Mountains in Nahj al-Balāghah with a Perspective on Geological Findings

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Abstract

Nahj al-Balāghah contains several sermons that employ diverse rhetorical treatments of mountain imagery to direct human contemplation toward the singular and omnipotent Creator. Geologists and earth science researchers assert that mountains have formed and evolved over long geological periods. Orogeny in the Earth's crust occurs as a result of processes such as subduction at active continental margins, folding of rock layers, or due to the intrusion of molten magma from the underlying molten magmatic layer, leading to various mountain formations, including volcanoes. Analyzing the references to mountains and their descriptions in these sermons reveals that these scientific insights align with well-established geological concepts such as plate tectonics, isostasy, the deep-rooted nature of mountains, their internal structure, their role in stabilizing the Earth's movements, and their environmental benefits. This coherence not only confirms the harmony between these statements and modern geological findings but also reinforces the divine origin of these words.

Keywords: Imam Ali (a.s), Nahj al-Balāghah, Mountains, Geology, Earth

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Introduction

Nahj al-Balāghah presents numerous scientific subjects, many of which have been discovered through modern sciences over the years, while some may still remain beyond the reach of contemporary knowledge. Moreover, certain scientific concepts discussed at that time were articulated more accurately, serving the dual purpose of inviting people to recognize God and demonstrating the scientific miracles in the words of Imam Ali (a.s). The knowledge of the Infallibles (a.s) does not stem from human empirical sciences; rather, their articulation of definitive scientific facts is beyond ordinary human capability. Among Imam Ali's (a.s) statements, references to various scientific fields such as physics, geology, and zoology can be observed. A thorough analysis of these topics reveals that the concepts expressed by the Imam (a.s) align with well-established and definitive empirical scientific theories.

By establishing connections between these statements and modern scientific discoveries, it becomes evident that the words of Almighty God in the Qur'an, as well as the interpretations provided by the Imams (a.s), have always served as a guide for humanity—encouraging people to observe the signs of divine power in the universe and sparking curiosity to explore these coded messages. In this context, not only is the compatibility of Imam Ali's (a.s) sermons with scientific certainties demonstrated, but also their divine origin and the legitimacy of his Imamate are affirmed. Ultimately, this recognition directs human attention to the unique Creator's immense order and harmony in the universe, leading them toward a conscious belief in monotheism.

A study of the narrations in Nahj al-Balāghah regarding the Earth and its mountains reveals that the words of Imam Ali (a.s) provide a monotheistic lesson derived from natural phenomena, aimed at those seeking spiritual perfection and intellectual growth. Numerous narrations from both Sunni and Shi'a sources affirm that Imam Ali (a.s) received the entirety of the Qur'an's revelation, interpretation, meanings, and teachings from the Messenger of God (PBUH) (see Kulaynī, 1388 AH: 7/442, hadith 15; Ḥākim al-Nayshābūrī, 1437 AH: 3/124, hadith 61; Ḥamawī al-Juwaynī, 1400 AH: 1/439; Qundūzī, 1384 AH: chapter 20/104).

Imam Ali (a.s) speaks about his knowledge of the paths of the heavens, stating: "*O people, ask me before you lose me, for I have greater knowledge of the paths of the heavens than the paths of the earth.*" (Nahj al-Balāghah: Sermon 189)

Imam (a.s) does not use conjecture or hypothesis in his words about scientific matters such as the origin of the universe and creation, but speaks with certainty and assurance, as someone who has witnessed these events. With the confirmation of the scientific personality of Imam (a.s), we believe that His knowledge is connected to the source of divine revelation and the divine treasure of the unseen, and also through the teachings of the Prophet (PBUHH), which also originates from the source of revelation.

Literature Review

Several academic articles have been written about the phenomenon of mountains and their benefits in the Quran. For example, *"Pazhūhish dar I'jāz Qur'an"* [A Study on the Scientific Miracles of the Quran] was written by Mohammad Ali Rezaei Isfahani and published by Mubin Publishing House, Qom, 1381 Sh. In addition to other miraculous aspects of sciences, he also discusses the role of mountains and their Quranic references. Mohammad Mahjal also wrote an article titled *"Iʿjāz-i ʿilmī-yi Qurʾān-i Majīd wa chigūnigī-yi būjud āmadan-i kūh-hā wa naqsh-i ān-hā dar ārāmish-i pūshtah-yi zamin"* [Scientific Miracle of the Quran Regarding the Formation of Mountains and Their Role in the Stability of the Earth's Crust] accessed in October 2012 on website of Iranian Scientific Association of Quranic Miracles, accessed."

However, no article has been found on mountains in Nahj al-Balāghah with a specialized geological perspective.

Mountains from the Perspective of Earth Sciences

Mountains are areas of the Earth's surface that are elevated compared to the surrounding land. Some of them exist as separate masses, while others form large mountain ranges. Examples include the Alborz, Zagros, and Himalayas, which are considered young, massive mountains that are still growing, while others are much older and eroded. Mountains are formed and evolved over long periods, either due to the compressive forces resulting from

the movement of tectonic plates at the edges of unstable continental and oceanic boundaries, which cause folding, or due to the intrusion of molten magma into the Earth's crust, forming volcanic mountains. Over millions of years, mountains are eroded by various factors and are washed away by rain, eventually being carried away by rivers to plains and seas, and eventually disappearing. As they are worn down and erased from the Earth's surface, new mountains form elsewhere due to the internal stresses of the Earth, rising once again. In other words, mountains also experience birth and death.

The processes that create mountains are known as Orogeny. This term is derived from the Greek words *oros* meaning mountain and *genesis* meaning creation. These processes lead to the folding, faulting, and deformation of large parts of the Earth's crust.

To explain the processes that lead to mountain formation, it is necessary to understand the geological phenomena associated with them. In short, to provide a general explanation for the origin of continents, ocean basins, mountain ranges, continental plains, and the locations of volcanic and earthquake belts, we must be familiar with processes like plate tectonics and ocean floor spreading. These processes involve the movement of several large plates, and the Earth's rigid crust is formed by the interaction of these plates. The simultaneous movement of these plates causes orogeny, volcanic activity, earthquakes, and the growth and closure of ocean basins.

1. Plate Tectonics

In 1968, the theory of plate tectonics was introduced, playing a fundamental role in understanding the formation of the Earth's crust, and most geological processes are interpreted based on this theory. According to this theory, the Earth's lithosphere, which is the rigid outer layer, is divided into about 20 solid pieces called plates, each approximately 6 kilometers thick for oceanic plates and up to 70 kilometers thick for continental plates. These plates are constantly either colliding with or moving away from each other. These plates cover the entire surface of the Earth and include continents and ocean floors. They move relative to one another at speeds of a few centimeters per year. The lithosphere rests on a softer, hotter layer known as the asthenosphere. Thus,

the lithospheric plates are the Earth's rigid outer shell, held in place by the plastically deformable asthenosphere beneath.

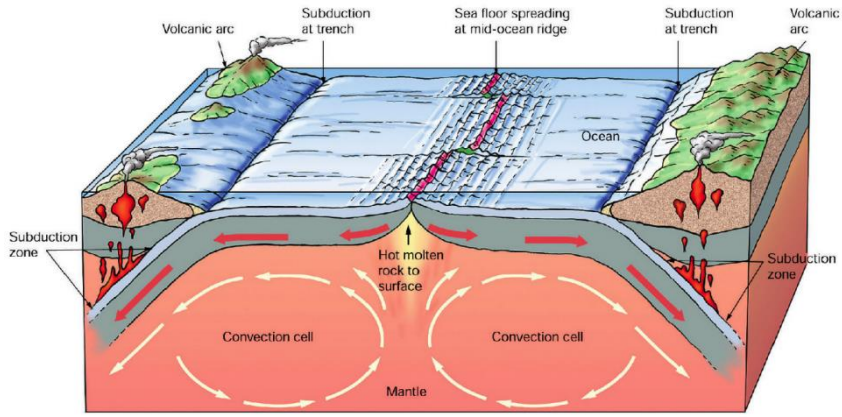

Figure 1: The Formation of Oceanic Crust from Oceanic Rifting Due to Convective Currents in the Asthenosphere and Its Subduction Beneath Continental Plates

The asthenosphere lies beneath the lithosphere, and its thickness varies, reaching up to about 200 kilometers. Beneath the asthenosphere is the mantle. The asthenosphere is capable of flowing, and convective movements, which drive the movement of the lithospheric plates, are concentrated in this layer. The boundary between the lithosphere and asthenosphere results from changes in the properties of the rocks above and below it and is influenced by pressure and temperature, which increase with depth. The lithosphere is cold and rigid, while the asthenosphere is at conditions close to the melting point, making its resistance much lower. The molten state of this layer makes convection and the horizontal displacement of the lithospheric plates easier.

This scientific finding marked a revolution in the way we view geological phenomena. With the advent of plate tectonics, geologists reevaluated all aspects of geology. This means that plate tectonics can predict geological events and explain some of the Earth's geophysical characteristics.

Continental plates form parts of the lithosphere, and as the plates are displaced by convection currents within the asthenosphere, the continents move with them. The new oceanic lithosphere that forms above rising convective currents displaces

the older oceanic lithosphere. Since lithospheric plates are rigid, the entire oceanic plate moves away from the site of the convective current. Given that the Earth is not expanding and its surface area is not increasing, the old lithosphere must be destroyed somewhere. As a result, one of the plates eventually subducts deep into the Earth, gradually heats up, and is absorbed and assimilated into the molten material of the asthenosphere.

Due to the lighter composition of continental lithospheric plates compared to oceanic plates, continents cannot subduct deeply into the mantle. Instead, the oceanic lithospheric plate subducts beneath the continental plate. At the location where this lithosphere bends into the Earth (the subduction zone), a long trench is created on the ocean floor. The edges of the descending lithospheric plate become heated due to friction with surrounding materials, and the temperature increases to the point that partial melting occurs. The molten material then rises toward the Earth's surface, where it erupts through large volcanoes (Wiley, 1368 Sh, 32-35). Thus, it is observed that plates have three types of motion relative to each other: divergent, convergent, and transform.

One of the key principles of plate tectonics is that each plate moves independently relative to the others. The movement of the Earth's outer crust is linked to the dynamic and fluid nature of the asthenosphere beneath it. Studying tectonic plates helps us explain the forces that drive plate movements, continental drift, ocean floor spreading, volcanic eruptions, and mountain formation (Ordway, 1972: 314). The forces that drive tectonic plate movements arise from the slow-motion convection in the underlying mantle. Mantle rocks, due to the high heat beneath them, are constantly moving upward, and as they cool, they sink back down. This cycle lasts millions of years, and the Earth's outer appearance continues to change due to this process.

The Quran refers to the phenomenon of mountain movement: "*You see the mountains, which you suppose, to be stationary, while they drift like passing clouds*" (Quran 27:88).

Certainly, the movement of mountains is meaningless without the movement of the other parts of the Earth's crust that are connected to them. Therefore, the meaning of the verse suggests that the lithospheric plates in the Earth's crust move like clouds, and this is one of the scientific miracles of the Quran.

In Nahj al-Balāghah, there are also references to the movements of the Earth. One of these movements is likely the movement of the Earth's plates, which can be explained by the theory of plate tectonics. In Sermon 211, Imam Ali (a.s) mentions the formation of mountains from flat plains, which is consistent with recent findings. This is because, through processes like folding and other mechanisms of mountain formation that will be discussed later, plains and flat regions are transformed into mountains. Italian scientist Galileo and Polish scientist Copernicus were the first to propose the Earth's movement in the early 17th century.

Some authors relate this verse to the Earth's translational movement because, just as clouds move around the Earth with translational motion and do not have rotational motion, mountains also only have translational motion (Rezaei Isfahani, 1381 Sh: 1/24). About a thousand years after the revelation of this verse, Alfred Wegener proposed the theory of plate tectonics and continental drift, proving that the Earth's solid crust is made up of several large and small plates floating on the molten material beneath them. Now, with this new understanding and by studying the movement of mountains through this perspective, it is easy to infer the movement of Earth's parts and the mountains that exist on them. Thus, the movement of mountains, in addition to accompanying the movement of the Earth, also involves the movement of the plates that make up the Earth's crust, and this is what the Quran alluded to and Imam Ali (a.s) explained.

2. Isostasy

Different components of the Earth's crust, such as mountains, plains, and seas, are not irregular depressions in the upper part of the crust. Rather, they all exist in a state of relative equilibrium, which results from changes in their density or thickness. According to the theory of isostasy, beneath the Earth's surface, there is a parallel level where the pressure exerted by the mountains, plains, and seas is equal. This level is called the "level of equilibrium" or the "isostatic surface" (see Figure 2).

(Lee Stokes, William & Sheldon Judson, 1968, p. 128)

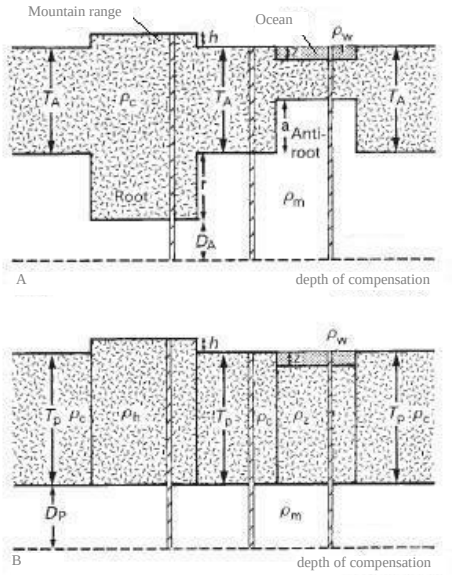

Figure 2 - The Airi mechanism for compensating isostatic buoyancy of different crustal pieces floating on the asthenosphere and their role in isostasy (for more information, refer to the original source).

In other words, the lithosphere, which is lighter, remains afloat on the more malleable and denser asthenosphere. This can be compared to two logs, one thick and one thin, floating on water. The thicker log will float higher and more prominently above the water than the thinner one. Similarly, in mountainous regions, the crust is thicker than in lower-lying areas. Mountains, like the thicker logs, not only have a higher surface but also extend deeper into the underlying materials. This fact has been confirmed by gravitational data.

Therefore, since the lithosphere beneath the oceans has a lower elevation, it must be thinner compared to the continental lithosphere. For this reason, oceanic rocks have higher density. According to this theory, whenever a weight is added to the crust, the crust compensates by sinking, and when a weight is removed, the crust rises. Mountains are areas of the crust that are unusually thick and are higher than the surrounding areas due to isostasy, with a large portion of them extending deep within the crust.

In Surah An-Naba, the anchoring of mountains to the Earth is

depicted: *Did We not make the earth a resting place? And the mountain stakes?* (Quran 78: 6–7). The phrase "تَغَلْغُلِهَا مُتَسَرِّبَةً فِي جَوْبَاتِ خَيَاشِيمِهَا" (*"And its roots are deeply embedded"*) or the sinking of its roots into the depths of the Earth (Nahj al-Balāghah: Sermon 91) can support the theory of isostasy. As mentioned in this theory, mountains are thicker due to their greater weight and seem to correlate with this description.

In part of Sermon 171, mountains are referred to as "الجِبَالَ الرَّوَاسِيَ الَّتِي جَعَلْتَهَا لِلْأَرْضِ أَوْتَادًا" meaning: *"the mountains as pegs which You have set for the Earth."* And in Sermon 211, it is stated:

وَ جَعَلَهَا لِلْأَرْضِ عِمَاداً وَ أَرَّزَهَا فِيهَا أَوْتَاداً

"He made it firm and anchored the mountains in it so that the Earth would be stable despite its motion." The totality of these phrases likens mountains to pegs with roots, emphasizing that mountains are embedded in the Earth. This is precisely the reality that was later proven by the theory of isostasy, which shows that mountains have massive roots deep within the Earth.

3. Internal Structure of Mountains

The vast majority of rocky mountains are located beneath the Earth's surface, with a smaller portion visible above the surface. Mountains act as pegs for the Earth, providing stability and firmness. As mentioned earlier, the solid crust of the Earth, which forms the landmasses and oceans, is made up of separate pieces.

However, these pieces are in close proximity to each other, with no gaps between them. Beneath the solid crust, there is a layer of relatively dense material that is in equilibrium with the solid crustal pieces. The mountains and mountainous regions, which are the heavy and thick parts of the Earth's solid crust, have sunk deeper into the molten layer beneath, and their roots extend deep into this molten layer.

The portion of the solid crust beneath the oceans is thinner; however, its relative thinness and lightness are compensated by the thicker, denser molten layer beneath it. In this way, mountains, by penetrating the Earth and anchoring beneath the solid crust, prevent the oscillations and instability of the Earth, contributing to its strength and stability.

Thus, the internal structure of mountains is different from what appears on the surface, as the interior of the mountains extends with their roots deep into the Earth. (Figure 3). The higher the mountains, the deeper their roots, and the thinner the crust, the shallower their roots in the mantle. This is the very reality referred to in parts of Sermons 91, 171, 186, and 211:

رَبَّ الْجِبَالِ الرَّوَاسِي الَّتِي جَعَلْتَهَا لِلْأَرْضِ أَوْتَاداً وَ لِلْخَلْقِ اعْتِمَاداً

"*O Lord, the firm and solid mountains, which You have made as pegs for the Earth, and as a reliable support for Your creation*." (Nahj al-Balāghah: Sermon 171)

فَأَنْهَدَ جِبَالَهَا عَنْ سُهُولِهَا وَ أَسَاخَ قَوَاعِدَهَا فِي مُتُونِ أَقْطَارِهَا وَ مَوَاضِعِ أَنْصَابِهَا، فَأَشْهَقَ قِلَالَهَا وَ أَطَالَ أَنْشَازَهَا وَ جَعَلَهَا لِلْأَرْضِ عِمَاداً

"He raised its mountains above its plains and stabilized their foundations in the depths of its quarters and locations. He elevated its peaks and extended its slopes, making the mountains a support for the Earth and firmly anchored them like pegs." (Nahj al-Balāghah: Sermon 211)

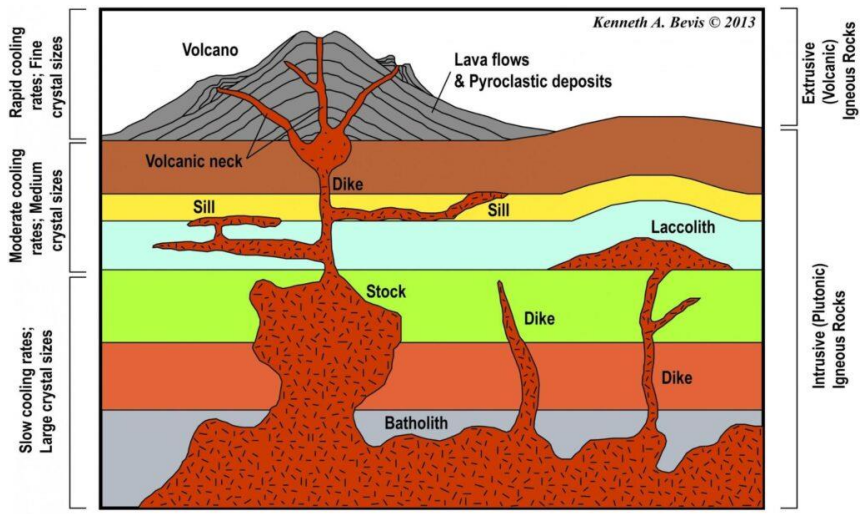

Figure 3: The root structure of mountains, considering their internal formation and the injection of magma between Earth's layers, leading to the formation of various intrusive masses and volcanic mountains. (For more information, refer to daneshnameh.roshd.ir - Accessed: 13/11/2010)

The Depiction of Mountains in the Statements of Imam Ali (a.s)

Imam Ali (a.s) emphasized the peace and stability that mountains provide to the Earth's inhabitants. He described their presence as a means of preventing imbalance, restlessness, and instability. Several sermons, including Sermons 1, 91, 171, and 211, refer to some of the physical characteristics and roles of mountains. Here, we focus on the relevant parts related to this discussion:

وَتَّدَ بِالصُّخُورِ مَيَدَانَ أَرْضِهِ

"*The shaking and turbulence of the Earth were calmed by the mountains*." (Nahj al-Balāghah: Sermon 1)

This phrase highlights the calming role of the mountains:

فَلَمَّا سَكَنَ هَيْجُ الْمَاءِ مِنْ تَحْتِ أَكْنَافِهَا وَ عَمَلَ شَوَاهِقَ الْجِبَالِ الشُّمَّخِ الْبُذَّخِ عَلَى أَكْتَافِهَا فَجَّرَ يَنَابِيعَ الْعُيُونِ مِنْ عَرَانِينِ أُنُوفِهَا وَ فَرَّقَهَا فِي سُهُوبِ بِيدِهَا وَ أَخَادِيدِهَا وَ عَدَّلَ حَرَكَاتِهَا بِالرَّاسِيَاتِ مِنْ جَلَامِيدِهَا وَ ذَوَاتِ الشَّنَاخِيبِ الشُّمِّ مِنْ صيَاخِيدِهَا فَسَكَنَتْ مِنَ الْمَيَدَانِ لِرُسُوبِ الْجِبَالِ فِي قِطَعِ أَدِيمِهَا وَ تَغَلْغُلِهَا مُتَسَرِّبَةً فِي جَوْبَاتِ خَيَاشِيمِهَا وَ رُكُوبِهَا أَعْنَاقَ سُهُولِ الْأَرَضِينَ وَ جَرَاثِيمِهَا

"*When the water's fury settled beneath the earth's surface, and the towering mountains bore the weight upon their shoulders, springs gushed from the mountain's sides. These waters spread across the plains, valleys, and riverbeds, and the Earth's movements were stabilized by the massive boulders and firm mountain peaks. This is how the Earth's tremors ceased due to the mountains' penetration into its surface, with their roots extending deep into the Earth and resting upon the plains, stabilizing the land's movements*." (Nahj al-Balāghah: Sermon 91)

In the above passage, the emergence of springs from the mountains, their flow into plains, and the formation of rivers are mentioned, and the tranquility of the Earth due to the presence of mountains is reiterated. As discussed in the concept of isostasy and the internal structure of mountains, this passage also refers to the same reality, indicating that the roots of the mountains extend deep into the Earth:

رَبَّ الْجِبَالِ الرَّوَاسِي الَّتِي جَعَلْتَهَا لِلْأَرْضِ أَوْتَاداً وَ لِلْخَلْقِ اعْتِمَاداً

"O Lord of the firm and steadfast mountains, which You have made as pegs for the Earth and as reliable supports for creation." (Nahj al-Balāghah: Sermon 171)

This part of Nahj al-Balāghah also recalls the internal structure

of the mountains, their rootedness, and the concept of isostasy. It further recognizes the mountains as a source of peace and refuge for the people:

وَ جَبَلَ جَلَامِيدَهَا وَ نُشُوزَ مُتُونِهَا وَ أَطْوَادِهَا [أَطْوَادَهَا] فَأَرْسَاهَا فِي مَرَاسِيهَا وَ أَلْزَمَهَا قَرَارَاتِهَا [قَرَارَتَهَا]، فَمَضَتْ رُءُوسُهَا فِي الْهَوَاءِ وَ رَسَتْ أُصُولُهَا فِي الْمَاءِ، فَأَنْهَدَ جِبَالَهَا عَنْ سُهُولِهَا وَ أَسَاخَ قَوَاعِدَهَا فِي مُتُونِ أَقْطَارِهَا وَ مَوَاضِعِ أَنْصَابِهَا، فَأَشْهَقَ قِلَالَهَا وَ أَطَالَ أَنْشَازَهَا وَ جَعَلَهَا لِلْأَرْضِ عِمَاداً وَ أَرَّزَهَا فِيهَا أَوْتَاداً، فَسَكَنَتْ عَلَى حَرَكَتِهَا مِنْ أَنْ تَمِيدَ بِأَهْلِهَا أَوْ تَسِيخَ بِحِمْلِهَا أَوْ تَزُولَ عَنْ مَوَاضِعِهَا. فَسُبْحَانَ مَنْ أَمْسَكَهَا بَعْدَ مَوَجَانِ مِيَاهِهَا وَ أَجْمَدَهَا بَعْدَ رُطُوبَةِ أَكْنَافِهَا

"*And the mountains, with their massive rocks and deep roots, have been firmly planted in their positions, establishing their bases in the waters. They have risen from the Earth, and their peaks reached into the air while their roots sunk deep into the water. By this, the mountains have been elevated from the surface of the Earth, and their foundations have been firmly established deep within it. Their summits were raised, their slopes were extended, and the mountains were made to support the Earth, like pegs driven into it. As a result, the Earth remained stable and did not sway with its inhabitants, nor did it collapse under its burdens, nor did it shift from its place.*" (Nahj al-Balāghah: Sermon 211)

This section not only discusses the formation of mountains and their placement in specific locations but also emphasizes the internal structure of the mountains and their rootedness while referencing the internal structure of the Earth. According to this, beneath the Earth's crust lies a layer that is semi-fluid and semi-solid in nature. The rocks in this area, due to the intense heat of the depths, have reached a near-melting point and become slippery. The movement of the Earth's crustal plates is influenced by this characteristic of the underlying layer. The phrase: "و رست اصوالها فی الماء" *"And their roots sank into the water"* refers to the fact that the roots of the mountains extend into this semi-fluid layer. Likely, the deep penetration of mountain roots and their extension into this region is being referenced here. This statement implies both the existence of roots for mountains and the presence of an inner section located in an area with characteristics such as fluidity, similar to water. As observed, a region with such properties exists beneath the Earth's crust, exhibiting a flowing and dynamic nature.

Earth's Internal Structure

Gaining insight into the Earth's composition and internal structure has only been possible through indirect methods. One such approach is the study of seismic waves. Through geophysical analysis of these waves, it has been determined that the Earth has a concentric structure, with two major discontinuities in the physical properties of its constituent materials.

These discontinuities divide the Earth into three main layers: the core, the mantle, and the crust. As shown in Figure (4), the boundary between the core and the mantle lies approximately halfway to the Earth's center at a depth of 2,900 kilometers, while the boundary between the mantle and the crust is much closer to the surface, varying in depth depending on whether it is continental or oceanic. This mantle-crust boundary is known as the Mohorovičić discontinuity (Mohorovičić, 1368 Sh: 129-132).

There is no discontinuity or significant change at a depth of 100 kilometers that corresponds to the lithosphere-asthenosphere boundary. In this region, which varies in thickness between 100 and 200 kilometers, the velocity of seismic waves is lower than that in both the upper and lower mantle. Another major boundary exists at a depth of 5,000 kilometers, separating the inner core from the outer core (Wiley, 1368, 129-132). Consequently, an asthenospheric layer exists between 100 and 200 kilometers deep, exhibiting a semi-fluid nature. According to divine revelation, the roots of mountains extend to this depth, emphasizing the profound depth of mountain roots and the presence of such a layer in the Earth's structure.

In the last sermon, the reference to mountains emerging from flat plains also aligns with the theory of plate tectonics, as the movement of tectonic plates—either diverging or converging—leads to mountain formation. This sermon further highlights that the stability of the Earth is due to the presence of mountains, which act like pegs, preventing the planet from becoming unsettled. The phrase "فسكنت على حركتها" refers to the movement of the Earth, while the sermon also addresses the balance of the Earth's motions and its adherence to its designated orbit and position.

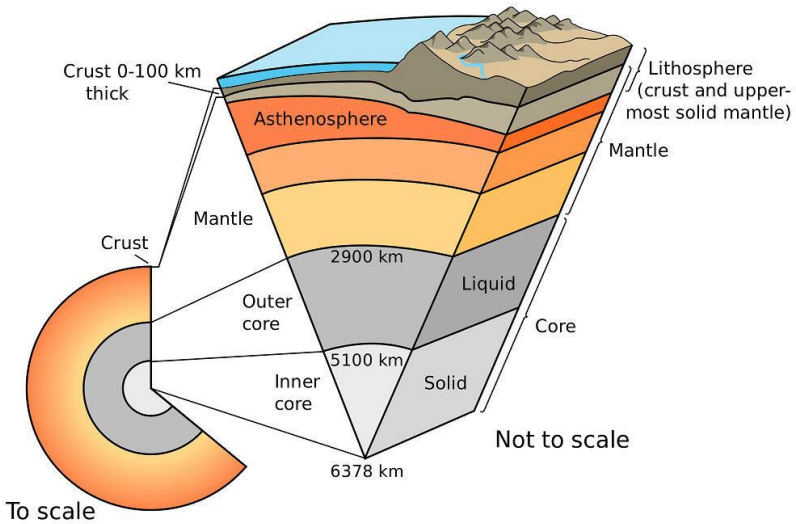

Figure 4 - The Different Layers Inside the Earth from the Crust to the Core

A Look at the Commentaries of the Exegetes of Nahj al-Balagha

In the phrase "وَتَدَ بِالصُّخُورِ مَيَدَانَ أَرْضِهِ" ("He secured the Earth's instability with solid rocks"), the Arabic term *Mayadān* refers to the Earth's intense and irregular movements, which are stabilized by mountains. When the Imam states that the Earth was secured with pegs, it implies that, following initial tremors and disturbances, the Earth was stabilized by solid rocks and mountains embedded within it. This statement metaphorically signifies the depth and interconnectedness of these mountain chains, which contribute to the Earth's stability.

A similar expression is found in the Quran:" وَأَلْقَى فِي الْأَرْضِ رَوَاسِيَ أَن تَمِيدَ بِكُمْ" *He cast firm mountains in the Earth lest it should shake with you* (Quran 16: 15-16; 31:10)

Mountains protect the Earth from excessive vibrations caused by the movement of tectonic plates. They play a crucial role in controlling and regulating the Earth's motion. Without their stabilizing effect, the planet would be turbulent and uninhabitable. Many mountains have formed as a result of volcanic eruptions, where

molten materials from beneath the crust accumulate at the surface, forming mountain structures that contribute to the Earth's stability.

Regarding the phrase "*The Earth, despite its movements, is protected from slipping, shaking, and collapsing,*" the following three key points were deducted:

1. The Earth experiences various types of movements, yet it maintains stability and equilibrium.
2. The crust remains intact and does not disintegrate, preventing it from collapsing under the weight of its inhabitants and structures.
3. The Earth's rotational, orbital, and other motions remain stable, ensuring that it stays within its designated paths and does not deviate from its orderly trajectories.

Additionally, in reference to the statement "رَسَتْ أُصُولُهَا فِي الْمَاءِ" (*Its roots are anchored in water*) from Nahj al-Balāghah, Sermon 211, it indicates that the interconnected roots of mountains extend into underground water reservoirs. This suggests that the foundation of these global mountain chains is deeply embedded within subterranean water sources.

The statements of the Imam have now been confirmed by modern scientific discoveries and research. The role of mountains in sustaining life on Earth is due to the fact that scattered mountain ranges in the Earth's rigid crust form a continuous, chain-like belt encircling the planet.

By examining geological maps, we observe that mountains, elevations, and depressions span across continents. In reality, the Earth's crust is enclosed by interconnected mountain chains, which act as a structural backbone for the continents, preserving the stability of the crust. As demonstrated, these mountain chains penetrate deep into the Earth's crust and are interconnected, forming a remarkable system that encircles the continental crust with a network of mountains. These mountains play a significant role in maintaining the Earth's balance, stabilizing its components, and ensuring the integrity of the crust. Despite the extreme temperatures in the Earth's interior and mantle, the crust and the mountains on its surface do not disintegrate.

Mountains extend not only across continents but also beneath

the seas and oceans. Most islands and their elevations are, in fact, extensions of mountain ranges, meaning a substantial portion of these mountains continues underwater. Furthermore, all continents are interconnected through mountain ranges, whether via land or sea, forming an intricate framework that secures the Earth. This network prevents the disintegration and scattering of Earth's particles into space.

The rigidity and thickness of the crust prevent the eruption of molten materials from the Earth's interior. Without the crust, continuous and intense seismic activity would engulf the entire planet. If the Almighty God had not stabilized and sustained the Earth, it would undoubtedly have collapsed, fractured, and everything on it would have been destroyed—just as such conditions exist on many other planets.

However, God preserves the heavens and the Earth from deviation, as stated in the Quran: "إِنَّ ٱللَّهَ يُمسِكُ ٱلسَّمَٰوَٰتِ وَٱلأَرضَ أَن تَزُولَا" *Indeed, Allah sustains the heavens and the Earth lest they should fall apart….* (Quran 35:41).

Thus, mountains encircle the Earth like a vast chain, directly influencing its balance and preventing catastrophic tremors. Moreover, the rigidity of the Earth's crust, which encloses the planet, prevents the ignition of its interior. Similar explanations have been provided regarding how the Earth's surface, after cooling, developed folds, elevations, depressions, mountains, and valleys. This is reflected in the statement: *"He raised the mountains from the surface of the Earth, fixed their foundations deep within, stabilized their positions, elevated their peaks, and expanded their hills."*

It has been mentioned that mountains, in addition to their towering forms above the ground, possess massive roots beneath the surface. These roots interconnect them from within—much like a tree, whose branches extend high into the sky while its roots penetrate deep into the Earth. The taller and more steadfast a tree stands, the deeper and stronger its roots must be (Figure 2).

The Imam (a.s) further highlights the benefits of mountains and their role in stabilizing the Earth and its inhabitants by stating: *"God made mountains as the pillars of the Earth and drove them into it like pegs, ensuring that despite its motion, the Earth remained stable, preventing distress to its inhabitants, keeping its*

burdens secure, and preserving its position." These magnificent formations are regarded as essential for maintaining the Earth's stability and preventing its disturbance.

It is known that part of the Earth's core and the entire mantle consists of molten materials and gases that exert pressure on the crust, occasionally escaping through volcanic vents in a controlled manner. However, mountains, with their deep and interconnected roots, absorb these pressures, preventing continuous tremors and ensuring the stability of the Earth's solid crust.

Additionally, mountains counteract external forces caused by the gravitational pull of the Moon and the Sun, which induce tidal movements. They also act as barriers against external storms (Makārim Shīrāzī, 1375 Sh: 8/178–180). If mountains did not exist, the Earth's crust would constantly shift over the molten layers beneath. However, since towering mountains have firmly rooted themselves in the Earth, they chain the crust from all directions and anchor it onto the mantle and core, preventing its movement.

It is possible that the instability and oscillations, that mountains prevent, originate from several factors:

The movements of the Earth are influenced by strong gravitational forces from the Moon and the pressure exerted by the molten materials in the Earth's core, both of which contribute to its instability. The Earth undergoes between 14 and 16 different motions, some of which originate internally, while others occur in relation to celestial bodies. Three of the most significant motions are as follows:

Earth's Rotation

The Earth rotates around its axis in a counterclockwise direction. A complete rotation of the Earth, defined as the time interval between two consecutive passages of a given meridian in front of a specific star, takes 23 hours, 56 minutes, and 4.09 seconds. This period is known as a sidereal day. The rotational speed of the Earth at the equator is approximately 1,970 km/h, while at the poles, it is zero (Degānī, 1382 Sh: 149).

Earth's Revolution

One of the most significant movements of the Earth is its revolution around the Sun. Over the course of a period known as a

solar year, the Earth completes a full orbit around the Sun. It travels at a speed of 30 km/s, covering a distance of 937 million kilometers during a solar year. The average distance between the Earth and the Sun is approximately 150 million kilometers (Ganjī et al., 1378 Sh: 51). The Earth's revolution results in key phenomena such as variations in the length of day and night, the formation of climatic zones, and the change of seasons (Ibid: 149).

Earth's Precession

This motion becomes apparent only over a long period. A complete precessional cycle takes 26,000 years to complete. Due to this movement, the Earth's axis gradually aligns with different points in the sky, meaning that over time, it no longer points exclusively toward the current North Star (Polaris). This movement can be compared to the wobbling motion of a spinning top, where the upper part of its axis traces a circular path as it spins (Ibid.).

The gravitational forces exerted by the Sun and the Moon attempt to straighten the Earth's tilted axis. However, every rotating body exhibits a gyroscopic effect, meaning it resists changes to its axial tilt. Because the Earth resists realigning its rotation axis, the gravitational forces instead induce its precessional motion. As a result of this precession, the Earth's axis traces a circular path with a radius of 26.5 degrees in the sky over a period of 29,000 years ʿAdālatī & Ashrafī, 1388 Sh: 146).

Nutation

Nutation occurs due to the misalignment of the Moon’s orbit with the plane of the ecliptic[1]. The gravitational forces exerted by the Moon and the Sun constantly change, resulting in a precessional wobble in the Earth’s axial motion. Consequently, the precessional path of the Earth’s axis forms a wavy curve, a phenomenon known as Earth’s nutation. The nutation amplitude caused by the Moon is 12.9 arcseconds, with a period of approximately 18.6 years, while the nutation amplitude due to the Sun is about 1.2 arcseconds, with one year (Degānī, 1382 Sh: 149).

1. When the Earth completes its annual revolution along its orbit, the Sun appears to trace a path across the background of stars. This apparent path is referred to as the ecliptic.

Other Motions of the Earth

The Earth exhibits additional motions. Stars also move extensively within their respective galaxies. Each star in space behaves similarly to atoms in a high-temperature gas, constantly in motion. At that moment, the sun is moving toward the star Vega[1] at a velocity of 19.2 km/s. The Sun, along with other stars, orbits the center of its galaxy. In this motion, the solar system, including Earth, travels a distance of 1.6×10^{18} km from the center of the galaxy at a speed of 320 km/s, completing one full orbit in approximately 250 million years. Additionally, the Milky Way Galaxy itself is in motion relative to other galaxies and is approaching the Andromeda Galaxy[2] at a speed of 288 km/s (ibid).

If we assume the absence of mountains during the Earth's rotation, the planet—moving at the mentioned speed—would experience extreme friction with the surrounding air molecules. This friction would generate enormous heat, making life difficult. However, the presence of mountains ensures that the air adjacent to the Earth's surface moves along with it, preventing significant friction between the stationary air and the rotating Earth. The Earth's topographical features, including mountains and varying elevations, play a crucial role in regulating the movement of adjacent air. The air in direct contact with the Earth's surface becomes trapped within valleys and depressions, some of which reach heights of up to 8 km. As the Earth rotates, the air confined within these depressions moves along with it, ensuring that both the planet and its immediate atmosphere continue their motion in unison.

Another potential source of Earth's irregular movements—prevented by mountains—is the gravitational pull of the Moon, which could induce tidal effects on land similar to those in the oceans, causing the Earth's surface to be in a state of constant motion and instability. However, mountains act as a solid shield, stretching across continents and oceans. Due to the interconnected roots of mountain ranges, they form a robust network that

1. "The brightest star in the constellation Aquila, which is eleven times more luminous than the Sun and has a very high rotational velocity."
2. It is a large spiral galaxy in the constellation Andromeda that appears as a faint, hazy patch visible to the naked eye. The Andromeda Galaxy is the largest galaxy in the Local Group and contains about twice as many stars as the Milky Way. The Andromeda spiral is located 2.2 million light-years from our galaxy.

counteracts the Moon's gravitational force. Despite the Earth's solid crust, minor tidal movements (approximately 15 cm) still occur due to this gravitational influence.

The third factor contributing to disturbances on Earth is the molten material in the mantle and the movement of Earth's continents, which exert pressure on the crust and cause earthquakes. First, the causes of earthquakes should be briefly mentioned. The movement of tectonic plates, volcanic lava eruptions, and convective currents in the mantle, along with the internal pressure exerted on the crust due to the temperature difference (approximately 5000°C) between the crust and the inner core, are three major causes of this phenomenon. Mountains, with their deep roots and coverage of Earth's surface plates, hold them together—like nails joining pieces of wood—and help prevent their separation. In doing so, they contribute to the stabilization of volcanic activity and inhibit the oscillation, fragmentation, and disintegration of the Earth's crust." (Makārim Shīrāzī, 1385 Sh: 8/180; see also: Encyclopedia of Ẓuhūr, accessed 26/7/2012).

Through the gradual formation of mountains, the Earth has transitioned from a state of constant seismic and volcanic instability to a stable environment. Mountains have absorbed much of the internal pressures from explosions and earthquakes, maintaining the Earth as a habitable and tranquil place. Without the cohesion of mountains—embedded deep within the Earth's crust—our planet would not have evolved into the stable home it is today (Ḥusaynī, 1380 Sh: 94-95).

In the Quran, mountains are likened to pegs, and as we know, when a peg is driven into a surface, a significant portion of it remains embedded while only a small part protrudes. Therefore, it can be inferred that the external portion of mountains has outward benefits.

Deep within the Earth's interior, particularly in the mantle, numerous intrusive masses have formed due to the injection of magma (Figure 4), each possessing its own distinct shape and characteristics. In igneous mountains, which originate from magma and essentially serve as the foundation for mountain formation, these intrusive bodies are interconnected internally, playing a crucial role in maintaining the structural integrity of mountains.

Among commentators of *Nahj al-Balāghah*, discussions regarding the formation of mountains and their functions have been presented over past centuries, some of which are inconsistent with modern geological findings. For instance, Ibn Maytham Baḥrānī, in his commentary on a specific sermon, refers to Fakhr al-Din al-Rāzī and states that since it has been established that the Earth is spherical, and mountains are embedded like rigid protrusions on this sphere, if these mountains and irregularities did not exist, the Earth—due to its spherical nature—would undergo rotational motion. He argues that the presence of mountains and their gravitational pull toward the Earth's center prevents such rotational movement (Baḥrānī, 1375 Sh: 1/263).

However, according to the present authors, this view is incorrect. At that time, the concept of Earth's sphericity had only recently been established, and the planet was still believed to be stationary, devoid of its known motions. Scholars of that era assumed that without mountains, the Earth would experience rotational motion. However, modern understanding confirms that, despite the Earth's motions, mountains contribute to stabilizing the Earth's layers, preventing frequent earthquakes, and providing stability for life on the surface. They function like pegs, securing the Earth's strata and preventing their disintegration (Najafī, 1377 Sh: 36).

In his commentary on *Sermon 91*, Ibn Maytham primarily discusses the formation of mountains but does not address their role in stabilizing the Earth. Given his period (the 7th century AH), when scientific knowledge had not advanced to its current level, his explanations regarding mountain formation lacked a solid scientific basis and contained errors. He attributes the formation of mountains to compressed gases that have lost their moisture or to the accumulation and elevation of soil in specific regions due to strong winds (Baḥrānī, 1375 Sh: 2/780).

Moreover, this commentator also mentions the detachment of a landmass due to an earthquake, which subsequently transforms into a mountain—an idea similar to the formation of fault-block mountains observed today (Ibid.).

From a scientific perspective, based on the principle of isostasy, the Earth's surface features remain in equilibrium with the underlying layers. Compared to other regions, mountains possess deeper and thicker roots, and the Earth's crust does not maintain a

uniform thickness everywhere (Ordway, 1972: 315). According to plate tectonic theory, the lithosphere is not a single continuous layer but is composed of distinct plates adjacent to one another. Beneath the solid crust lies the asthenosphere, which, due to extremely high temperatures, remains in a semi-molten state and interacts dynamically with the rigid crust.

To maintain this equilibrium, mountain regions—where the crust is thicker—extend deeper into the Earth, whereas in oceanic areas, the crust is thinner. The downward extension of mountains into the Earth's interior and their structural cohesion beneath the solid crust help mitigate ground oscillations and seismic activity, thereby contributing to the Earth's stability.

Considering that tectonic plates are not stationary but continuously in motion, massive mountain ranges tend to form along plate boundaries. Additionally, earthquake epicenters and volcanic activity are predominantly concentrated along these margins and are closely associated with mountain formation. Essentially, mountains forming at plate boundaries, with deep-rooted structures resembling pegs, serve to dissipate seismic shocks and tectonic stresses within those regions.

It is well known that the Earth exhibits both external motions in space and internal movements within its structure. Each of these motions occurs at distinct velocities. The Earth's rotational and orbital speeds are precisely calculated values. However, due to intense forces exerted by the molten interior upon the surface, the crust experiences significant vibrations. Given the Earth's vigorous motion, if mountains did not exist, each shift and force emanating from the planet’s depths could potentially disrupt and destabilize everything on the surface.

In Sermon 211, Imam Ali (a.s) refers to mountains as "pegs" of the Earth, explaining their role in preventing the Earth's crust from shaking and trembling. In the explanation of the Imam’s words: "أن تميد بأهلها", "أو تسيخ بحملها", and "أو تزول عن مواضعها", the following points have been mentioned:

The first phrase refers to how mountains prevent the Earth's surface from shaking, as in an earthquake, without the crust sinking inward. The second phrase highlights the role of mountains in cases where movements become so intense that they could cause the Earth's surface to collapse inward. The third

phrase suggests that mountains prevent the disintegration of landmasses due to strong winds, floods, or the separation of different geological layers.

Thus, mountains function like deep roots embedded in the Earth, preserving its structural integrity and preventing its disintegration (Hāshimī Khūī, 1358 Sh: 14/71).

Regulation of the Earth's Movements

The Earth, despite its various motions, is stabilized by mountains, which prevent excessive vibrations and disturbances. Mountains connect different layers of the Earth's crust, keeping them from slipping or shifting.

In Imam Ali's (a.s) statement "فسكنت على حركتها من أن تميد بأهلها" - Thus, the moving Earth became stabilized so that it would not shake with its inhabitants (Nahj al-Balāghah: Sermon 211), two key points are established:

1. The Earth is indeed in motion, exhibiting various movements such as rotation, revolution, axial precession, and nutation.
2. These movements are moderated by mountains, which were discussed in previous parts of the sermon. Their deep roots penetrate the Earth's crust, linking solid layers beneath and reducing oscillations, thereby reinforcing the Earth's stability.

Furthermore, the expression "أو تزول عن مواضعها" signifies that mountains help maintain the Earth's designated position, as ordained by God. In astronomy and the statements of the Imam, the Earth follows a specific orbit. Modern scientists affirm that the Earth occupies multiple positions within an elliptical orbit. Mountains play a role in holding the Earth's components together, preventing their dispersion, and ensuring stability in a defined celestial path. This perspective directly contradicts the claims of early scholars who believed in the complete immobility of the Earth (Shūshtarī, 1376 Sh: 1/516).

In addition to the Earth's movements in space relative to other celestial bodies, as discussed in plate tectonics, the Earth's crustal plates also move relative to one another. Since mountain

formation occurs along plate boundaries, the emergence of mountains helps regulate the movement of tectonic plates. At convergent plate boundaries, plates collide, causing the crust to fold and form massive mountain ranges. In regions where an oceanic plate collides with a continental plate, the denser oceanic plate subducts beneath the continental plate and melts due to the mantle's intense heat. Conversely, at divergent plate boundaries, molten magma rises to the surface as lava, forming a new oceanic crust (Figure 1). This continuous cycle of plate creation and destruction maintains the Earth's surface stability and prevents geological layers from disintegrating.

Overall, the formation of massive mountains along plate margins contributes to Earth's stability, even during tectonic shifts. Furthermore, earthquake epicenters and volcanic activity are often concentrated along plate boundaries and closely linked to mountain formation. The deep-rooted structure of mountains at these boundaries dampens violent tremors and seismic fluctuations. Encircling the planet like armor, mountains form a vast interconnected network deep within the Earth, reinforcing its structure and protecting it from catastrophic seismic disturbances.

Mountains as a Source of Earth’s Stability

Given the Earth's internal structure—where temperature and pressure increase with depth—deeper layers experience a gradual rise in heat. However, due to the immense pressure at great depths, rock materials do not become fluid but instead exhibit plasticity. In certain thinner crustal regions, these materials can move and, when pressure decreases, partially melt, leading to volcanic eruptions. It is known that the Earth’s crust is solid, the mantle is semi-molten, the outer core is liquid, and the inner core is solid.

Due to its rotational, orbital, and axial movements, the Earth would experience continuous slippage of its crust over the semi-fluid mantle layer if mountains did not exist. This would make life impossible and could even lead to the rupture of the crust. However, mountains, which extend skyward while anchoring deep into the Earth, effectively stabilize the crust by acting as pegs that secure it onto the mantle. The internal structure of mountains includes deep roots, interconnected intrusive masses, and

formations that penetrate between tectonic fragments, reinforcing the Earth's structural integrity. This cohesion prevents the separation of the Earth's layers, resulting in its stability (Lutgens, 1372: 292).

On the other hand, storms on Earth can either increase or decrease its movement speed. For example, in a 50 km stretch of the storm, if the average height of the mountains is assumed to be 2 kilometers, the speed of the Earth can be reduced or increased by 86 millimeters per second in the direction of the storm. Although this change is minimal, its impact is equivalent to the sudden explosion of 69 million 50-megaton hydrogen bombs. A 50-megaton hydrogen bomb is equivalent to 2,500 atomic bombs, the same as those dropped on Hiroshima, Japan. If the Earth were subjected to such impacts during violent storms, all life and its traces would be destroyed (see: Maktab Islam Journal, issue 8, 1351: 72).

However, mountains absorb these impacts and, like a flywheel, convert sudden speed changes into gradual changes, thereby calming the Earth. In other words, mountains act as a "flywheel" against the Earth's pressure fluctuations, preventing rapid speed changes. The flywheel in rotational machinery serves to regulate speed; for example, when external pressure is suddenly applied to such machinery and then released, it can cause a sudden forward motion, creating a jolt. However, if a flywheel is attached, it absorbs that pressure and gradually releases it, preventing any shock to the machine.

Numerous storms from various directions affect the Earth's movement. When the pressure from the storm dissipates, it transforms into an acceleration that could cause a severe impact on all living beings and disrupt everything. However, mountains act as a flywheel, absorbing all positive and negative pressures, preventing shocks, and maintaining the Earth’s balanced motion, thus preserving stability and preventing any disturbances.

If at the time these verses were revealed, there had been any discussion about concepts like 'flywheels' and their effects in the world of that era, the expressions in these verses would not seem so astonishing. But given that such topics had no precedent at the time, one must admit that the articulation of such verses constitutes a great scientific miracle.

In other words, based on the expressions found in Nahj al-Balāghah and the Quranic verses, when mountains are described as stabilizers that prevent the Earth from shaking and trembling, the nature and mechanics of this phenomenon were not understood in that era. It is only through the lens of modern science can the role of mountains in this regard be properly understood.

Mountains essentially serve as a steel armor encircling the Earth. Due to the connections and bonds they have deep within the Earth's crust, they form a powerful, continuous network. Had this not been the case and if the Earth's surface were covered by soft soils, the Earth would easily be affected by the strong gravitational pull of the Moon. The tides on land would cause the Earth to tremble, similar to the tides in the oceans, and anxiety, movement, and shaking would dominate the Earth's surface throughout the day, potentially destroying every building. However, the existence of this strong armor minimizes such tides. Even now, the Earth's rigid crust moves slightly up and down every day, unlike the oceans, where tides can cause several meters of movement up and down. The Sun's gravity also creates a much weaker tide, and when the Moon and the Sun align and their gravitational forces combine in the same direction, these movements become stronger and more intense (Rezaei Isfahani, 1381 Sh: 1/30).

Another factor, which was previously mentioned, is the internal pressure from the extreme heat inside the Earth, which continuously affects the Earth's crust. Without mountains, this would result in the Earth experiencing constant instability. If we imagine the Earth having a soft crust and consider the internal pressure and tidal movements acting on it, there would be no peace or stability on Earth. The molten materials in the mantle and the movement of the continents lead to earthquakes. The most important factor preventing the disintegration and separation of Earth's crust pieces is, in fact, the mountains. The deep roots of the heavy mountains that extend into the Earth's interior envelop and connect the crust pieces, much like nails fastening planks together, preventing them from separating and scattering. Earthquakes and volcanoes are the result of internal forces within the Earth, and therefore, the primary cause of earthquakes is the molten materials and tectonic pressures inside the Earth.

In this regard, it is stated in Tafsīr Al-Mīzān: *If mountains are described as nails, it may be because the formation of most mountains on Earth results from underground volcanic activity, where a point on the Earth's surface cracks open, and molten materials erupt, spreading outwards. Gradually, the area around this point rises until it forms a shape similar to a nail hammered into the Earth, which brings stability and calmness to the Earth, eliminating its trembling and oscillations* (Ṭabāṭabā'ī, 1379 Sh: 20/261).

Without mountains, the Earth would constantly be in a state of shaking and turmoil, and its pieces would separate and disintegrate. Additionally, during the Earth's movements, mountains, with their powerful roots, carry the surrounding air along with them. Now, if we assume that the Earth rotates at its current speed of approximately 30 kilometers per minute, and if there were no mountains and the surrounding air remained still, the constant impact of air molecules against the Earth's surface would generate severe storms and dust clouds. Moreover, such friction would create so much heat that everything would burn, much like how the wings of fast-moving airplanes become dangerously hot when flying at lower altitudes. For this reason, they are required to ascend to higher altitudes where the air is thinner and cooler to reduce the heat generated by air contact. However, the mountains on Earth solve this problem by spinning the massive atmospheric layer along with the Earth's rotation, much like the teeth of a gear turning other objects. Thus, mountains contribute to the stability of the Earth and its inhabitants by protecting against the gravitational pull of the Moon and the Sun, internal pressures, constant violent storms, and unbearable heat.

Mountains create a chain-like network within the Earth that resists the gravitational forces of the Moon and the Sun. Without this, massive tidal forces would occur in the Earth's crust, resembling ocean tides, making life impossible for humans. Mountains act as the primary force preventing floods and storms, resisting the winds of hurricanes. Furthermore, mountains help distribute air currents. Without mountains, the speed and intensity of these winds would increase several times over. In deserts and barren wastelands, where there are no mountains or other obstacles, everything is vulnerable to dangerous storms and

shifting sands, causing significant damage.

The irrigation system of the Earth through mountains and the connection between mountains and streams is also very important. This is because many mountains on Earth store water, which has turned into snow at their peaks or in the crevices of their valleys. Gradually, this snow melts, and according to the law of gravity, the water flows from higher regions to lower, more expansive areas, irrigating many lands throughout the year. On the one hand, mountains cause the accumulation of water vapor and the condensation of clouds, and on the other hand, they cause the adjacent air to cool. As a result, a large portion of precipitation is stored as snow and ice, preventing it from being wasted, and forming a continuous source for surface water flow.

The Earth, with its plains, mountains, highlands, and valleys, is a sign of the divine wisdom of creation. If the Earth were uniformly flat and lacked mountains and elevations, rain and snow would not remain on the surface, and the entire Earth would become a swamp, which would create many difficulties for life. The creation of mountains offers many benefits. The Earth is irrigated through the mountains. The snow accumulated in the heights of the mountains gradually melts, either infiltrating into the ground and being transferred to underground reserves, or emerging through springs or flowing down the slopes of the mountains, forming small and large streams.

In one of his sermons, Imam Ali (a.s) refers to this benefit of mountains: "*He caused springs of water to gush forth from the nostrils of the mountains and distributed them across the open plains and deep channels and valleys*" (Nahj al-Balāghah: Sermon 91).

In both the Quran and Nahj al-Balāghah, when mentioning the creation of mountains, the emergence of springs and rivers is also highlighted, as these are manifestations of divine creation and essential for human life. The reason these two phenomena are mentioned together is that the springs and rivers originate within the mountains. In addition to gathering rainwater, the air at high altitudes is very cold, and snow and rain are stored there like natural ice vaults. For much of the year, the mountain surface is covered in snow and ice due to a decrease in temperature. During the warmer seasons, the snow and ice gradually melt, turning into flowing springs, and the majority of this life-giving water is

supplied through the mountains.

On the other hand, when rainwater passes through different layers of the mountains, it undergoes "sandy filtration." Sandy filtration refers to the process where water passes through sandy layers, which helps filter out foreign materials from the water. Mountains are the main reservoirs of water. By creating valleys, they direct water downhill according to the law of gravity, which ensures that trees and crops are irrigated and grow. This process also leads to the formation of streams and the development of lush natural landscapes and other divine blessings.

Mountains also serve as shelters and habitats for living beings. As mentioned earlier, due to the Earth's translational and rotational movements, if mountains did not exist, severe friction would occur between the stationary air at the Earth's surface and the moving Earth, making life impossible. However, the presence of mountains allows the stationary air to move with the Earth, preventing friction. Mountains significantly increase the usable surface area of the Earth and, due to the temperature variations at different altitudes and slopes, provide a highly diverse environment for the cultivation of various plants and crops. Additionally, mountains contain vast mineral deposits, which play a crucial role in human life, and the construction materials used by people are sourced from mountain stones.

Conclusion:

Through studying mountains from a geological perspective and examining the way they form, as well as reflecting on the references to mountains by Imam Ali (a.s), it has become evident that, as modern geological findings suggest, the formation of mountains is linked to the movement of tectonic plates. The theory of plate tectonics has clarified that mountains are created at the boundaries of these plates, which are pieces of the Earth's crust. This concept is also reflected in the statements of Imam Ali (a.s).

As Imam Ali (a.s) mentioned, mountains act like pegs in the Earth, and this is due to their internal structure. Furthermore, the rootedness of mountains was confirmed by the theory of isostasy, as mountains, because of the thickness of the crust and to maintain balance, have greater thickness beneath them.

Imam Ali (a.s) consistently referred to the calming role of

mountains in his statements, and from a scientific perspective, this is linked to several factors. Since mountains act like armor, encasing the Earth, with their roots extending deep into the ground and having internal connections with each other, they provide stability and prevent the shaking of the Earth. This is because they serve as the binding force that connects the pieces of the Earth's crust.

In his mention of the other benefits of mountains, Imam Ali (a.s) points to the emergence of springs from the mountain peaks, the flowing of waters down the slopes, and the formation of rivers and water systems. All of these phenomena are scientifically explained and confirmed by modern science.

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