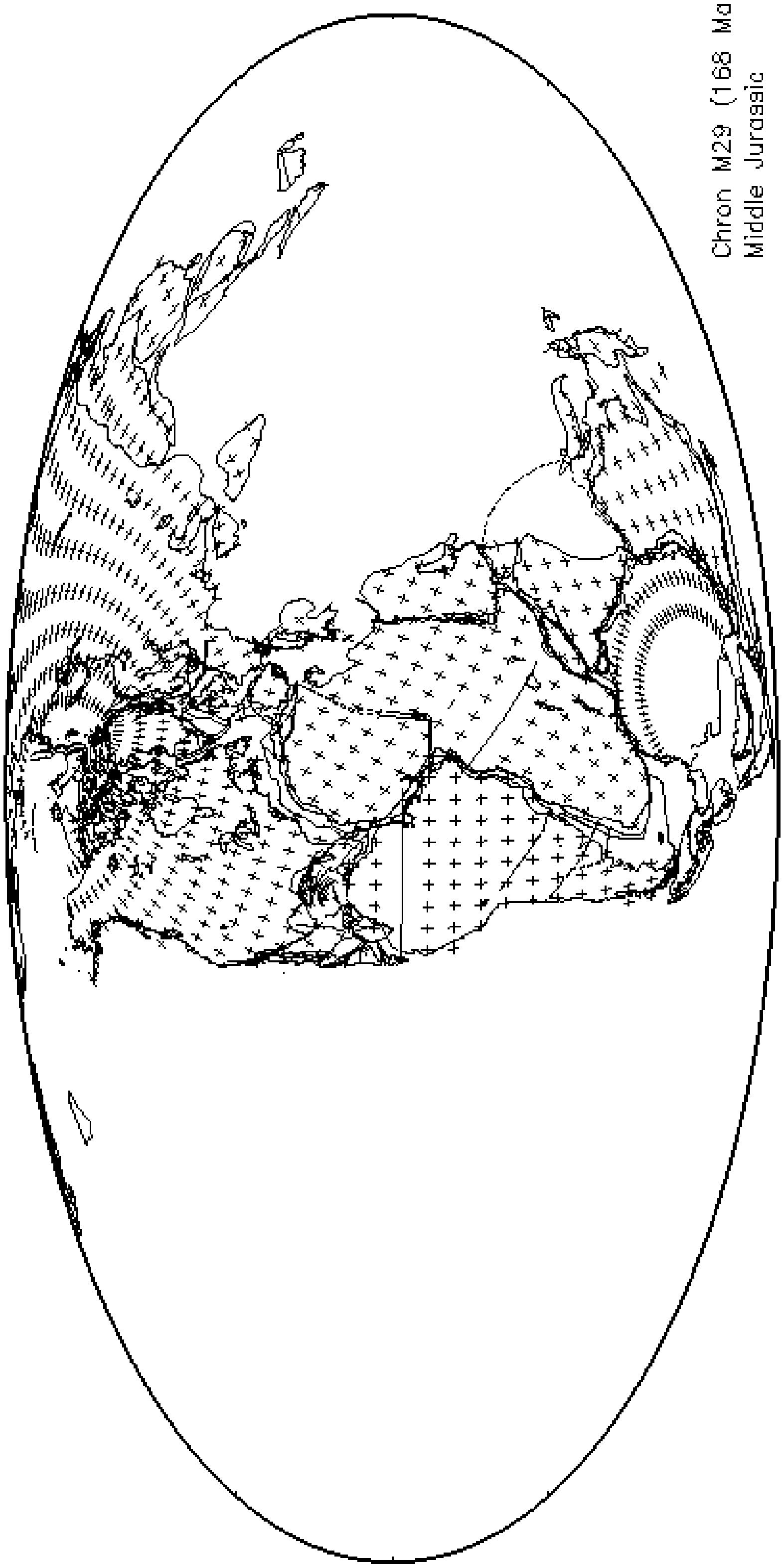
Chron M21 (149.9 Ma)
Late Jurassic

FIG. 16



Chron M25 (156.6 Ma)
Late Jurassic

FIG. 17



Chron M29 (168 Ma)
Middle Jurassic

FIG. 18

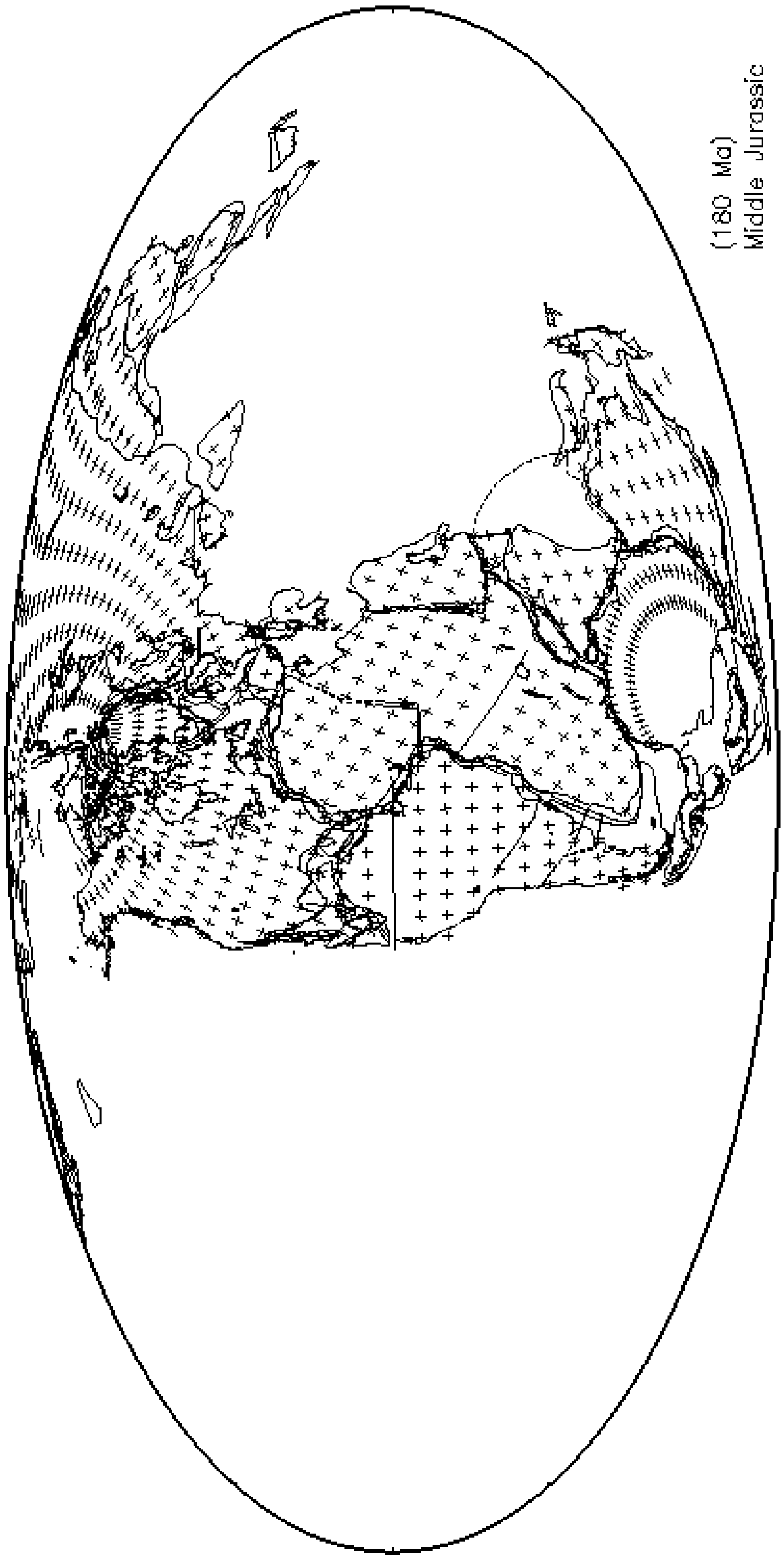


Fig. 19

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Global Isochron Chart of Ocean Floor

A global model for Mesozoic and Cenozoic plate motions has been developed by the Paleoceanographic Mapping Project (POMP) during the last 4 years. It is based on a digital tectonic database that includes modern plate boundaries, marine magnetic anomaly data, fracture zone lineations, bathymetric data, Seasat and Geosat altimetry data, mapped ocean continent boundaries, and continental tectonic data.

An internally consistent model has been developed for the entire Pacific ocean using a combination of satellite altimetry, magnetic anomaly, and bathymetric data. The high density of Geosat deflection of the vertical profiles, along with magnetic anomaly identifications, were used to produce a tectonic fabric map that reveals previously unknown details in paleospreading directions for the major plates.

Our model for the Indian Ocean is based on a compilation of magnetic anomaly data, including reinterpretations of magnetic anomalies as well as interpretations of Geosat deflection of the vertical data. The resulting reconstructions are consistent with the early opening of the Indian Ocean as well as the development of the northwestern Indian Ocean in the Late Cretaceous.

The reconstructions for the Atlantic Ocean are based on recently published plate models. In addition, our reconstructions for the South Atlantic take into account intracontinental deformation in Africa and South America during their breakup. This model suggests a stepwise northward-propagating rift system in the South Atlantic from Tithonian to Aptian times, resulting in a fit reconstruction of Africa and South America without substantial overlaps or gaps as is inherent in rigid plate reconstructions. The motion of smaller plates such as in the Canadian Arctic, the western Mediterranean, and the Caribbean have been included in our model for the Central and North Atlantic.

Our model attempts to be consistent with regard to the relative plate motions in complex areas near plate margins of the major plates. Such areas include the ocean floor around the Bouvet triple junction between the South American, Antarctic, and Indian plates as well as the Macquarie triple junction between the eastern Indian Ocean and the Southwest Pacific.

This model was used to construct a self-consistent global isochron chart of the ocean floor. Continuous isochrons consist of paleoridge segments and paleotransforms. The paleoridge segments were drawn by finding the best average lines for reconstructed magnetic anomaly picks from conjugate plates. The positions of transforms were determined from fracture zone lineations in the deflection of the vertical field from Geosat satellite altimetry data and from offsets in magnetic lineations. The orientation of transform segments for a given isochron are defined by small circles about the stage poles (i.e., quasi-instantaneous pole of motion for this time). On reconstruction maps, the isochrons were first drawn on the plate kept fixed in the reconstruction. A complete set of isochrons was derived by rotating each isochron from the fixed plate to its corresponding position on the conjugate plates by applying finite rotations. Synthetic isochrons were constructed for equatorial ocean floor, where no magnetic anomalies are present, as in the equatorial Atlantic and Pacific.

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