

A GIANT METEORITE IMPACT AND RAPID CONTINENTAL DRIFT

J. MICHAEL FISCHER, BS
1620 IRA ROAD
EFLAND, NC 27243

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ABSTRACT

An alternative to plate tectonics theory is offered. It is proposed that a giant meteorite impact in what is today the Western Somali Basin sundered the protocontinent, producing the present global arrangement of landmasses and the significant topographic features in the region of the proposed impact.

INTRODUCTION

With the revival in 1961 of Alfred Wegner's ideas on continental drift, observations such as the apparent fit of landmasses together, the presence of mid-ocean ridges, the paths of transform faults across ocean basins, etc. were incorporated into the uniformitarian framework of geologic time. This framework had been devised to support evolution's requirement for vast amounts of time. Extremely slow convection hidden deep within the Earth was depicted as the mechanism that shaped the crust. The observations, the time scale, and the mechanism were combined to form the theory of plate tectonics. The positions of the continents today are presumed to be temporary, only the latest in an endless cycle of collision and division of landmasses, subduction and emergence of plates, that has been repeated in various arrangements over billions of years. Plate tectonics clearly dominates the literature of geology to the degree that it is regarded as foundational.

The creationist time scale requires that continental division occurred much more quickly than in plate tectonics theory. Because today there is no rapid continental drift (on the order of 1000 feet or more per year), creationists must regard continental separation as a fait accompli instead of as an ongoing process.

Oberbeck et al. write that "continental crustal plates are rigid and of high strength; some mechanism is required to initiate continental breakup" [44, p.15]. They have recently proposed that impacts initiated the breakup of Gondwanaland [44]. According to Hill [27], mantle plumes alone provide insufficient stress to initiate breakup. He believes they could only affect existing spreading systems. Yet even after continental breakup has been dealt with, there are questions concerning the driving mechanism of plate tectonics. Artyushkov points out that spots of hot asthenosphere, probably a result of convective upwelling, have been identified, but that this material does not spread far laterally [2]. "Convection can produce large-scale horizontal displacements of lithospheric plates only if convective cells have a large horizontal size: thousands of kilometres or more." "The distribution of inhomogeneities in the asthenosphere indicates that no convective cells of a very large horizontal scale exist in the upper mantle. This means that convective flows are unable to drive the plates for thousands of kilometres" [2, p.175].

This paper offers an alternative to plate tectonics theory: that Earth's protocontinent was rapidly sundered by a single giant meteorite impact in what is now the Western Somali Basin. Because of the scope of the theory, space allows only brief treatment of each supporting element. More detail is available from the references cited.

The Event

According to the proposed model, a giant meteorite of undetermined size, composition, and speed penetrated Earth's atmosphere unscathed [38, p.211] and struck the protocontinent at 8°S 47°E (Figure 1). The meteorite traveled on a northwest (298 degrees) to southeast (118 degrees) azimuth and impacted obliquely, probably at an angle close to 45 degrees. The bolide penetrated the crust to a depth approximately equal to its diameter [38,

p.48]. Much of the ejecta was thrown out of the crater to the northeast and southwest, perpendicular to the line of travel, as is typical of oblique impacts. All continental material within the crater and along gouges to the northeast and southwest of the crater were excavated. Impact-generated tektites were carried to the upper atmosphere and beyond by a rising column of hot gas and distributed by high-altitude westerly winds to become the Australasian strewn field. Following excavation, the transient crater collapsed to form a complex crater by acoustic fluidization and "freezing" in the manner of a Bingham fluid. Wilkes Rise (8°S 47°E), including its moat and uplifted rim, is the roughly 200-mile-diameter central peak and ring structure, the surrounding basin is the flat interior floor, and what remains of the crater walls on the East African coast are the faulted rim. If correct, it is the largest crater on Earth, over 500 miles across.

The final form of the crater is unique (and partially disguised), however, because the shock wave from the impact overwhelmed the confining crust - first compressing, then shattering it. The amount of compression depended on the level of resistance. A small subduction zone along the Amirante Trench is a remnant of the initial pressure against the relatively narrow strip of land, composed of the Seychelles Bank, India, Australia, and Southeast Asia, which quickly yielded to the shock wave. Initial pressure against the bulk of the southern lobe of the protocontinent, composed of Africa and the Americas, had much larger consequences. The crust under Lake Victoria was downwarped, while the crust on the east and west sides of Lake Victoria was upwarped [45]. The crust fractured along what would become the East African Rift system, the largest such system in the world. Deep fracturing induced volcanism around the impact site: in Madagascar, in the island arc north of Madagascar's current position, along the East Branch of the East African Rift system, and, most dramatically, in Western India. The crust confining the impact was shattered in three places: directly in front of the oblique impact (between India and Madagascar) and northeast and southwest of the crater where ejecta had gouged the crust and thus established a natural break line.

The shock wave propagated in all directions. Africa, Madagascar, and the Seychelles Bank transmitted the pressure through themselves to the Americas, Antarctica, and India respectively, which were propelled directly away from the point of impact. Thus Africa, Madagascar and the Seychelles Bank moved very little and remain near their original positions today. The initial push-off raised low mountains on the east coasts of North and South America and the west coast of India. As has been proposed for long-runout landslides, the movement of the landmasses initiated acoustic fluidization at their bases, reducing friction to near zero and allowing them to glide across the oceanic crust without disturbing their sedimentary sequences. Prior to impact, India, Australia, and Southeast Asia formed the strip of continental crust on the east side of the southern lobe of the protocontinent (revised from [21]). The impact severed this strip where India joined Africa and forced the Horn of Africa westward about 250 miles like the closing of a lobster claw, pinching up crust and raising mountains in Ethiopia. Antarctica was pushed to the south with a counterclockwise spin, separating cleanly from Australia, Madagascar, and South Africa. Antarctica's overlap with southernmost South America began the peeling off of South America from Africa and added a slight clockwise swing to South America's movement which, like North America, was pushed away from Africa by the shock wave. The movement of India, Australia and Southeast Asia to the east, and of the Americas to the west, caused east-west extension throughout the entire region of Eastern and Central Africa and the Western Somali Basin. The East African Rift system and the north-south-aligned fractures in the Western Somali Basin are products of this extension. Southeast Asia was caught between India headed northeast and Australia headed southeast. Southeast Asia continued northeast with India, whose pull redirected Australia to the east, but in the process Australia ripped large pieces off of Southeast Asia. (The area where this happened has been designated as a large oceanic diffuse plate boundary [14]). Rolling slightly counterclockwise as it slid east, Australia peeled away the Malay Peninsula and the islands of Indonesia and the Philippines. A fluid crustal wave, which the Philippine Islands rode for several hundred miles, flowed east-northeast beyond the debris of Southeast Asia until its acoustic energy attenuated to the point where the rock regained its normal strength and "froze", forming the South Honshu Ridge and the Bonin and Mariana Trenches.

Having traveled only a short distance, the collision of India and Southeast Asia with Asia caused tremendous compressional mountain building throughout Asia east of about 70°E. India penetrated approximately 1250 km into Asia [32] and pulled the Arabian Peninsula off of Africa. Southern India and Indochina were bent eastward by the contact with Asia with such shock that Ceylon separated from India. The collision forced all of Eurasia to rotate counterclockwise, pivoting on a point near 37°N 75°E. East Asia moved sharply northward leaving Japan behind, tearing open the Yellow Sea and Sea of Okhotsk, dragging Sakhalin Island and the Kamchatka Peninsula, and, in a "crack the whip" motion, spinning Alaska eastward until it collided with North America which was moving westward. Europe, which had been partially drawn out as North America pulled away from it, was forced south by the rotation of Eurasia. The resulting compression formed mountains in Southern Europe and from Turkey to Pakistan, as well as the Urals. As the Americas and Antarctica glided forward, the leading edge of their fluidized continental material gradually spread out. It eventually reached the point (because of thinning and deceleration) where acoustic energy loss exceeded gain. This led to the solidifying of the leading edge of each landmass and put a brake on forward motion. Compressional mountain building occurred behind the leading edges until each landmass slowed to the point where acoustic fluidization had ceased. Considering the similar distances that North America, South America, Australia and Antarctica travelled, braking in all four was nearly simultaneous. The crustal wave referred to earlier that "froze" south of Japan also flowed beyond Australia and "froze" to form the Tonga and

Kermadec Ridges and Trenches. The turbulence of the northern end of this section of the wave is evident between Papua New Guinea and the Tonga Islands on free air gravity maps [52].

Magma extruded during rapid sea-floor spreading quickly raised the temperature of the ocean waters rushing in to fill the gaps opened between the sundered pieces of the protocontinent. This temperature shock severely stressed the fauna and flora of the oceans [19]. Vast populations of plankton died and sank. The turbulence of in-rushing waters scoured the Western Somali Basin, and slumping from the backwash of impact-induced tsunamis [44] deposited thick sediment on the African margin. During the following months, fallout of iridium and volcanic ash and glass from the atmosphere mixed with sediment settling on the ocean floor. In contrast to the heating of the oceans, the event initiated atmospheric cooling. The injection into the upper atmosphere of particulate matter from the impact and volcanism was an important factor. However, the injection of sulfur dioxide, especially from the Deccan flood basalts, into the upper atmosphere probably had greater long-term significance. Air temperature fell dramatically and remained low for years. Hot moist air rising from the heated oceans fell as snow on the continents, building glaciers and lowering global sea level.

The sweeping landmasses and rushing waters would have reworked ocean floor sediments from the "Jurassic" up. They would subsequently have been redeposited, mixed with volcanic and other impact-related fallout. While the atmospheric and fallout phenomena persisted for months or years, according to this model the sundering of the protocontinent was completed in a matter of hours or days, in stark contrast to the pace of plate tectonics theory.

Centrality

The quality that immediately directs attention to the Western Somali Basin is its unique central position relative to the landmasses that split from the protocontinent. North America, South America, Antarctica, Australia, and India all moved directly away from this point (Figure 3). The directions of movement are clear: in each case a mid-ocean ridge lies behind the landmass, and mountain chains formed by lateral compression lie along the leading edge. In addition, to the northwest is the heart of the extensive East African Rift system, while to the northeast, by the Seychelles Bank, is the place where even plate tectonics advocates propose the massive Deccan flood basalts began to be loosed [42] [33].

Complex Craters

Simple craters form in the familiar bowl shape. On Earth, craters larger than about 2 to 4 kilometers have the characteristics of complex craters: a central peak structure, flat inner floor, and terraced rim, which slumps toward the center (Figure 4) [24]. What begins as a bowl-shaped crater quickly collapses under the force of gravity to form the complex crater. The floor under the transient crater rises, rocks under the center are uplifted, and rocks along the rim slump inward. Why this occurs is the subject of much debate, for it is apparent that the stresses related to crater collapse are far less than the strength of even loose rock debris. Terrace morphology is characteristic of the failure of plastic materials, while the central peak is essentially a hydrodynamic damped harmonic oscillator, similar to the central jet that rises from an impact in water. Yet if it remained fluid within the crater, the end result would be a flat surface. Somehow the rising jet must be suddenly "frozen" [38, p.147].

Acoustic Fluidization

A material with a plastic yield stress that flows as a fluid when applied shear stress exceeds its cohesion is called a Bingham fluid. Once shear stresses fall below its cohesion, the material quickly resolidifies [38, p.149]. Melosh contends that the Bingham fluid model describes the formation of complex craters, and has proposed that acoustic fluidization is the mechanism [38, p.154] [37]. "The basic idea behind acoustic fluidization is that rock debris subject to strong vibrations can flow like a fluid even in the absence of air or water. The vibration is transmitted as a sound wave via rock-to-rock contacts" [38, p.151]. Behind the expanding stress wave generated by the impact follows a region of random vibrations that exceed the overburden pressure. This dense acoustic energy fluidizes the debris within the crater, but is attenuated beyond the vicinity of the crater, confining the flow. Crater collapse ends when the acoustic energy has dissipated below the level of cohesion [38, p.154].

Long-runout Landslides

Avalanches typically fall a certain distance and then slide horizontally less than twice that distance [40]. However, landslides with volumes over about 100,000 cubic meters travel much farther horizontally than would be expected, as if running on a lubricated surface. The longest one measured so far, from the Nevado de Colima volcano in Mexico, ran about 25 times farther than it dropped [54]. Concerning these so-called long-runout landslides two elements are clear: the coefficient of friction (height of drop/length of runout) tends to decrease as the volume of the landslide increases [35], and the rock debris tends to keep its order, indicating a lack of turbulent flow [20]. Melosh [37] suggests that the greatly reduced internal friction in large landslides appears to have much in common with crater collapse, and has proposed that acoustic fluidization is again the active mechanism. In this case, the initial fall generates the friction that produces the acoustic energy density needed to fluidize the base of the

landslide. The mass of rock over the basal layer determines both the amount of pressure applied and the degree to which the acoustic energy is contained. The larger the mass, the greater these effects. When the thickness is reduced (through spreading of the flow) to the point where acoustic radiation loss exceeds energy gained, the slide slows and then stops. Stratigraphy is undisturbed because the rocks have remained in contact with each other at all times.

I propose that the giant meteorite impact started the greatest long-runout landslide in Earth history. The shock wave provided the initial push on the sundered landmasses, equivalent to the initial fall of a typical landslide, and the slide continued virtually frictionless due to acoustic fluidization of the basal layers. Fluidization of the leading edges led to their spreading forward and thinning. Thus the point of critical energy loss was reached there first, and the result was braking and compressional mountain building along the leading edges.

Oblique Impacts

Meteorites never impact Earth precisely vertically. In fact, mathematically the most probable angle of impact is 45 degrees. Except in cases where the angle of incidence is very low, oblique impacts produce circular craters and their shock waves propagate in the same way as in vertical impacts, although they are somewhat weaker. Much of the ejecta from oblique impacts are concentrated in a "butterfly" pattern, being blown out to the sides perpendicular to the projectile's line of travel. Impacts with incident angles between 90 and 20 degrees also produce downrange jets containing the projectile and some target material [38, pp.49,101].

Tektites

Tektites are generally rounded, black, silicate glass objects resembling obsidian and range in size from less than a millimeter to chunks weighing several kilograms or more. Analysis of their composition indicates that the parent material was terrestrial sedimentary surface deposits, and that they were formed under conditions of high pressure and extremely brief but intense heating. Therefore most investigators favor a terrestrial impact origin. Areas where tektites of similar composition are found are called strewn fields. Each strewn field is thought to have been produced by a single event. Of four main strewn fields, source craters have been located for two, and an area of probable impact has been indicated for a third (North American strewn field). No source crater has been generally accepted for the Australasian strewn field. It is immense, covering one tenth of the Earth's surface (Figure 5) [22].

Hot vapor plumes rush rapidly up from high-velocity impacts. An impact that formed a large (perhaps 3 km, more likely at least 10 km) diameter crater would produce a column of hot, rising gas that would "blow out" of the upper atmosphere. Tektites within this column would be ballistically launched great distances. This apparently occurred in the cases of the Ries Crater in Germany and the Bosumtwi Crater in Ghana [38, p.212].

I propose that the impact in the Western Somali Basin, which is located on the western edge of what is estimated to be the boundary of the Australasian strewn field, is the source of the tektites in this strewn field, and that they were widely distributed by high altitude westerly winds.

Impact-generated magmatism

Jones [28] concluded that the shock wave from impacts forming craters with diameters larger than 24 km would fracture the crust all the way to the Moho. Magmatism is associated with at least three large terrestrial impact craters. Dressler [15] believes there was impact-triggered volcanism at the Manicouagan Structure in Quebec, and impact-triggered intrusive magmatism at the Sudbury Structure in Ontario. A "collar" of volcanic extrusives partially surrounds the Vredefort Dome impact structure in South Africa [34].

The volume of volcanic extrusives in the Eastern Branch of the East African Rift system, northwest of the proposed impact site, is enormous, estimated to be 500,000 cubic kilometers [29]. Models formulated from recent seismic data postulate a combination of asthenospheric upwarping with regional extension to explain the complex structure of the East African Rift system [23] [31]. Activity began with the uplift of the Kenya Dome (Figure 6), followed by continuous rifting and extrusion [26] (also in some places along the Western Branch [18]). Extension across the rift is estimated to be no more than 10 percent, so that lithospheric thinning is insufficient to account for the extensive magmatic accretion [29].

I propose that shock wave pressure against East Africa not only warped the crust at and around Lake Victoria [45], but simultaneously forced magma upward. The pull of the landmasses away from Africa to the west and east caused the regional extension.

With growing acceptance of the idea that mass extinction followed a large meteorite impact, plate tectonics theorists have tried to incorporate this catastrophe. It has been suggested that large impacts started persistent hotspots beneath them by excavating and fracturing the crust, initiating pressure relief melting and producing flood basalts similar to lunar maria. They have also been said to crack stressed lithosphere, allowing slow continental rifting to

begin [1].

It has been proposed that an impact near Bombay unleashed the flood basalts of the Deccan Traps of India. India's position at the time is said to have been east of the Seychelles. The period of extrusion has been whittled down to about one million years, with a main eruptive phase of "only" about 10,000 years. The crater, however, has not been found [42] [13].

In contrast, I propose that India was adjacent to Africa and joined to the Seychelles Bank. The impact in the Western Somali Basin to the southwest rent a deep fracture at the site of a conduit structure detected near Bombay [42]. As with the Eastern Branch of the East African Rift system, shock wave pressure forced an extraordinary volume of magma up through this conduit structure in a short period of time.

The impact also induced volcanism in the Diego Basin at the northern tip of Madagascar and produced the volcanic island arc north of Madagascar (the Comoros to the Farquhar Group). This arc is concentric with the impact site.

Volcanically-induced Ice Age

The eruption of Mount Pinatubo in June 1991 had a strong cooling effect on Earth's atmosphere, the predicted maximum being 0.5 degrees Centigrade in late 1992 with temperatures returning to normal by mid-1995 [39]. Beginning in June 1783 and continuing for eight months, the eruption of the Laki crater row, Iceland, was linked to severe winters in England and the eastern United States. In the U.S., the period from December 1783 to February 1784 had an average temperature 4.8 degrees Centigrade below the 225 year average. The annual mean temperatures of 1784 and 1785 were also well below normal [51].

Volcanoes emitting large amounts of sulfur dioxide into the stratosphere cause cooling of Earth's surface temperature. Whereas volcanic ash falls out of the atmosphere before it can have a significant impact on the climate, sulfur dioxide combines with water and remains for long periods as a haze of sulfuric acid droplets. These sulfuric acid aerosols in the stratosphere absorb incoming solar radiation, warming the upper atmosphere but cooling the lower atmosphere [51].

The Laki eruption produced from 1.3 to 6.3×10^7 tons of sulfur dioxide and 12.3 cubic kilometers of lava [51]. By comparison, the sulfur dioxide from Mount St. Helen's was estimated at about 2.2×10^5 tons [5]. To a large degree, the ferrous iron (FeO) content determines the solubility of sulfur in basaltic magma [51]. The FeO content of Laki magma is 11.34% [55], Mount St. Helens magma is 4.43 to 4.78% [53], and Deccan Trap lava is 9 to 10% [49]. Considering that the volume of lava erupted at the Deccan Traps may have been over 120,000 times the volume of the Laki eruption (as much as 1,500,000 cubic kilometers [50]), the cooling effect on surface temperatures must have been staggering.

Further study is required to determine the effect of the injection of this quantity of sulfur dioxide into the stratosphere and its duration. However, it appears that the extrusion of the Deccan flood basalts could have been a key factor in initiating an ice age.

REGIONAL OVERVIEW

Only a portion of the Western Somali Basin has been studied. Paleomagnetic surveys (Figure 8) and basement sampling have been spotty. Gravity field maps made from satellite altimeter readings of the surface topography of the oceans provide a good starting picture [52] [3]. In these, the proposed crater's central peak and ring structure can be seen to center on Wilkes Rise (Figure 7).

Wilkes Rise is about 2 km high at its northern and western summits, and about 3 km high on the southern side. The highest points are 1 to 2 km below sea level [10]. It has never been geologically sampled. The moat surrounding it is roughly 200 miles in diameter [9] and contains sediment exceeding depths of 3 km in places [10]. Large amplitude magnetic anomalies are near to, and surround, Wilkes Rise (Figure 8).

The crust in the Western Somali Basin is oceanic, yet the igneous crustal thickness of 5.22 ± 0.64 km is approximately 20% thinner than what is considered normal [12]. According to Coffin and Rabinowitz [10], a high energy environment persisted there from the Middle Cretaceous through much of the Cenozoic. Intense erosion is evident in layers of the Middle Eocene through the Middle Oligocene, and a major network of canyons and channels is carved into Neogene and Quaternary deposits. A series of perhaps 4 to 6 faults have been detected north-northeast of Wilkes Rise, east of Kenya [46]. Two of these, the Dhow and VLCC, have been described as essentially north-south oriented with their scarps facing east [11].

Near the African margin is the 30 to 120 km wide Davie Ridge (or Davie Fracture Zone), which trends north-south between 19° and 9° South and rises as much as 2300 m above the sea floor. It has a west-facing scarp, apparently produced by a normal fault [41] [47]. Earthquake focal depths of up to 35 km have been observed

along it [6]. The Davie Fracture Zone continues north of 9° South, without the prominent ridge, to intersect the coast of Kenya. The entire feature is about 2200 km long [11] [10]. The current regional plate tectonics scenario makes the Davie Fracture Zone a relic transform fault along which Madagascar had moved south. However, Chen and Grimison write that along its entire length (2° to 18° South) "all the large to moderate-sized earthquakes have focal mechanisms of pure normal faulting with NNW trending nodal planes. ...there is no significant component of strike-slip motion" [6, p.142]. Neither has a continuous rift or system of large-scale normal faults developed [6]. There is no evidence today that the Davie Fracture Zone was ever a transform fault.

The East African Rift system has two separate branches, the Western and Eastern rift valleys. It is volcanically and seismically active, and sits upon the East African Plateau, a broad intracontinental swell. The rift valleys are made up of a series of generally asymmetric basins, each about 100 km long [17]. Seismic studies have revealed several characteristics of the system: earthquake focal mechanisms are dominated by normal faulting with horizontally oriented T-axes perpendicular to the strike of the rift valleys, i.e. in a generally east-west direction [6] [30]; the East Branch extends into oceanic lithosphere along the Davie Fracture Zone [25]; and between 10° and 20° South, a diffuse zone of extension, up to 2000 km wide, reaches from the Davie Fracture Zone west through Zambia. The westernmost part of this zone of extension lacks extensive volcanism and rift morphology, yet some of the deepest earthquakes found in Africa, nearly equal to those along the Davie Fracture Zone, have been detected there [25] [6]. Earthquake focal depths in the northern part of the East African Rift system, in the vicinity of the Afar depression in Ethiopia, are shallower than those in the southern part [30]. According to plate tectonics, upwelling along the East African Rift system began the opening of Africa and the formation of a new ocean [7, p.271]. Ebinger states that "no connection between the... Western and Kenya rifts, however, is apparent in structural, morphologic, or seismicity patterns" [17, p. 885]. Grimison and Chen [25] conclude that "a single, narrow plate boundary does not seem to exist between the Nubian and Somalian plates" [25, p.10,449]. The features appear to be expressions of broad regional extension rather than nascent continental separation.

The margins of Kenya and Tanzania are marked by severe faulting and diapirism. Landward of the Davie Fracture Zone are numerous normal faults, downthrown to the east on the Tanzanian margin and to the southeast on the Kenyan margin. The latter are apparently listric. The continental shelf is quite narrow (25 to 50 km wide), with a rather steep continental slope. There was a major sediment slide offshore Somalia and Kenya, supposedly in the mid-Tertiary. The thickness of the sediment exceeds 8 km [10].

Precambrian rocks cover approximately the central two-thirds of Madagascar, with normal faults trending north-northeast near the east coast. Volcanism is most prominent on the northern tip of the island, but narrow strips of Cretaceous volcanics line parts of the coast, primarily in the northwest (Majunga Basin), where the strip is notably concave, and on the east coast. The east coast is strikingly linear and has a narrow coastal plain. A wide band of Phanerozoic sediments covers the west and northwest coasts. These are riddled with normal faults that generally parallel the coastline [4]. The northwestern shelf of Madagascar is distinguished by the normal-fault structure of its outer ridge. A block of sialic crust lies subparallel to the shelf margin, separated from the continental bench by a deep normal-fault depression [36]. Gross sediment thickness on the conjugate margin of Madagascar exceeds 5 km. The shelf is up to 100 km wide [10]. The Mozambique Channel, separating Madagascar from Africa, averages about 400 km in width, but tapers to as little as 250 km. Boast and Nairn [4] believe, based on the geology alone, that if Madagascar moved at all it went east, and not more than 200 km.

Northeast of Madagascar lie the Amirante Arc and Trough. The arc, a 400 km-long series of banks and small islands, is bounded to the west and south by the trough, which is 600 km long and reaches depths of over 5000 m [33]. Though it is far from nonmarine sources of sediment, the trough holds sediment accumulations of over 2 km [10]. The long central portion of the trough is relatively straight and has a steep gravity gradient, while the shallower ends curve toward the east, giving the trough an overall arcuate appearance [48]. A line drawn perpendicular to the central portion of the trough and through its center passes through Wilkes Rise. Even though the Amirante region is aseismic, a reasonable interpretation of the morphology and gravity profiles of the arc and trough is that they result from a brief episode of subduction [33].

Adjacent to the Amirante Arc is the Seychelles Bank, a section of continental crust over 30 km thick. It measures about 400 x 200 km and has a nearly flat top which sits an average of 50 m below sea level. Deep saddles connect it to the Amirante Arc and the Mascarene Plateau, but in all other directions the edges of the bank drop steeply to depths exceeding 3000 m [33]. The sedimentary cover of the Seychelles Bank is up to 500 m thick, with faulted blocks of strata displaced up to 30 m from adjoining blocks [36]. Partial melting below the crust followed by intrusion apparently occurred in the western part of the bank, the end nearest the Western Somali Basin [33].

The Mascarene Plateau is a 2000 km-long arcuate series of banks extending from the Seychelles Bank to Mauritius Island. Like the Seychelles Bank, banks of the Mascarene Plateau are approximately 50 m below water, and are bounded by steep scarps that plunge to depths of over 3000 m [33]. The Chagos-Laccadive Plateau is a similar series of banks that stretches north from the island of Diego Garcia to off the west coast of India. Central portions of both plateaus are covered by carbonate bank and reef deposits up to 2 km thick. Just north of Mauritius Island lies the 450 km-long Rodrigues Ridge. This ridge intersects the Mascarene Plateau at right angles and trends

toward the east. At its eastern extremity is Rodrigues Island. All of these plateaus and ridges are built on volcanic rocks [16]. I propose that these features are the product of three phenomena: first, the floor of the Mascarene Plateau region was stretched thin by the exit of India to the northeast, Australia to the east, and Antarctica to the south; second, the shallow magma below this region was forced up by the pressure of the impact, similar to what happened in East Africa; and third, concurring with Norton and Sclater [43], seafloor spreading formed the Chagos-Laccadive Plateau as the mirror image of the Mascarene Plateau.

The Northern Somali Basin is a small oceanic basin that lies between the Horn of Africa and Chain Ridge. The flat basement is one to two kilometers deeper than neighboring basement to the north or southeast. Chain Ridge can be traced south to 2° North [9]. I propose that Chain Ridge marks the original boundary of the Horn of Africa, and that the Northern Somali Basin was formed when the Horn was forced to the west by the impact.

CONCLUSION

Earth is no stranger to meteorite impacts. Approximately 130 terrestrial craters have been found so far [24], and more likely remain undiscovered. Meteorites may have encountered Earth individually or in swarms, as proposed by Clube and Napier [8, p.147-154]. With crater sizes ranging up to 140 km, and perhaps even 200 km, in diameter [24], they must have produced terrifying catastrophic events. Some are likely to have generated persistent climatic effects. Yet none are mentioned in the Bible. If the proposed giant impact caused the "dividing of the Earth" mentioned in Genesis 10:25, as seems appropriate, then it is the exception. This silence is not surprising since reports of meteorite impacts contribute nothing to the revelation of God's purpose. However, if the theory offered in this paper someday supplants plate tectonics theory in the scientific community, it will go a long way toward debunking the uniformitarian timescale and validating the creationist timescale of Earth history; and that will promote more than just good science.

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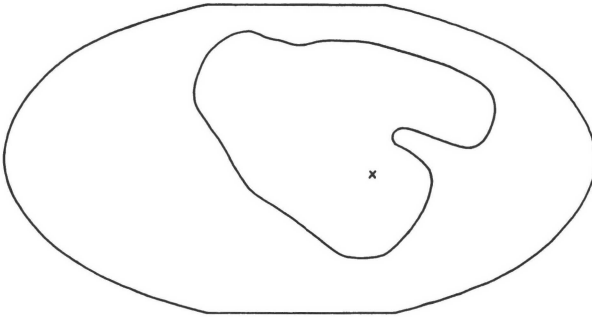


Figure 1. Author's reconstruction of the protocontinent and proposed point of impact (X).

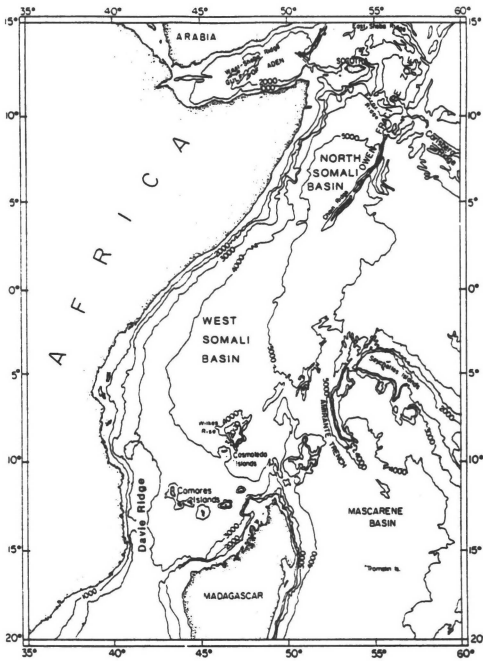


Figure 2. Locations of some on the features discussed in the text [9,p.11,986].

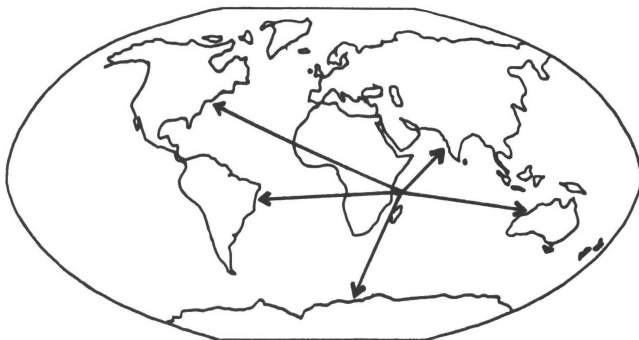


Figure 3. Central position of the proposed impact site in relation to the directions that the continents slid.

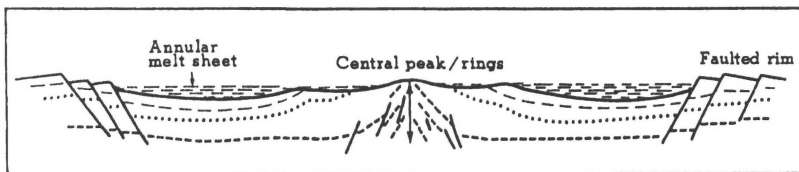


Figure 4. Schematic cross section of a large complex crater [24,p.185].

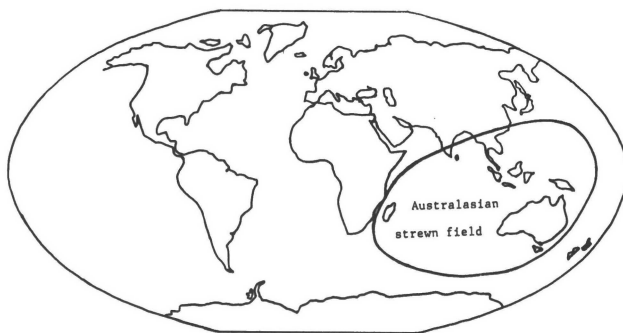


Figure 5. Approximate boundary of the Australasian tektite strewn field [22,p.395].

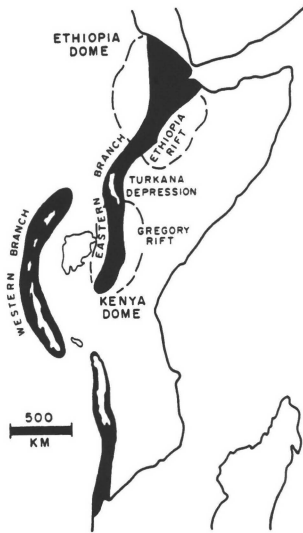


Figure 6. Sketch map of the East African Rift system. Black shows the extent of Cenozoic rifting; white shows major rift lakes [29,p.433].

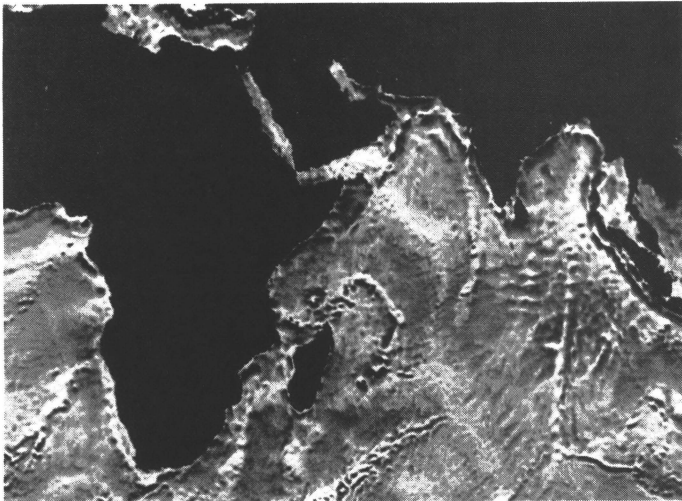


Figure 7. SEASAT - derived gravity anomalies in the Western Indian Ocean [9,p.11,989].

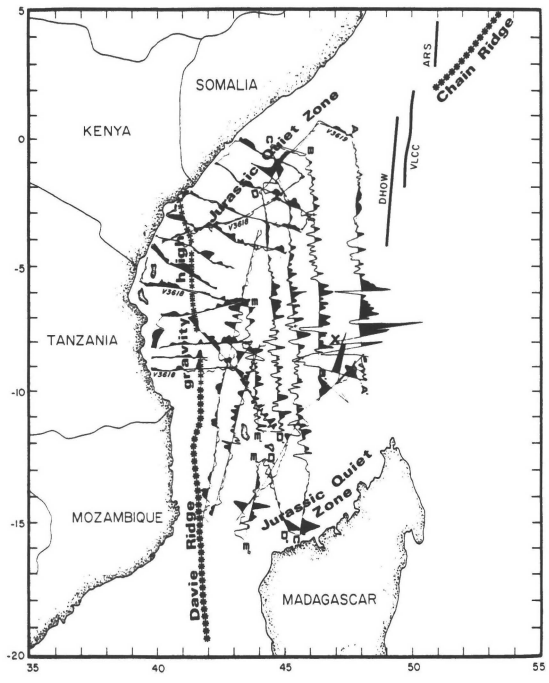


Figure 8. Magnetic anomalies in the Western Somali Basin [11,p.9392]. Note Wilkes Rise (X).

