Journal of Environmental & Earth Sciences
https://journals.bilpubgroup.com/index.php/jees

ARTICLE

An Asteroid Impact Event Forming the Intercontinental Geomorphology from East Asia to North Africa, and More

Yanju Wei[1,*], *Yajing Yang*[2], *He Liu*[1]

[1] *School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an 710049, China*
[2] *School of Aerospace Engineering, Xi'an Jiaotong University, Xi'an 710049, China*

ABSTRACT

From the perspective of the thin shell droplet dynamics and based on the geographical and morphological data of the vast area from east to west Asia, this study suggests a tangential impact event of a quartzite asteroid with 430km diameter which may explain the formation of all basins, plateaus, mountains, Gobi and deserts northeast from the Outer Mongolia East Gobi Province and southwest to the Sahara Desert and connect the series of the huge geomorphic formation event with a homologous and sequential formation process. On this basis, a "continent formation theory" is proposed that continent and mountain are formed from the cooling of lava surge flow, and the new continental movement and structure was thus explained as well.

Keywords: Asteroid impact event; Tarim basin; Tibetan plateau; Iranian plateau; Continental formation hypothesis

1. Introduction

Started in the 1960s, the plate tectonics is a basic geological theory once considered as a great revolution in the earth science, however, with the continuous discovery of new scientific facts, the problems and defects of plate tectonics have been increasingly revealed. With the ongoing researches of astronomy, geography and biology [1, 2], an earth system science thought was put forward [3], scientists realized they must went beyond the plate structure, with system theory, transformation theory and evolution theory to study the tectonic, to "take the Earth's various spheres, including

*CORRESPONDING AUTHOR:
Yanju Wei, School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an 710049, China; Email: weiyanju@xjtu.edu.cn

ARTICLE INFO
Received: 18 July 2024 | Revised: 30 August 2024 | Accepted: 4 September 2024 | Published Online: 20 September 2024
DOI: https://doi.org/10.30564/jees.v6i3.6899

CITATION
Wei, Y., Yang, Y., Liu, H., 2024. An Asteroid Impact Event Forming the Intercontinental Geomorphology from East Asia to North Africa, and More. Journal of Environmental & Earth Sciences. 6(3): 111-123. DOI: https://doi.org/10.30564/jees.v6i3.6899

the atmospheric sphere, hydrosphere, biosphere, lithosphere and the earth as a whole, with the four dimensional and evolutionary perspective of time and space" and "emphasis to study the process of tectonic evolution from the global dynamics, to consider not only the earth itself, but also the influences of the cosmic factors" [2].

According to this theory, the formation of the plateau is generally interpreted as the collision and uplift of the plate. The Tibetan Plateau is known as the "Roof of the World" and the "Third Pole". It is currently believed that its formation is mainly due to the collision and extrusion between the Indian Ocean plate and the Asian-European plate about 240 million years ago. The South Asian subcontinent crashed into the Eurasian continent, thus raising the earth's crust and gradually forming the Tibetan Plateau. Due to the extrusion, the Kunlun Mountains, the Qilian Mountains in the north and the Hengduan Mountains in the east. The Iranian Plateau, on the other hand, is regarded as the terrain formed by the collision between the Indian plate and the Eurasian plate. Many other plateaus are also generally interpreted as plate collisions. Plate drift can reasonably explain the formation of some of the mountains, such as the Cordillera Mountains in North and South America. Because the width of the mountains is much smaller than the length, they were created by the collision of the Pacific plate and the Atlantic plate. But geological monitoring suggests that the Pacific plate is separating from the American plate. Moreover, it is a little difficult to explain the formation of the semi-circular Tibetan Plateau with plate collisions.

Suspended in space, the earth is essentially a large thin crust lava droplet, the crust produced by the outer layer of magma with an average thickness of 17km with the ocean of 6km and the continent 35km, and the thickest crust is 70km at Tibetan Plateau. From the scale of human activities, the thickness of the crust is far beyond the limit of human excavation, and its average thickness is only 0.5 ‰ to 2.7 ‰ of the diameter of the earth (12800km). As a result, the crust can not actively restrain the movement of the lava flow inside the earth, but can only passively follow the internal flow to produce the corresponding movement. The crust is the result of lava flow and radiative cooling of the surface, so the various surface forms are also closely related to lava flow.

From the perspective of fluid dynamics of thin shell droplets, this study proposes a new geological structure theory named "Gushing Lava Oriented Mountain and Continent Formation Hypothesis (GLOMCFH)". Using an asteroid impact event, this hypothesis can provide a unified interpretation to the large topography and the formation of the geological structure east from the Mongolian plateau, north to the Hinggan Mountains, Yabilonov Mountains, Lake Baikal, Sayan ridge, Tannu-Ola Mountains, west to the Sahara desert area. Finally the GLORLGH is proposed, and the origin of the mountains, island chains and ridges along the Pacific Rim is further explained.

2. Impact process of the asteroid

The topography of central and western Asia is highly related, the entire line from the Mongolian Plateau, Altai Mountain, Tianshan Mountain range, Tarim Basin, Tibetan Plateau, Iranian Plateau to the Sahara is dominated by arid landforms such as Gobi, mountains and deserts. The current explanations of this landform are mainly caused by the Indian plate colliding with the Eurasian plate, and the Mongolian Plateau is believed to be a by-product of the uplift of the Tibetan Plateau. Including the formation process of large mountain ranges on other continents, which is mainly caused by plate drift and collision. However, the impact of the Indian plate's collision with the Eurasian plate extends 3,000 km to the shores of Lake Baikal, about 100 times the thickness of the Earth's crust, making it difficult to comprehend. More importantly, why did the stable, primordial continents suddenly start moving so much? The theory of plates does not provide a reasonable explanation of the original driving force of this plate drift. Based on the analysis of the morphology and trend of the large-scale landforms of intercontinental landforms, this paper tries to connect many typical landforms with an asteroid impact event, and gives a unified and reasonable explanation.

2.1 Tarim basin

The Tarim Basin occupies the central position of arid landform. According to the traditional theory, the Tarim Basin became the inland basin today mainly because of the Indian plate colliding with the Eurasian plate. Under the impact of the Indian plate, the Tibetan Plateau and the Tianshan Mountains experienced a dramatic uplift, while the geologically hard Tarim platform did not undergo significant uplift, and eventually formed today's Tarim Basin. But by observing the trend of Tarim Basin and its northern mountains, we can understand its formation process from another perspective.

As shown by the black dotted line in **Figure 1a**, the trend of the mountains on the edge of the Tarim Basin is roughly elliptical, while the edge of the Taklimakan Desert inside the basin is a standard ellipse. The southeast and southwest sides are cut by two chords, and the corresponding trend of the Kunlun Mountains is the same. The corresponding Angle of the two chords is about 90° and 60° respectively. The northern side of the basin is bordered by the Tianshan Mountains. In addition to the arc-shaped mountain ranges surrounding the basin, there are also parallel subsidiary ranges running northwest to southeast. These features are all typical traces of meteorite impact craters. **Figure 1b** shows the simulation results of a spherical rocky asteroid with a diameter of 1 km impacting the ground at an angle of 5° and a velocity of 8 km/s [4]. The elliptical impact crater formed by the collision, along with the surrounding circular mountain belt and radial mountain ranges, exhibits a similar pattern to the Tarim Basin. This indicates that the formation of the Tarim Basin and the Tianshan Mountains can be attributed to an asteroid impact event.

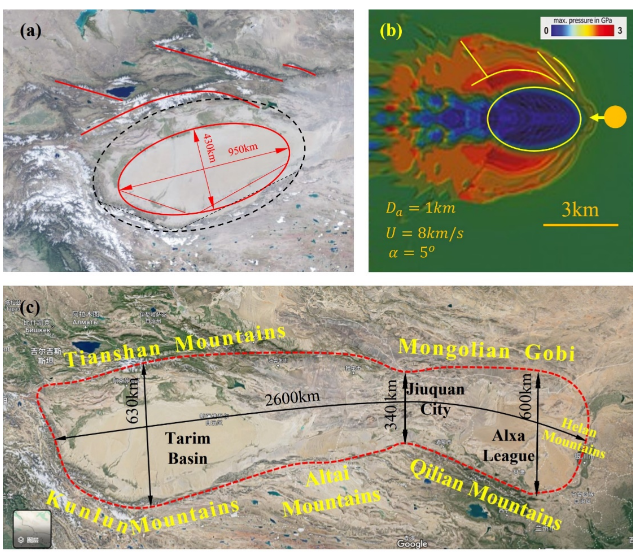


Figure 1. (**a**) The contour of the Tarim Basin and the orientation of its northern mountain range. (**b**) Numerical simulation results of asteroid impacts [4]. (**c**) The range of asteroid impact craters and "plow furrows".

The difference between the two is that the left side of the elliptical impact crater in **Figure 1b** has a large blue secondary impact crater formed by the secondary impact after the asteroid bounce, but the west side of the Tarim Basin does not have, which depends on the size of the asteroid. According to the estimated diameter of the short axis of the black and red ovals in **Figure 1a**, the diameter of the asteroid forming the Tarim Basin can reach 430km–630km, which is much larger than the thickness of the crust, and the asteroid eventually broke through the crust and sank into the mantle.

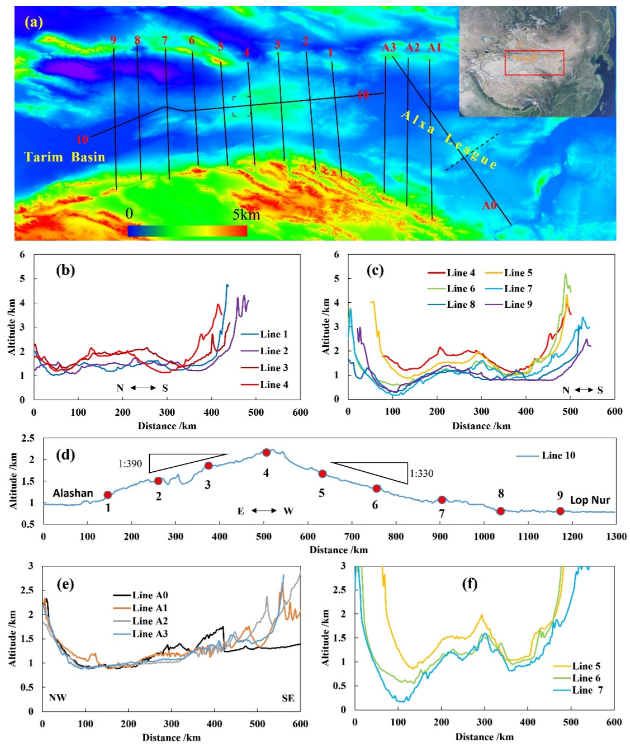


Figure 2. The elevation characteristics of impact craters in the Alashan-Tarim Basin.

2.2 The large "ploughed furrow" in Alxa

The asteroid entered the Tarim Basin from east to west at a very small angle of incidence, and the planet formed a huge strip-like "ploughed furrow" and impact crater across the ground. As shown in **Figure 1c**, the crater starts from the Helan Mountains in the east and ends in the Kashi section of the Kunlun Mountains in the west, and is surrounded by two parallel mountain belts in the north and south, such as the Tianshan Mountains—Mongolian Gobi and the Kunlun Mountains—Aljinshan Mountains—Qilian Mountains, forming a huge "ploughed furrow" from the Alashan League in the east to the Tarim Basin in the west. The furrow spans 2600km, is about 600km wide and 340km at its narrowest point, and is located in Jiuquan City, Gansu province.

Figure 2 shows the elevation characteristics along the "ploughed furrow" axis (Line 10) and the vertical lines (lines A0–A3 and 0–9).As can be seen from **Figure 2b,c**, the profile of the "ploughed furrow" is in the shape of "W" as a whole, with a corrugated bulge in the middle, reflecting the outline of the contact surface at the bottom of the asteroid. The elevation along the east-west direction (from Line 1 to Line 9) shows a pattern of initially ascending and then descending heights, exhibiting a uniform trend of both upward and downward changes, as shown in **Figure 2d**. The ascending segment has a slope of approximately 1:390, while the descending segment is steeper with a slope of 1:330. The labeled red dot represents the intersection of Lines 1–9 and Line 10, as shown in **Figure 2a**.

The cross section of Alashan is similar to that of Jiuquann-Lop Nur section of "ploughed furrow", as shown in **Figure 2e**, which also presents the characteristics of a stretched "W" section, and the inclined A0 line cross section shows the "M" shaped mountain range between Badain Jaran Desert and Tengger Desert. Comparing the "M" mountain contour with the "M" bump of "ploughed furrow" in **Figure 2f**, the similarities can be observed.

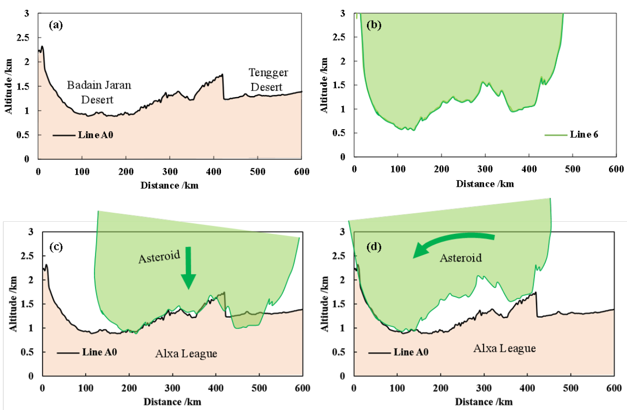


Figure 3. Comparison of the bottom profile of the asteroid and the cross-sectional profile of the Alashan region.

As shown in **Figure 3**, by comparing the contours of line 6 and line A0, it can be found that the bottom contour of the asteroid (the "ploughed furrow" contour) is not only in good agreement with the contour of the "M" shaped mountain of Alxa, but also the edge contour of its north side (left side) is completely consistent. This indicates that the edge contour and surface features of the Alxa League and the "ploughed furrow" are caused by the same object, namely the impact and scratches of the asteroid. Combined with the longitudinal elevation features of the "ploughed furrow" in **Figure 2d**, it can be concluded that the asteroid made a landing impact in Alxa, then slightly jumped about 1km and continued to slide westward, eventually sinking into the Tarim Basin.Notably, line A0 is not parallel to line 6, suggesting that the asteroid's motion was shifted to the right at the time of impact, or that Earth was deflected to the left.

2.3 The "ploughed furrow" group in Northwestern China and Mongolia

The Alxa League serves as the final landing point for the asteroid, and tracing its path backward reveals a massive desert corridor extending from Alxa to the direction of Mount Sainshand in Mongolia, as indicated by the rectangular area labeled "A" in **Figure 4**. This corridor represents the trace left by the asteroid as it passed over the region. It intersects with "ploughed furrow" A and "ploughed furrow" B until it extends in a straight line near Hami. In addition, there are a number of large "furrows" (numbers 1–4) running northwest to southeast, and parallel ground marks on the west side of Alxa. Furrow extensions 1 and 2 end in lakes in western Mongolia. It can be seen that there are circular or oval craters around Lake Usub and Lake Sagir. Furrows 3 and 4 point to the quasi-Geer Basin, furrows 5 and 6 are slightly curved, and furrows 7 and 8 are parallel lines.

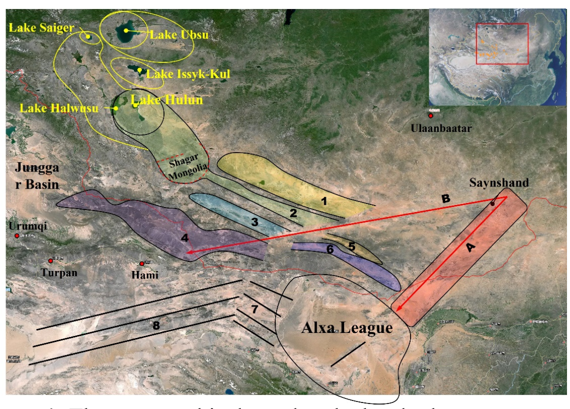


Figure 4. The topographical trend at the border between Northwestern China and Mongolia.

2.4 Asteroid impact process

Taking into account the topography of the Tarim Basin, the Alxa "ploughed furrow", the Alxa League, and the large number of furrows and lake groups shown in Figure 4, we can boldly construct a giant asteroid impact process. As shown in **Figure 5**, an asteroid with a diameter of 430km–630km rushes towards the Earth at a very small Angle from northeast to southwest. During the landing process, the loose star shell is stripped by the atmosphere, forming a large amount of sand and dust floating in the atmosphere.Its dense core first made contact with the ground in Hulunbuir City, but after a slight scrape, it flew up again, and then hit the ground near Saiyinshanda-Erenhot. At least three large fragments were chiselled from the star core by the impact of Saiyin Shanda Mountain in Eastern Gobi Province of Outer Mongolia, and they all moved towards Hami along line B in **Figure 4**.

The main part of the star core continues to jump and slide forward, forming a huge rocky Gobi corridor from the Alashan Right Banner in the west to the Gobi Province in outer Mongolia in the east. In the process of sliding, dust from the core falls along the way, forming the Loess Plateau. The core of the star landed on the missing surface of the Alashan League, and the huge impact formed the Badain Jaran Desert and the Tengger Desert of the Alashan League, and its forward thrust line formed the Qilian Mountains.

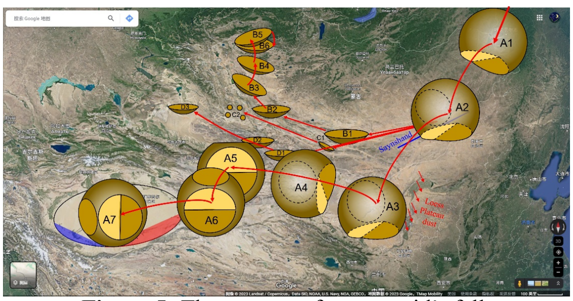


Figure 5. The process of an asteroid's fall.

The diameter of the asteroid is 500km, the velocity is 7.9km/s, and the density of the rock material is 3000kg/m^3. It is estimated that the kinetic energy of the asteroid is about 1×1028J, which is 5% of the kinetic energy of the earth's rotation (2×1029J), which is enough to drive the crust movement and even change the rotation attitude of the Earth. Considering that the asteroid landing line roughly landed along the "Hulun Lake Alashan-Tarim" line, and the line produced a clockwise deflection of about 70° in Alashan (the Angle between line A and line family 1–7 in **Figure 4**), and then turned counterclockwise about 35° (the Angle between line family 7 and line family 8 in **Figure 4**), and finally the overall path of the asteroid produced about 35° counterclockwise deflection.Since fragments 1–4 were deflected in the same direction as the asteroid's remnant core, it should be considered that the instantaneous rotation of the Earth caused this. The asteroid's landing in the Alashan League making the Earth to undergo an instantaneous counterclockwise rotation of 70 degrees, followed by a subsequent reversion of 35 degrees., Causing the diversion of Lines 7 to 8 family.

As a result, we can roughly predict the debris movement trajectory of "ploughed furrow" No. 1–4 in **Figure 4**: Debris No. 1 or No. 2 should be disk-shaped debris, which glided forward after landing in Shagar area of Mongolia, and finally fell into Ubusu Lake after continuously flipping over Har Lake and Kyrgyz Lake. The debris eventually landed first on the western side, followed by a collapse on the eastern side, forming two elliptical basins, both centered on Lake Usub, where the debris may have melted or sunk into the mantle, as shown by the path of debris B in **Figure 4** and **Figure 5**. Fragment 3 eventually broke up into meteorites along the C1–C2 route. Debris 4 followed a D1–D2 path to land in the Junger Basin, but the topography of the Junger Basin does not reflect the ultimate fate of the debris, whether it broke up, disintegrated, or sank into the mantle.

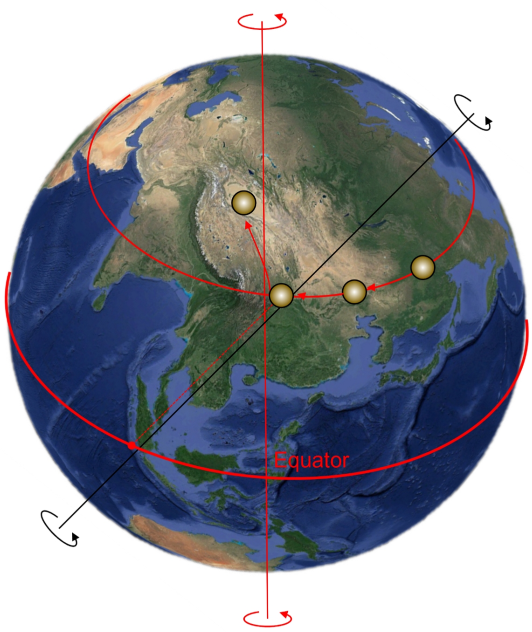


Figure 6. The original orientation of the Earth.

Since the direction of the asteroid's motion has not changed, while the Earth has been deflected, and now the Alxa-Tarim direction is roughly east-west, we can reasonably assume that the asteroid is an inner solar system planet, which fell into the Earth from the east to the west of the original Earth, with an incident latitude of about 32° north latitude. The rotating posture of the primordial Earth is shown in **Figure 6**, with its North Pole in the Berlin-Copenhagen region. Tilt of the earth after a posture adjustment, eventually make the earth's axis stability in today's 23.5° deflection position.

After the star core landed in the Alxa League, the Earth tilted, it bounced up again and continued to roll westward, fell again in Jiuquan City, crossed Lop Nur, crushed the crust on the east side of Lop Nur, and gradually sank into the mantle to form the oval Tarim Basin, as shown in **Figure 1a**. The Mongolian debris caused the spheroid surface to form two bow regions with spheroid angles of about 90° and 60°, respectively. Considering the relative positions of the "Hami-Turpan" furrow and Kuluktag Mountain, the star core may have tilted southward or fallen forward at a small Angle after receiving the North Tianshan Mountain. Thus, a transfer occurred from position A4 to position A5 as depicted in **Figure 5**.

In short, "Buzhou-Shan" asteroid bounced and rolled through Hulunbuir, Mongolia's East Gobi, Alashan League, "Hami - Turpan" furrow four times before finally plunging into the mantle in the Tarim Basin.

It is worth mentioning that during the landing process, A large number of debris continued to fall on the star core, as shown in **Figure 7**. Along the northern side of the Gobi corridor A-"Alxa-Tarim" ploughed furrow as depicted in **Figure 4**, and the two paths of the mountain ridges between the 3rd and 4th "ploughed furrows", a regular distribution of 52 small meteorite crater-like landforms was observed. The locations and characteristics of these landforms are presented in **Appendix A**.

3. Formation of the large geological features and landform

As shown in **Figure 8**, the impact, rolling and sinking of the asteroid kernel lead to five direct consequences: (1) The Earth axis was tilted by 23.5°;(2) Formation of the strip extrusion mountains (illustrated as blue lines and curves), including the Qilian Shan Mountains, Altun Shan Mountains, western section of Kunlun Shan Mountains and Tian Shan Mountains and their affiliated mountains and the affiliated mountains; (3) Extrusion of mantle magma in the front of the asteroid kernel, forming a western lava lake (illustrated as a pink crescent area), which flowed west from the Alataw Pass and filled the ancient Aral Sea and part of the Caspian Sea, forming the majority of the current territory of Uzbekistan and Turkmenistan; (4) When the core sank, some of the disintegrated fragments fell into the southeast region, and its shock wave formed the Qaidam basin floor, the eastern section of the Kunlun Mountains and the Burhanbuda Mountains.(5) After the asteroid sank, the magma in the central area of Tibetan Plateau gushed to form a vast volcanic rocky area due to the increased mantle pressure. The magma lake cooled faster on the south side, so to form the cambered Himalayas Mountains. While on the north side where just after the orogenic events, the magma cooled slower due to the higher ground temperature. Part of the hot magma flowed eastward to form the cambered eastern edge of the Tibetan Plateau. Since the cambered edge cooled faster, it blocked the subsequent magma and induced the magma to flow southward all the way down to southeast Peninsula, forming the Yunnan-Guizhou Plateau and Hengduan Mountains. Another part of the magma flowed westward via the Pamir Plateau all the way down to Mediterranean Sea at eastern Turkey, forming the Iranian Plateau and Armenia Highland.

It can be inferred that the ancient Aral Sea, Caspian Sea, Black Sea, Mediterranean Sea and the Indian Ocean were all integrated before the impact, and even Tibetan Plateau and Qinghai Lake were also a part of the ancient Indian Ocean. This is why, as inland lakes, the Aral Sea, the Black Sea and the Qinghai Lake are all saltwater lakes.

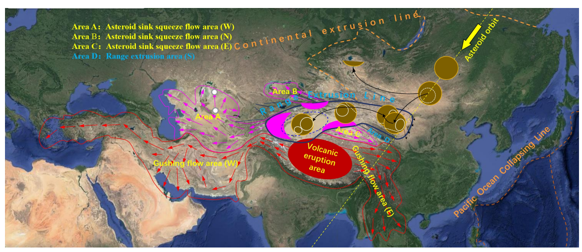


Figure 8. The geology caused by the great collision of the asteroid.

Due to the large size of the asteroid, the impact moved the whole China continent northwestward, forming a continental extrusion line bordering the Outer Hinggan Mountains, Jablonov Mountains, Lake Baikal, East and West Sayan Mountains and Tannu-Ola Mountains. A lake chain lays along the extrusion line, extending from the Lake Aydarkul (lagon) in Uzbekistan, the Balkhash Lake (lagon), Lake Allah (lagon) and Zaysan Lake (fresh) in Kazakhstan, Lake

Figure 7. The location of meteorite impact and the morphology of the impact crater.

Issyk-Kul in Kyrgyzstan, to the Uvs Nuur and Hovsgol Nuur at the west Outer Mongolia, and finally to the Lake Baikal in Russia. The vast area of the lake chain may also be integrated with the ancient Indian Ocean. The impact may put the China continent westward and trigger a general sank of the South China Sea, the Sea of Japan and even the Pacific Ocean.

4. Stardust settlement process

The impact asteroid had a relatively loose sandstone shell and a dense kernel. Most of the sandstone shell were almost stripped off into the atmosphere, and the tiny burnt stardust settled and moved forward, as shown in **Figure 9**, forming the Sahara, Arab, Afghan and Central Asian deserts. The huge impact force and the scraping when the asteroid kernel hit and slid on the Earth generated a strong erosion effect on the ground, which removed the ground soil, formed the vast Gobi desert from east Outer Mongolia to Xinjiang Region in China. During the rolling process, the remaining soft sandstone on the kernel to form the Loess Plateau. The vast arid ellipsoidal region circled in **Figure 9** from eastern Outer Mongolia to West Africa are the remains of the asteroid's loose shell.

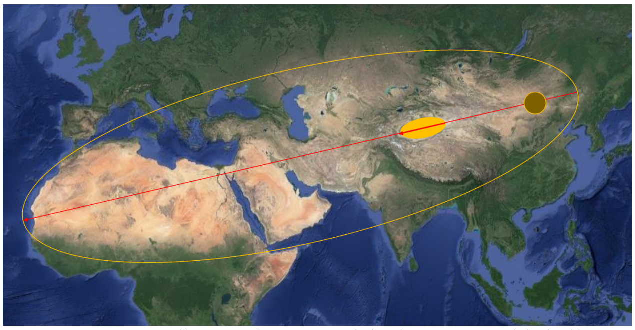


Figure 9. Sedimentation area of the loose asteroid shell.

Considering that the Mongolian Cap was a spherical cap or disk fragment, it is speculated that the material of the asteroid is mainly anisotropic quartzite, which is consistent with the above desert sand. And this can also explain the large number of scattered molten rock blocks in the Outer and Inner Mongolia and Xinjiang Gobi desert, namely agates, jades, and various strange rocks.

This devastating impact of heaven and earth, almost in an instant, is likely to bring about significant changes in the Earth's axis, "Gonggong angrily collides with Buzhou-Shan" is likely to refer to this impact event. The Chinese ancestors living in the Central Plains witnessed the planet roaring through the sky, followed by an overwhelming amount of sand, wind and mud, earthquake and tsunami followed. The core area of Chinese civilization fortunately escaped this super natural disaster, as the experience of this historical event, the Chinese ancestors engraved this extremely shocking historical event in the genes, handed down to the present. Therefore, this paper named the asteroid "Buzhou-Shan".

The asteroid impacted at least at the first cosmic speed of 7.9 km/s. It landed from Hulunbuir and finally rolled to the eastern side of the Tarim Basin, with a landing distance of about 2000km, so it could be estimated that the landing took at most 253s. Since the maximum flow rate of lava is 65 km/h, and the lava lake from the kernel sinking flowed to the farthest distance about 2000km into the Caspian Sea, so the sinking time of the asteroid kernel was about 30h. The stardust peeled off the kernel mainly landed in the Sahara desert with a distance of about 13,000 km, so it could be estimated that the landing process only took about 30 min. The volcanic lava flow of the Tibetan Plateau reached as far as the Mediterranean Sea with a flow distance of about 5500km, so the rise of Tibetan Plateau took at least 85h.

The hot dust falling all over the sky buried all the land instantly, turning the primordial forests in Shanxi and northern Shanxi Provinces into coal. The magma contained large amount of natural gas and oil, which flowed into deposited in central Asia, Caspian Sea and the Persian Gulf. There is also a quartzite asteroid remains below the Tarim Basin, which causes the gravity [5, 6] and the magnetic [7–9] anomalies. As shown in **Figure 10**, the whole basin is magnetically high, and the highest point on the western side of the basin is the final position of the asteroid kernel.

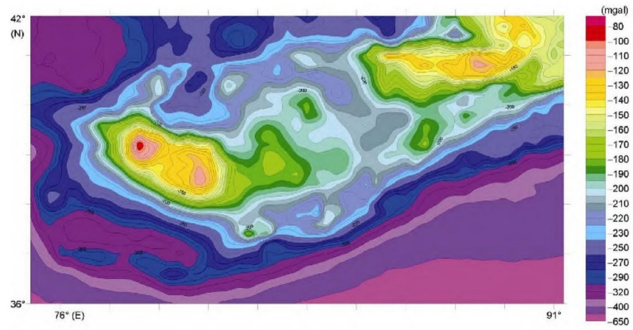


Figure 10. Bouguer gravity anomaly in Tarim Basin [5].

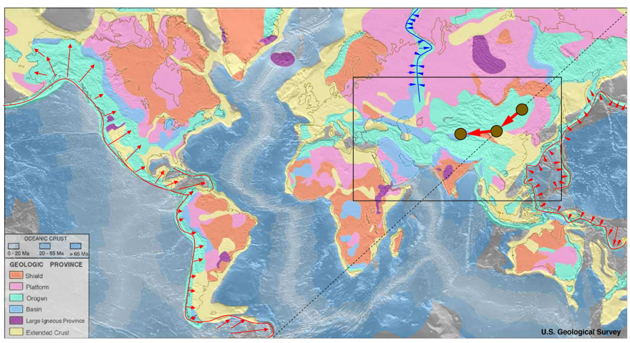
5. Continent formation hypothesis

The lithosphere is the thin stony shell of the huge lava droplet of the Earth planet floating on the liquid mantle, which may break due to the uneven distribution of gravity or thermal stress, or can be broken into multiple plates by foreign impacts. For the former reason, the Earth is stable, the crust and sequential plates cannot be violently drifted. According to the "plate tectonics", almost all the existing major geological events occurred during the split of Pangaea at 200 million years ago. The earth's rotating centrifugal force and the lunar attraction force are relatively stable, and they cannot provide the driving force needed for such sudden plate splitting and rapid plate drift. External forces should be introduced, such as the impact of an asteroid.

The magma emitted from the impact mainly formed the Tibetan Plateau and the Iranian Plateau. The total area of Tibetan Plateau is about 2.5 million km^2 with the average altitude about 4000 meters, so its total volume is about 10 million km^3; Iran Plateau area is about 2.7 million square kilometers with the altitude 1000∼1500 meters, its total volume is 2.7∼4 million km^3. Excluding the Pamir and Armenian plateau volumes (<1.5 million km^3), the total volume of lava flow is about 14 million km^3.

Based on the shape of the Tarim Basin, the diameter of the core impacting the ground is about 430km–630km, and the minimum volume of the core is [V=(π4303/6)=] 41.6 million km^3, ignoring the two spherical holes with center angles of 90° and 60° respectively. The volume of lava flowing out of the surface is only 33.7% of the volume of the core, except for the volume of the gusher used to create the plateau, the rest of the mass can expand the diameter of the Earth by 52m, which is enough to shatter the lithosphere.

Under the tangential impact of the asteroid kernel and the sinking pressure, the lithosphere cracked into several independent plates and moved on the Earth surface. Lava gushed from the bottom fissure of the Atlantic Ocean, separating the African continent from the Americas, and the Pacific plate collapsed, with the extruded lava forming the Pacific Rim ring. The impact of the asteroid just powered the splitting and drift of the plates, made up for the shortcomings of the two existing basic theories, and improved the formation and movement theories of the plates, mountains and continents.



USGS. Earthquake Hazards Program. Geologic Province and Thermo-Tectonic Age Maps. https://earthquake.usgs.gov/data/crust/maps.php

Figure 11. The forward trace of the lava flow [10].

As shown in **Figure 11**, under the impact of the asteroid, the Asian plate also pushed the European plate westward to form the Urals Mountains. The overall westward movement of the Asian plate could also trigger the overall collapse of the South China Sea, the Sea of Japan and even the Pacific Ocean. Lava flows could not be only originated from the impact of extraterrestrial bodies, the subsidence of the crust itself could cause emission of the mantle magma. The lava flowed along the Earth's surface and gradually cooled down, forming large mountains, ridges and island chains along the plate edge. There are two orogenic belts in the south of the Eurasian plate and the Pacific Rim. As can be seen above, the southern Asian orogenic belt (framed in black rectangle) was mainly originated from the lava gushing flow caused by planetary impact, while the Pacific Rim orogenic belt (shown by the red line and arrows) could be uniformly interpreted as the formation of lava extruded by the overall collapse of the Pacific plate, which exhibited the extrusion of adjacent plates in the outflow process. So even if the Pacific plate as a whole moved northwest, the Cordillera Mountain System across the American continent can still be explained by the extrusion of the Pacific plate on the American plate.

To sum up, during the long cooling process of the primitive Earth, the thin and soft primitive crust was covered by numerous impacts, collapses and surges, as shown in **Figure 12**, forming the current continental structure of laminar cake,oil and natural gas are formed by the deposition of magma cargoes, while coal is the product of the carbonization of forests covered by hot dust or magma. This is the core theory of the Gushing Lava Oriented Mountain and Continent Formation Hypothesis (GLOMCFH).

Based on the fluid theory, this hypothesis simply and reasonably explains the "plate tectonics", "continental drift" and many large-scale geological features from the macroscopic perspective of the earth scale. It has strong rationality and can provide a new way of thinking for establishing a perfect geological structure theory.

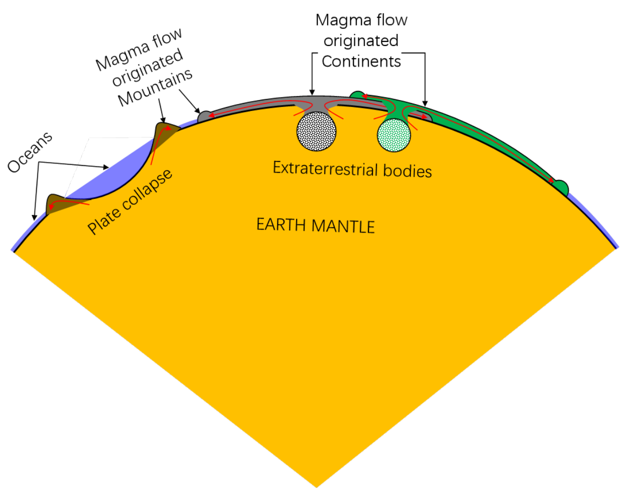


Figure 12. The principle of mountain orogenesis and continent formation.

6. Conclusions

This article establishes a model for the formation of major geomorphic features in Asia through the impact of a quartzite asteroid with a diameter of 430km–630km, named "BuzhouShan". It reveals the mechanisms behind the formation of significant landforms such as the Hulunbuir Grassland, the Mongolian Gobi, the Alxa Desert, the Tarim Basin, basin-surrounding mountains, the Qinghai-Tibet Plateau, the Pamir Plateau, the Iranian Plateau, and the Arabian and Sahara Deserts.

According to the theory, the Hulunbuir Grassland is the 1st contact point of the "Buzhou-Shan" asteroid, Mongolian Gobi are the 1st "ploughed furrow"of the landing, and the Alxa Desert was the landingsite, the Tarim Basin the sink site. The corridor between Alxa Desert and Tarim Basin was the 2nd "ploughed furrow". The surrounding basin-surrounding mountain ranges were the impact wave traces. The Qinghai-Tibet Plateau, the Pamir Plateau and the Iranian Plateau were the condensed lava flow squeezed out by the sinking asteroid core.

Based on this, a theory of the Gushing Lava Oriented Mountain and Continent Formation Hypothesis (GLOM-CFH) was propsed. In this theory, the ancient Earth plate was driven apart by the asteroid impact event which resulted in the Plate Drift, the collapse of the Pacific Plate and a series of orogenic event around the Pacific Ocean.

Author Contributions

Yanju Wei: Conceptualization, Writing—Original draft, Methodology, Supervision; Yajing Yang: Conceptualization, Writing—Review & Editing, Project administration; He Liu: Data Curation, Validation, Resources, Investigation.

Conflict of Interest

The researcher claims no conflicts of interests.

Data Availability Statement

Data available on request from the authors.

Funding

This research received no external funding.

Acknowledgment

The authors thank the funds of the National Natural Science Foundation of China (Grant No. 52176128) and Shaanxi Provincial Natural Science Fundamental Research Program (Grant No. 2024JC-YBMS-312) for supporting the research opportunity inspiring this work.

References

[1] Rothery, D.A., Gilmour, I., Sephton, M.A., (Eds.), 2018. An Introduction to Astrobiology. DOI: https://doi.org/10.1017/9781108355162

[2] Ren,J., Niu, B., Xu, Q., et al., 2022. Multisphere tectonic view of the Earth system. Acta Geological Sinica. 9601, 50–64.

[3] NASA. Earth systems science: a close review. Report of the Earth System Science Committee of the NASA Advisory Council.

[4] Elbeshausen, D., Wünnemann, K., Collins, G.S., 2013. The transition from circular to elliptical impact craters. Journal of Geophysical Research: Planets. 118(11), 2295–2309. Portico. DOI: https://doi.org/10.1002/2013je004477

[5] Hou, Z., Yang, W., 2011. Multi-scale inversion of density structure from gravity anomalies in Tarim Basin. Science China Earth Sciences. 4101, 29–39.

[6] Jing, X., Cheng, S., Wang, X., et al., 2009. Satellite gravity anomaly characteristics of western China. Xinjiang Petroleum Geology. 3001, 61–64.

[7] Xu, W., Sun, Z., Li, H., et al, 2013. New Permian paleomagnetic data from Gudong Mountain area in the Tarim Block and their tectonic implications. Geological Bulletin of China. 3210, 1566–1574.

[8] Fang, D., Wang, P., Shen, Z., et al., 1998. Cenozoic paleomagnetic results and phanerozoic apparent polar wandering path of Tarim Block*. Science in China Series D: Earth Sciences. 41(S2), 105–112. DOI: https://doi.org/10.1007/bf02984518

[9] Li, Y., Sharps, R., McWilliams, M., et al., 1989. Paleomagnetic Results of the Permian in the Tarim Block and Reconstruction of the Permian Continental China. Xinjiang Geology. (02), 22–33. DOI: https://doi.org/10.1007/BF02984518

[10] USGS. Earthquake Hazards Program. Geologic Province and Thermo-Tectonic Age Maps.

Appendix A

Table A1. The location of meteorite impact.

NO	Longi.	Lati.	Address	Features
1	113.71467590	45.61691914	Mongolia Sühbaatar Дарьганга	Oval, with ring craters
2	113.52155685	45.56262171	Mongolia Sühbaatar Дарьганга	Round, with ring craters
3	108.58955383	42.96496504	Mongolia Dornogovi Хатанбулаг	Oval, with ring craters
4	107.13489532	43.05734949	Mongolia Ömnögovi Ханбогд	Round, with ring craters
5	106.87740326	42.92110918	Mongolia Ömnögovi Ханбогд	Oval, with ring craters
6	106.63845062	43.28320394	Mongolia Ömnögovi Ханбогд	Meteor crater group
7	106.50300980	43.22506747	Mongolia Ömnögovi Баян-Овоо	Oval, with ring craters
8	102.42622375	41.54970015	China Inner Mongolia Alxa League Ejin Banner Wendu Gaole Sumu	Oval, with ring craters
9	101.79828644	42.16620267	China Inner Mongolia Alxa League Ejin Banner Subei Naol Sumu	Oval, with ring craters
10	100.12733459	42.43587354	China Inner Mongolia Alxa League Ejin Banner Saihantaolai Sumu	Oval, with ring craters
11	100.01026154	42.36539334	China Inner Mongolia Alxa League Ejin Banner Saihantaolai Sumu	Oval, with ring craters
12	97.66983032	42.39709387	China Inner Mongolia Alxa League Ejin Banner Hariburgedyin Wula Town	Round, with ring craters
13	96.72912598	42.47665501	China Gansu Jiuquan Subo Mongol Autonomous County Mazongshan Town	Meteor crater group
14	96.64054871	42.50298420	China Gansu Jiuquan Subo Mongol Autonomous County Mazongshan Town	Meteor crater group
15	96.48899317	42.58459113	China Gansu Jiuquan Subo Mongol Autonomous County Mazongshan Town	Oval, without ring craters
16	96.27113342	42.57179276	China Gansu Jiuquan Subo Mongol Autonomous County Mazongshan Town	Round, with ring craters
17	96.25740051	41.24761187	China Gansu Jiuquan Subo Mongol Autonomous County Mazongshan Town	Meteor crater group
18	95.28287888	42.03762803	China Xinjiang Hami Yizhou District Shuangjingzi Township	Oval, without ring craters
19	94.76463318	42.65946419	China Xinjiang Hami Yizhou District Qin Town-ship	Oval, without ring craters
20	94.47830200	41.62827478	China Xinjiang Hami Yizhou District Daquanwax-iang	Oval, without ring craters
21	94.29737091	41.73417319	China Xinjiang Hami Yizhou District Daquanwax-iang	Oval, with ring craters
22	94.29016113	41.54147767	China Xinjiang Hami Yizhou District Daquanwax-iang	Round, without ring craters
23	93.90563965	40.82420200	China Gansu Jiuquan Dunhuang City Qili Town	Oval, with ring craters

Table A1 continued

NO	Longi.	Lati.	Address	Features
24	93.71234894	42.11987198	China Xinjiang Hami Yizhou District Nanhu Township	Oval, without ring craters
25	93.67630005	41.65495811	China Xinjiang Hami Yizhou District Yamansu Town	Oval, without ring craters
26	93.46687317	42.13031207	China Xinjiang Hami Yizhou District Nanhu Township	Oval, without ring craters
27	93.24062347	41.96816974	China Xinjiang Hami Yizhou District Nanhu Township	Oval, without ring craters
28	93.21830750	41.66880856	China Xinjiang Hami Yizhou District Yamansu Town	Round, without ring craters
29	92.67517090	41.64469660	China Xinjiang Hami Yizhou District Nanhu Township	Round, without ring craters
30	92.43720531	42.05137993	China Xinjiang Hami Yizhou District Wubao Town	Oval, with ring craters
31	91.65432215	41.62376767	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Oval, with ring craters
32	90.99477768	41.52798540	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Oval, without ring craters
33	90.48511505	42.07299771	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Meteor crater group
34	90.44837952	41.93727505	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Meteor crater group
35	90.38692474	41.61800902	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Round, with ring craters
36	90.37250519	42.02430353	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Meteor crater group
37	90.30040741	41.97608250	China Xinjiang Turpan Shanshan County Nanshan Mining Area	Meteor crater group
38	89.20537949	42.37886802	China Xinjiang Turpan Gaochang District Qiatekale Township	Round, with ring craters
39	89.00796890	42.38951890	China Xinjiang Turpan Gaochang District Qiatekale Township	Oval, with ring craters
40	88.30467224	42.43536677	China Xinjiang Turpan Toksun County Bostan Town	Round, with ring craters
41	88.12185287	42.49776355	China Xinjiang Bayingolin Mongol Autonomous Prefecture Heshuo County Narenkeli Township	Round, with ring craters
42	100.73913574	43.30869145	Mongolia Ömnögovi Гурван тэс	Round, with ring craters
43	97.48168945	44.30223008	Mongolia Govi-Altay Эрдэнэ	Round, without ring craters
44	97.41680145	45.16509478	Mongolia Govi-Altay Эрдэнэ	Oval, with ring craters
45	97.11502075	44.64325408	Mongolia Govi-Altay Эрдэнэ	Round, with ring craters
46	95.42518616	44.76428681	Mongolia Govi-Altay Алтай	Round, with ring craters

Table A1 continued

NO	Longi.	Lati.	Address	Features
47	91.39526367	45.86371571	Mongolia Hovd Булган	Oval, with ring craters
48	91.03958130	46.01889974	Mongolia Hovd Булган	Round, with ring craters
49	90.90774536	46.07275427	China Xinjiang Altay Qinghe County Takeshiken Town	Round, with ring craters
50	90.65711975	45.95067228	China Xinjiang Altay Qinghe County Agash Ovoo Township	Oval, with ring craters
51	90.52940369	46.42839216	China Xinjiang Altay Qinghe County Agele Township	Oval, with ring craters
52	86.30207062	47.50467825	China Xinjiang Altay Jimunai County, Tost Township	Round, with ring craters