

k36 Calculation of durations between the existence of supercontinents < break up, divergence, coalescence >

To complete his measurement, he [a friend of Archimedes named Eratosthenes and nicknamed ‘Beta’ because he was second-best at everything—beta is the second letter of the Greek alphabet] had to estimate the distance ... from Aswan to Alexandria and to observe the angle ... made by the shadow of a vertical stick erected in the library’s grounds at noon on midsummer day. He estimated the distance at 5000 stades, a number so round as to create the suspicion that it was more a guess than a measurement.

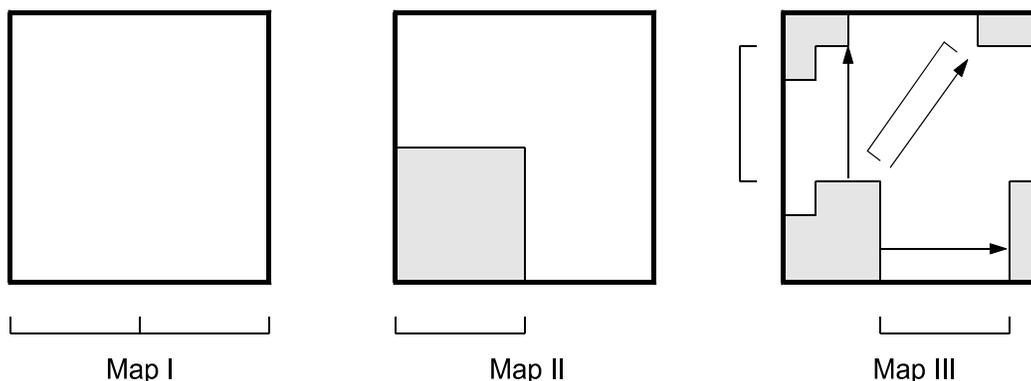
— J. L. Heilbron *Geometry Civilized*, 1998.¹

A “back of an envelope” calculation for the time between coalescences and fragmentations of supercontinents can proceed as follows:

Widths of oceans that open between coalescences

French revolutionaries defined the meter as ten-millionth of the distance from the North Pole to the Equator. We can use $10,000,000 \times 4 \times 100 = 4,000,000,000$ centimeters as an easy to recall (approximate) measure of Earth’s circumference in any direction.

A map of Earth’s surface can be drawn as a square with sides equal to its circumference (Map I).



Often quoted is that the oceans (including islands) cover almost three quarters of Earth’s surface. So divide the area of the map into four quarters. Then the area of the continents can be represented by one of these squares. The other three are continuous ocean. This map (Map II) represents a supercontinent surrounded (as the map area represents the surface of a sphere) by ocean.

Let one or more pieces the land area break away into the ocean area and move away. At their farthest they will reach the far sides of the square map area (Map III). With this as their position, a single land area is again in existence (as the map area represents the surface of a sphere).

The widths of the oceans that opened are 2,000,000,000 cm (the length arrows in Map III. Note: the diagonal arrow is the same length distance, as the map represents a sphere).

Rates of continental divergence

The present distance between the passive south margin of Australia and the passive north margin of Antarctica (**Figure k36.1**) about 30° in angular measure along a great circle of opening (which is conveniently the line of longitude 130° E). The South Ocean floor between has been widening for 40 My. The average full rate of this seafloor spreading is therefore:

$$(30/360) \times (4,000,000,000/40,000,000) = 1/13 \times 100/1 = 7.7 \text{ cm/yr.}$$

The 1986, NASA Geodynamics Branch,² published, measure of this rate is 7.4 cm/yr.

The present distance between the passive east margin of North America and the passive west margin of North Africa (**Figure k36.2**) is in angular measure (which must be measured on a globe) is 45°. The North Atlantic ocean floor between has been widening for 180 My. The average full rate of this seafloor spreading is therefore:

$$(45/360) \times (4,000,000,000/180,000,000) = 1/8 \times 200/9 = 2.8 \text{ cm/yr.}$$

The 1986, NASA Geodynamics Branch, published, measure of this rate is 2.8 cm/yr.

Durations between supercontinents at the above great-circle spreading rates is $2,000,000,000 / 7.7, 2.8 = 260, 714$. The mean of these two is ~500 million years and this ball-park figure is in agreement with the history of five supercontinents (*see Topic k34*) with average coalescence spacings of $(2650-200)/4 = \sim 600 \text{ My}$. Time between coalescences would be less by time-out for when the supercontinentents existed. □

Figure k36.1³ (right) Map showing the passive southern margin Australia and the passive northern margin of Antarctica.

The South Ocean that has been opening between these margins as a result of seafloor spreading for the last 40 My from the east west ridge (heavy line) between them (this ridge is part of the Southeast Indian Ridge).

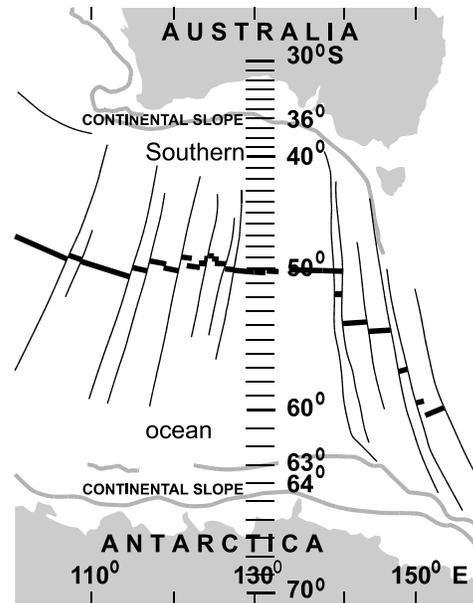


Figure k36.2⁴ (below) Southern North Atlantic seafloor spreading, west and east of the Mid-Atlantic ridge, along a great circle (through NYC and Canary Islands) totals 45 degrees since 180 Ma (isochrons in My).

