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Study on the Relationship Between Deccan LIPs and Chicxulub Crater Based on "Collisions Aggregation Effect"

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Abstract: Based on the previous studies, the author has proposed that the "Collisions Aggregation Effect" by the impact of a celestial body in the geological academic circles, which can lead to the endogenic process of the "collisions aggregation point", the formation of volcanic eruptions and even the formation of LIPs. According to the principle of physics, this article further theoretically enriched the content of "Collisions Aggregation Effect" on the previous work and put forward the linear "Collisions Aggregation Effect" and nonlinear "Collisions Aggregation Effect". On the basis of the global paleo-plate and paleogeographic data, this paper takes the Deccan LIPs and the Chicxulub crater as the research objects and conducts the research work based on the "Collisions Aggregation Effect". The main conclusions are as follows: 1. The main eruption time of the Deccan LIPs is 66 Ma, while the Chicxulub crater was formed at about 65 Ma in approximate time; 2. At 65 Ma, the Deccan LIPs are located at 35°S, 65°E, while the Chicxulub Crater is located at 20°N, 50°W, both of which have the characteristics of the distribution of nonlinear "Collisions Aggregation Effect" on the Earth; 3. A Severe meteorite impact occurred at the Chicxulub crater in the Gulf of Mexico, causing "Collisions Aggregation Effect", which may be an important reason for the formation of the Deccan LIPs; 4. The velocity vector direction of the Chicxulub meteorite may not be exactly pointing to the Earth's center, but is a little south-easterly direction; 5. Using the "Collisions Aggregation Effect" for the "impact point" or "collisions aggregation point" geographic location constraints, but also should taking into account the celestial body impact velocity vector direction; 6. May be precisely because of the meteorite impact and the Deccan LIPs formed by the "Collisions Aggregation Effect" of the Chicxulub crater impact caused the massive dinosaur-based mass extinctions at the 65 Ma of the K/T boundary and accelerated the Indian Plate drift.

Keywords: Deccan LIPs, Chicxulub Crater, "Collisions Aggregation Effect", Celestial Body Impact, K/T, Paleogeography

1. Introduction

Based on the previous studies [1], the author has proposed that the "Collisions Aggregation Effect" by the impact of a celestial body collisions in the geological academic circles, which can lead to the endogenic process of the "collisions aggregation point", the formation of volcanic eruptions and even the formation of LIPs [2-4]. The proposed hypothesis provides a new thought and direction to the research on the genesis of LIPs. In recent years, geologists both at home and abroad have made many achievements and understanding in the recognition of LIPs and the discovery of meteorite craters. According to Hartmann [5], the probability of the impact of various extraterrestrial materials in the history of the earth, that a craters larger than 20 km in diameter formed is about 0.36×10^{-14} km^2/a on the earth's surface, with an average diameter of about 30 Ma, but most of them are hard to discern due to the influence of later geological process. The number of craters currently discovered and identified in the world may reach hundreds of locations. With the application of new detection technologies, the number of craters may continue to increase. According to statistics by Ren Zhenqiu [6], the impact time of the 24 craters with diameter more than 25 km around the world at present, depends on their respective size with the boundary of the era, period, epoch or stage, that have a good corresponding relationship. And the 3 craters with a diameter of more than 160 km have the impact time of 65 Ma, 570 Ma and 1850 Ma, which respectively correspond to the boundary of the Mesozoic and Cenozoic, Proterozoic and Paleozoic, Paleoproterozoic and Mesoproterozoic; The 7

craters with the diameter of 54-100 km, of which the 6 occurred at the boundary of the period, the other one is not at the boundary of the period, but also fell in the boundary of a series of major geological events. Recent studies have revealed that it has formed four large igneous provinces (Emeishan LIPs, Siberia LIPs, Himalaya-Panjia LIPs and Deccan LIPs) in the Asian continent since the Late Permian [7]. However, there is no scholar has ever paid attention to the relationship between the meteorite impact events and the LIPs during the history of the Earth. What is the relationship? This article is based on the question and the "Collisions Aggregation Effect " under the premise that carrying out this research work. And under the work of the author, with the Chicxulub crater and the Deccan LIPs as the research object, on the basis of the global paleogeographic data about 65 Ma, it is concluded that 65 Ma ago, the Chicxulub crater and the Deccan LIPs are not in the symmetric point with the Earth as its center of symmetry in the ancient geography, but it is corresponding to the nonlinear " Collisions Aggregation Effect " proposed by the author; The formation of the time of the Chicxulub crater and the Deccan LIPs tend to be at the same time in general. So, The author believes that the relationship between the Chicxulub crater and the Deccan LIPs should have the following characteristics: 1. The two are approximate in time. Some studies have shown that the formation time of the Chicxulub crater is about 65 Ma [8], while the Deccan LIPs is about 66 Ma [9-11]. 2. The two have the characteristics of the distribution of nonlinear "Collisions Aggregation Effect" on the Earth; 3. The meteorite impact occurred at the Chicxulub crater in the Gulf of Mexico, causing the"Collisions Aggregation Effect", which may be the main reason for the formation of the Deccan LIPs. Does this relationship characteristics between the Chicxulub crater and the Deccan LIPs explain the practical and universal characteristics of the "Collisions Aggregation Effect" from the impact of a celestial body? Has it verified that the "Collisions Aggregation Effect" from the impact of a celestial body?

1.1. Deccan LIPs

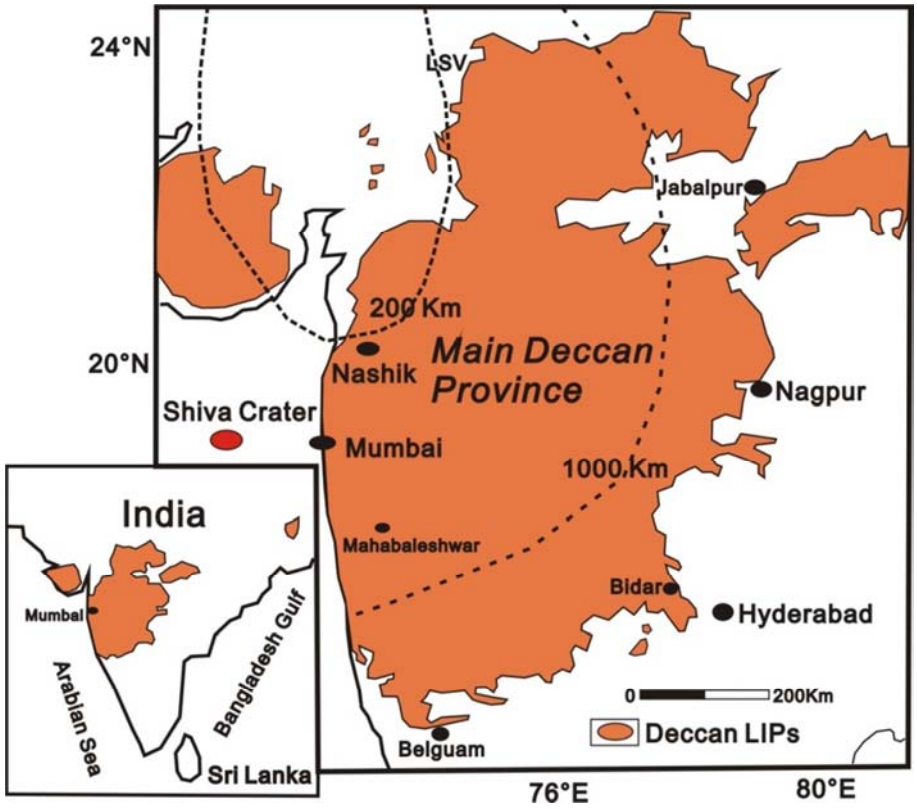


Figure 1. *Distribution of basalts in the Deccan large igneous province (Modified) [6], [24].*

In the Figure 1, the Deccan Traps or Deccan LIPs (DLIP) are a large igneous province located on the Deccan Plateau of west-central India (17°-24°N, 73°-74°E) and are one of the largest volcanic features on Earth. They consist of multiple layers of solidified flood basaltthat together are more than 2,000 m (6,600ft) thick, cover an area of c. 500,000 km^2 (200,000sq mi) [12], and have a volume of c. 1,000,000 km^3(200,000 cu mi)[13]. Originally, the Deccan LIPs may have covered c. 1,500,000 km^2 (600,000 sq mi) [14], with a correspondingly larger original volume. It is generally accepted that the Deccan LIPs were generated when the Indian continent moved northward to the Réunion mantle plume about 56 Ma ago [9-11]. The Deccan LIPs is mainly composed of the differentiation of tholeiite and a small amount of basaltic andesite. In addition, there is very little picrite, picrite basalt, alternating layers of rich potassium lava, differentiation

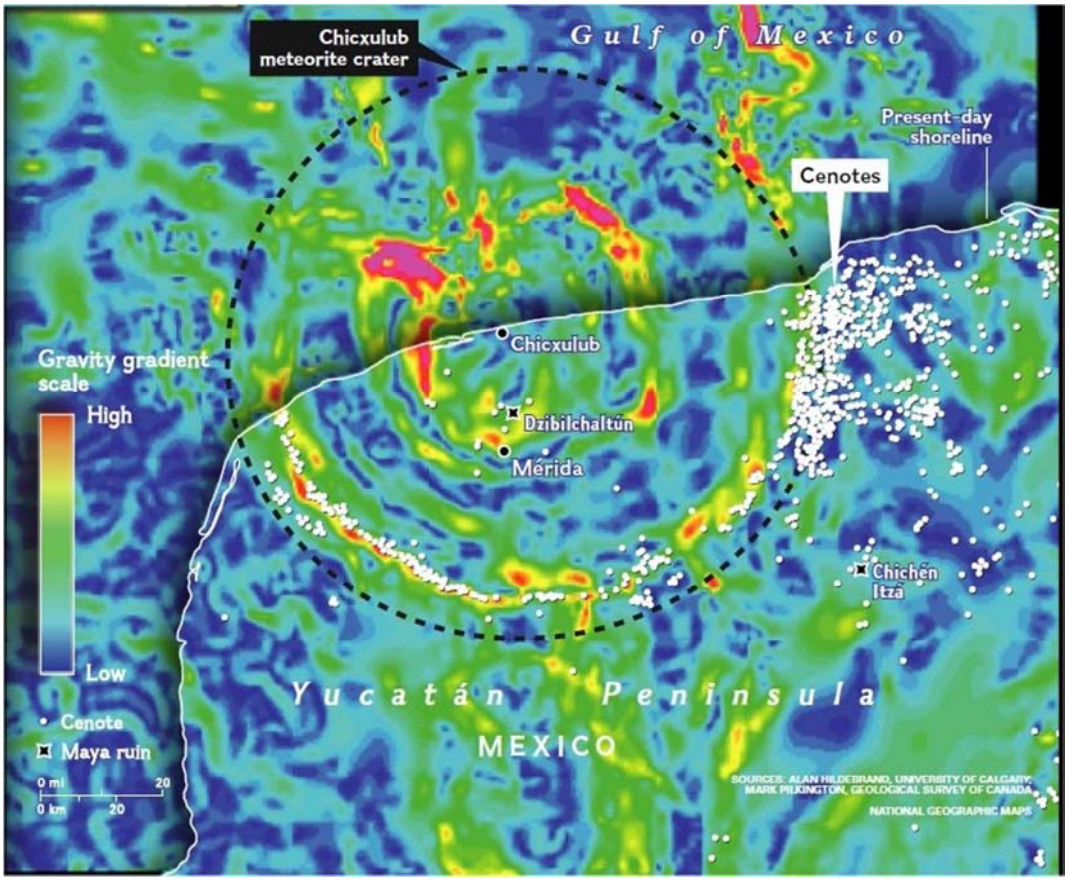
of felsic rocks and alkaline intrusive body. At present, the area of the Deccan LIPs distributed on land is about 5×105 km^2, and its original eruption volume is estimated to be 0.75-1.5×106 km^3. Due to the subsidence during the Cenozoic, the Deccan LIPs also have a large area of distribution in the offshore areas of western India. It is estimated that the initial area of Deccan LIPs is about 1.5 × 106 km^2. The basement of the Deccan Igneous Province consists mainly of the Archean and Proterozoic landmass, covered with young sediments. The Deccan LIPs are best known and widely discussed in all LIPs because of its main eruptions period along with the Cretaceous-Tertiary Boundary (KTB) [15-18]. The earliest (68 Ma) magmatism product of the Deccan LIPs was characterized by a small amount of alkaline volcanic rocks and intrusive rocks that occurred in the north [17] and gradually evolved into large-scale tholeiite lava eruptions in the Main Deccan Province. The flood basalts magmatism started at about 67 Ma and gradually moved from the north to the south, and the last flood basalts eruption occurred in the southern margin of the Main Deccan Province in the Early Paleocene (64 Ma) [18-19]. The rhyolitic, trachyte and basaltic eruptions (62-64 Ma) occurred in the Mumbai area [20-22], which developed in a newly formed shallow gulf. Due to the fall of the continental crust and seawater intrusion [23], the gulf was formed along the thinned margins of the Indian landmass before the final separation of the Seychelles-Mascarene microcontinent from the Indian landmass at 62-64 Ma [24]. Saundersren [25] suggested that the Deccan LIPs may start 67 Ma and end 61 Ma, but the main eruptive activity of the Deccan LIPs occurs between 66-65 Ma with a time limit of only 0.5-1 Ma.

1.2. The Chicxulub Crater

In the Figure 2, according to the Wikipedia, the Chicxulub crater is an impact crater buried underneath the Yucatán Peninsulain at the Mexico [26]. Its center is located near the town of the Chicxulub, after which the crater is named. It was formed by a impact from a large asteroid or comet about 10 to 15 kilometres (6.2 to 9.3 miles) in diameter [27], the Chicxulub impactor, striking the Earth. The date of the impact coincides precisely with the Cretaceous-Paleogene Boundary (K-Pg Boundary), slightly less than 66 million years ago, and a widely accepted theory is that worldwide climate disruption from the event was the cause of the Cretaceous–Paleogene extinction event, a mass extinction in which 75% of plant and animal species on Earth suddenly became extinct, including all non-avian dinosaurs. The crater is more than 180 kilometres (110 miles) in diameter and 20 km (12 mi) in depth, well into the continental crust of the region of about 10-30 km (6.2-18.6 mi) depth. It makes the feature the third of the largest confirmed impact structures on Earth, and the only one whose peak ring is intact and directly accessible for scientific research [28].

(according to https://www.ufochn.comthread-15306-1-1.html.jpg)

Figure 2. *The Chicxulub crater current location map.*



(according to https://en.wikipedia.org/wiki/Chicxulub_crater#cite_note-6)

Figure 3. *The gravity anomaly map of the Chicxulub crater.*

The crater was discovered by Antonio Camargo and Glen Penfield, geophysicists who had been looking for petroleum in the Yucatán during the late 1970s. Penfield was initially unable to obtain evidence that the geological feature was a crater and gave up his search. Later, through contact with Alan Hildebrand in 1990, Penfield obtained samples that suggested it was an impact feature. Evidence for the impact origin of the crater includes shocked quartz [29], a gravity anomaly, and tektites in surrounding areas (Figure 3). In 2016, a scientific drilling project drilled deep into the peak ring of the impact crater, hundreds of meters below the current sea floor, to obtain rock core samples from the impact itself. The discoveries were widely seen as confirming current theories related to both the crater impact and its effects.

2. “Collisions Aggregation Effect” of a Meteorite Impact

The author believes that the violent celestial body impact event can cause "Collisions Aggregation Effect" and form a large igneous province at the "collisions aggregation point"[2-4]. However, not every impact and the "Collisions Aggregation Effect" caused by a celestial body impact can create a magmatic activities, volcanic eruptions or LIPs, it may be determined by factors such as the size of the celestial body, the velocity, the direction of the impact velocity vector, and the geographical location of the impact point.

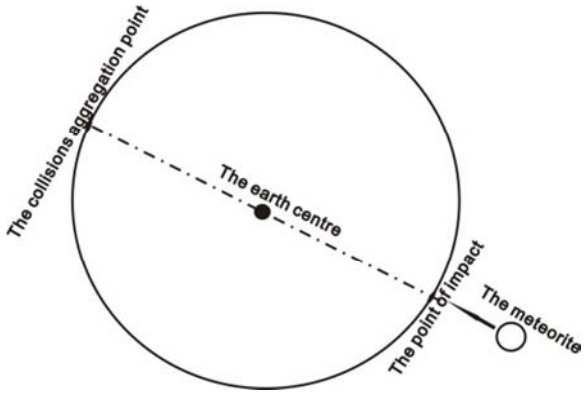
2.1. Linear "Collisions Aggregation Effect"

Figure 4a shows the "Collisions Aggregation Effect" of the vector of impact velocity of the celestial body pointing to the Earth's center. It shows the destruction of the two points "impact point and collisions aggregation point"[2-4], that due to the violent impact of extraterrestrial celestial bodies, and the "impact point, collisions aggregation point" and the Earth's center should be in a straight line. Due to the violent impact of the celestial bodies, the author believes that not only the "impact point" can cause a violent endogenic process and magmatism [30], but also the " collisions aggregation point " may create a violent magmatic activities and even a large igneous provinces. In Figure 4b, the author believes that when the impact velocity vector of the celestial body pointing to the Earth's center, the geographical relation of the two points "impact point and collisions aggregation point" should have the point-symmetric position characteristics of the earth's center on the earth, namely: latitude symmetry, and the meridian is the same. The author defines this feature represented by Figure 4a and Figure 4b above as the Linear "Collisions Aggregation Effect".

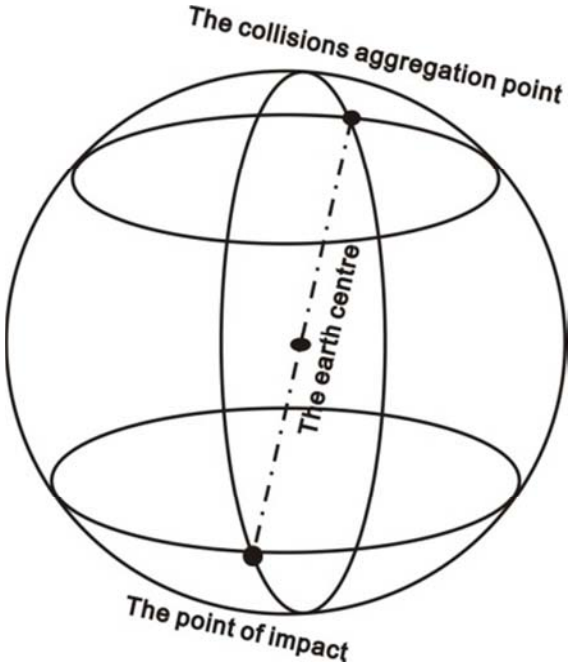
2.2. Nonlinear "Collisions Aggregation Effect"

In Figure 5, when the impact velocity vector of a celestial

body is not pointing to the Earth's center, the position of the "collisions aggregation point" may be "a" or "b" or "a" to "b" location, this feature is the Nonlinear "Collisions Aggregation Effect". If the velocity vector direction of the celestial body point to the center of the Earth, the linear "Collisions Aggregation Effect " is stronger at the "collisions aggregation point". During the history of the Earth, it is possible that most of the impact velocity vector of celestial bodies are not pointing to the Earth's centet.



a. Diagram of the "Collisions Aggregation Effect" of a meteorite impact



b. The geographical location of the two point

Figure 4. *A model of the linear " Collisions Aggregation Effect".*

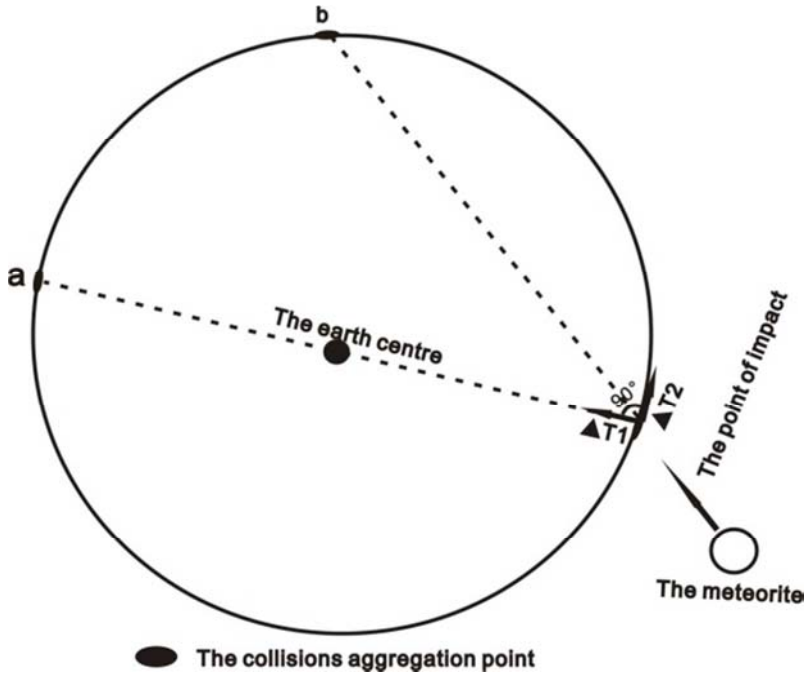


Figure 5. *A model of the nonlinear " Collisions Aggregation Effect".*

3. The Relationship Between the Deccan LIPs and the Chicxulub Crater

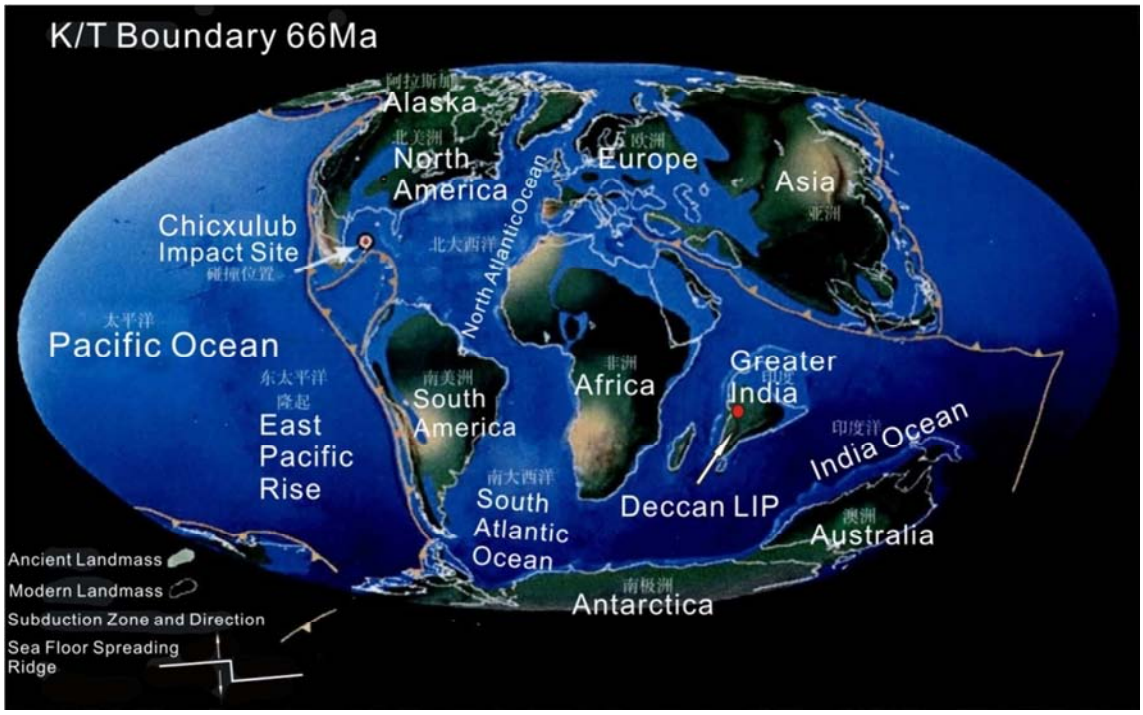
3.1. Time Relationship

The main forming time of the Deccan LIPs was 66 Ma [9-11], while the Chicxulub crater in the Gulf of Mexico formation time was about 65 Ma [8]. Therefore, the two have the approximate simultaneous relations.

3.2. Positional Relationship

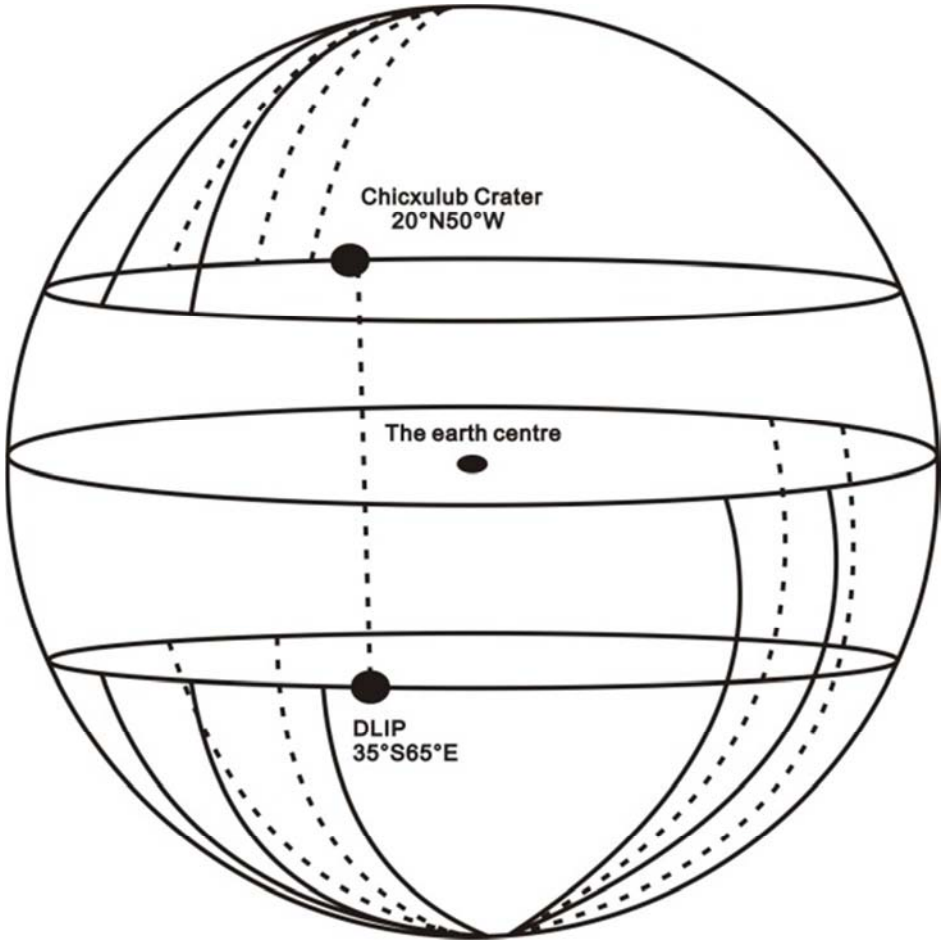
According to the research on the global paleogeographic restoration at the K/T boundary about 65 Ma, concluded that the Deccan LIPs were located at 35°S, 65°E, and the Chicxulub crater was located at 20°N, 50°W (Figure 6, Figure 7a) [31-32]. According to the Figure 7a, the author finds that the two locations do not have the distribution rule of the linear "Collisions Aggregation Effect", but similar to the nonlinear

"Collisions Aggregation Effect" (Figure 5).

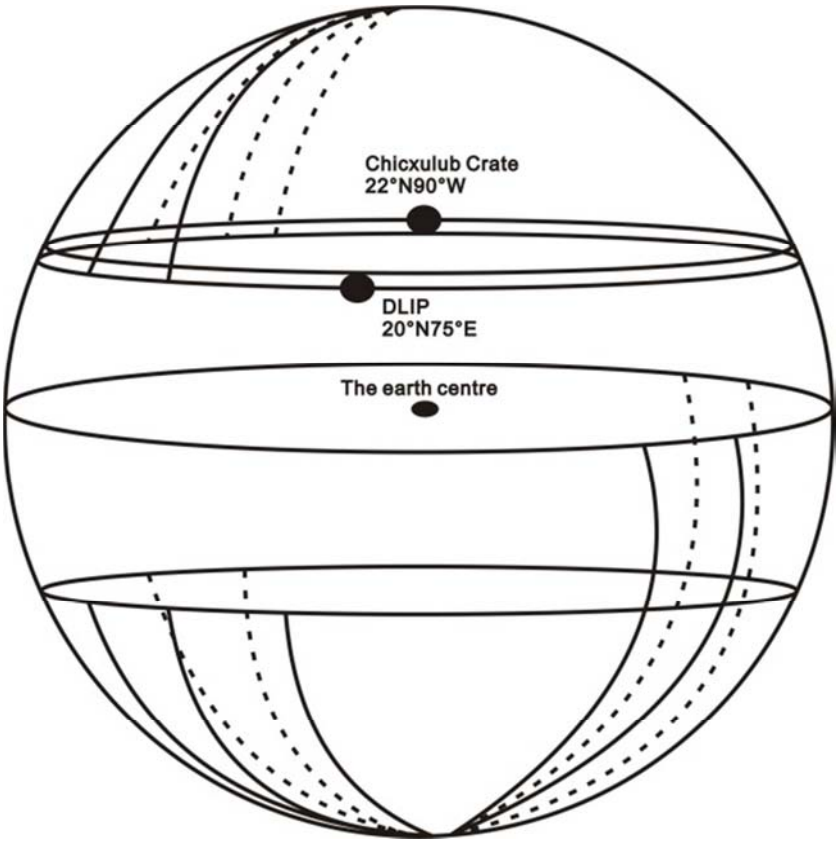


(according to http://www.bioon.com/popular/dili/89690.shtml)

Figure 6. *The global paleogeographic recovery map of the K/T Boundary.*



a. DLIP and Chixculub crater relative position diagram at the K/T boundary



b. Current relative position of the DLIP and Chicxulub crater diagram

Figure 7. *Deccan LIPs (DLIP) and Chixculub crater relative position diagram.*

At this point, consider that the relationship between the Deccan LIPs and the Chixculub crater is characterized by the following characteristics: 1. The formation time of the two is approximately simultaneity; 2. The two are spatially distributed in a nonlinear "Collisions Aggregation Effect"; 3. The "Collisions Aggregation Effect" caused by a dramatic meteorite impact at the Chicxulub crater in the Gulf of Mexico 65 Ma ago, which may be one of the important reasons for the formation of the Decan LIPs. 4. The velocity vector direction of the Chicxulub meteorite may not be exactly pointing to the Earth's center, but is a little south-easterly direction.

4. Discussion

Based on the above results, the author thinks the following points need to be discussed:

(i). The "Collisions Aggregation Effect" of a meteorite impact proposed by the auothor is a idealized model [2-4], the earth is assumed to be a standard sphere, and the impact velocity vector direction is pointing to the Earth's center, then form a distribution characteristic of the linear "Collisions Aggregation Effect"(Figure 4). In Figure 5, when the direction of the impact velocity of the celestial body does not point to the center of the Earth, the position of "collisions aggregation point" may be "a" or "b" or somewhere of the "a" to "b". In Figure 5, if the direction of the impact vector of a celestial body points to the Earth's center, the "Collisions Aggregation Effect" is stronger at the "collisions aggregation point", because the "▲T2" component is smaller, dispersed energy is smaller. However, based on the paleogeographical positions of the Deccan LIPs and the Chixculub crater, the author thinks the velocity vector direction of the meteorite hit the Chixculub 65 Ma ago may not be pointing to the center of the Earth but may be the southeastern direction and cause the decreases in longitude and latitude moves south at the "collisions aggregation point"(relative to the linear"Collisions Aggregation Effect"). For the celestial bodies that hit the Earth during the historical period, the directions of the impact velocity vector are not necessarily exactly pointing to the Earth's center, and not every impact and the "Collisions Aggregation Effect" caused by a celestial body impact can create a magmatic activities, volcanic eruptions or LIPs, it may be determined by factors such as the size of the celestial body, the velocity, the direction of the impact velocity vector, the components of the planet, the geographical location of the impact point and others. Therefore, it is difficult to strictly quantify the geographical position constraints of the "impact point" or "collisions aggregation point" using the "Collisions Aggregation Effect", and the resulting geographical location may not be unique or accurate. At present, about the simulated impact experiment which the velocity vector direction is not pointing to the Earth's center, the author has not collected related papers and experimental data and even has not carried out any relevant experiments. In this regard, the author will

continue to pay attention;

(ii). Using the "Collisions Aggregation Effect" to carry out paleogeographic restoration research on the "collisions aggregation point" or "impact point", it need to use the latitude and longitude data of higher accuracy. However, judging from the global perspective, the latitude and longitude data of the relevant landmass vary in their opinions and none is entirely credible. In particular, the restoration of the paleogeographic longitude at home and abroad is still difficult and no series of results have yet emerged. Therefore, this has a great impact on the author's research work, but also brings uncertainty to the author's research results.

(iii). The author noticed that there was a giant Shiva Crater distribution near the Deccan LIPs (Figure 1) and the impact time was almost exactly the same as that of the Deccan LIPs [33-34]. A. P. Jones [30] suggested that the violent celestial body impact could lead to the formation of the magmatism, volcanic eruptions and even LIPs at the "impact point". Therefore, the author believes that the impact event represented by the Shiva Crater may also be one of the reasons that lead to the formation of the Deccan LIPs.

(iv). At the K/T boundary period, around 65 Ma, a asteroid hit at 20°N, 55°W (the paleogeographic geographical location of the Chicxulub) and the impact point was located in the North Atlantic (Figure 6). There are reports that at 65 Ma there is a large area regression, a decline in sea level and a significant warming of the ocean [35-36], the author thinks this may have a direct relationship with the impact point exactly in ocean [37];

(v). It has been reported [38] that the Indian Plate drifts suddenly to a very rapid rate of about 20 cm/a after about 65 Ma at the K/T boundary [39]. At this juncture of time, the author had to be reminded of the relationship with the celestial body impact incident. And thinks that there are two kinds of situations if the velocity vector direction of celestial body impact does not exactly point to the Earth's center in Figure 5: (1) When the velocity vector direction of the celestial body exist in a velocity component (▲T2) which is consistent with the sense of rotation of the Earth, it will speed up the Earth's rotation speed; (2) When the velocity vector direction of the celestial body exist in a velocity component with opposite direction of the Earth's rotation speed, it will slows the Earth's rotation speed. Through the paleogeographic restoration research, the author believes that the velocity vector direction of the celestial body that hit the Chixculub 65 Ma ago should not be pointing to the Earth's center, but may be in the southeastern direction and with a velocity component to the eastward direction speed up the Earth's rotation. When accelerating the Earth's rotation speed, the Plate drift speed will be accordingly accelerated? The Deccan LIPs caused by the "Collisions Aggregation Effect" of the Chicxulub impact will also be the driving force to promote the Indian Plate to speed up the drift? In addition, the Shiva Crater impact incident will also prompt the Indian Plate to speed up drift?

(vi). At the K/T boundary period, about 65 Ma, the occurrence of mass extinction event, the dinosaurs cluster-based extinction, and also provided a lot of evidence [40]. At this point, the author believes that the corresponding evidence shows that there may indeed be a celestial body impact incident, the impact point may also be located in the Chicxulub crater. However, for those creatures extinct with dinosaurs as the main species, they were not extinct in a flash and should also have a great relation with the Deccan LIPs caused by the "Collisions Aggregation Effect" of the Chicxulub crater impact.

5. Conclusion

Combined with the full text of the research results, the author came to the following understanding:

(i). The main eruption time of the Deccan LIPs is 66 Ma, while the Chicxulub crater was formed at about 65Ma in approximate time; (ii). At 65Ma, the Deccan LIPs are located at 35°S, 65°E, while the Chicxulub Crater is located at 20°N, 50°W, both of which have the characteristics of the distribution of nonlinear "Collisions Aggregation Effect" on the Earth; (iii). A Severe meteorite impact occurred at the Chicxulub crater in the Gulf of Mexico, causing "Collisions Aggregation Effect", which may be an important reason for the formation of the Deccan LIPs; (iv). The velocity vector direction of the Chicxulub meteorite may not be exactly pointing to the Earth's center, but is a little south-easterly direction; (v). Using the "Collisions Aggregation Effect" for the "impact point" or "collisions aggregation point" geographic location constraints, but also should taking into account the celestial body impact velocity vector direction; (vi). May be precisely because of the meteorite impact and the Deccan LIPs formed by the "Collisions Aggregation Effect" of the Chicxulub crater impact caused the massive dinosaur-based mass extinctions at the 65Ma of the K/T boundary and accelerated the Indian Plate drift.

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Biography

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