AL-QUR'AN AND MODERN GEOSCIENCE: PART I

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Abstract : Islamic tradition and science have been going through a long history. The Islamic world centred in the Middle East was once a centre of knowledge that was marked by the birth of prominent Islamic scientists and the development of knowledge and technology. Islamic tradition and science are naturally integrated. For instance, it can be seen from the necessity of Earth science knowledge in Islamic ritual practising. However, the decline of Muslim civilization also had an impact on science, including in the field of geoscience. This paper seeks to explain the relationship between the Tafsir al-Qur'an and geoscience, among of them are about the creation of the earth, the structure of the earth, as well as tectonic and volcanism, wherein al-Qur'an they are delivered in many parts.
Keywords : Tafsir al-Qur'an, geoscience, tectonic, volcanism.

Abstrak : Tradisi Islam dan sains mengalami sejarah yang panjang. Dunia Islam yang berpusat di Timur Tengah pernah menjadi pusat pengetahuan yang ditandai dengan lahirnya ilmuan Islam terkemuka dan pengembangan pengetahuan dan teknologi. Tradisi Islam dan sains terintegrasi secara alamiah termasuk integrasi antara ilmu kebumian dan peribadatan ummat Islam. Namun, kemunduran Islam juga berdampak pada kemunduran di bidang sains, termasuk pada bidang kebumian. Makalah ini berupaya memaparkan hubungan antara tafsir-tafsir Al-Quran dengan ilmu kebumian, diantaranya penciptaan bumi, struktur bumi, serta tetonika dan vulkanisme, dimana hal tersebut telah disebutkan di beberapa bagian di dalam Al-Quran.
Kata kunci : Tafsir Al-Quran, ilmu kebumian, tektonika, vulkanisme.

Introduction

Science and religion interact from time to time. The results of these interactions can produce conflict, differences, debate, competition and integration as well (Herman, 2001; Sweet & Feist, 2007). In the field of science, the interaction of science and religion is not only in the philosophical area, but also reaches the practical level (Hameed, Ahmed & Bawaniy, 2019). Several fields of science have interacted with religion including: physics, biology, geography,

mathematics and chemistry (Barr, 2003). Meanwhile, cosmology which is one of the subdivisions of physics is the most prominent and directly intersects with religion and beliefs (Fitzgerald, 2013). In fact, in the texts of the Scriptures, the creation of the universe is mentioned and explained explicitly.

Like other religions, Islam experienced an intense interaction with science as well. This interaction has occurred from century to century, even though during the period, the interaction of both occurred in tides. In the 19th century, for example, Islam and science interacted both materially and intellectually. At that time, the Ottoman Empire needed western science and technology to defend themself in confrontations with other countries (van Huyssteen, 2003). In the development of Islamic civilization, Islamic and scientific traditions are not something new to be correlated. Even basic sciences such as mathematics and astronomy have naturally been integrated with Islamic traditions since the Middle Ages (Dixon, 2008).

In addition to the fields mentioned above, geoscience has long been integrated into Islamic culture. In the range of the 8th century until the 15th century, there have been a number of Islamic scientists in the field of geoscience, including: Thabit bin Qurra, (Rashed, 2009) Al-Khawarizmi, Abdul Ibn Khuradadhbih, Abu Rahyan Al-Biruni (Kamiar, 2009), Al-Zarqali, Ibn Jubayr, Al-Qazwini, and Ibn Battuta (Muzaffar, 2007). At that time, geoscience, especially in the fields of geography and geodesy became serious concerns. One reason behind this is that geographical and geodetic studies such as mapping needed by Muslims to support Islamic ritual activities. For example, geography is needed to assist the pilgrimage route and the determination of the Qibla direction (Muzaffar, 2007).

Along with the deterioration of the Islamic civilization, today science and technology are far from the reach of the Islamic world. It can be seen by the absence of Islamic scientists leading in the fields of science and technology, including in geoscience. In fact, Islam and geoscience have strong and interesting relationships to correlate and or to integrate with. Geoscience is directly needed in supporting Islamic ritual activities. Even it is not only on a practical level because there are 178 verses in al-Qur'an, which mention the word of earth and sky (*al-samawatu wa al-ardhu)* together (al-Baqi, 1997).

This paper is aimed to describe some of the fundamental theories in the field of geoscience which are related to interpretations of al-Qur'an. Theories that will be explained include: the creation of the earth, the shape of the earth as well as tectonics and volcanism. This study is expected to be a preliminary study to stimulate efforts to integrate Islam and the field of modern geoscience in the future.

The Creation of the Earth

The process of creating the sky and the earth is found in several verses in the al-Qur'an, including: Q.S. Hud: 2, Q.S. Al-Anbiya': 30 and Q.S. Fushshilat: 9-12. In al-Qur'an, the word of the earth (*al-Ardu*) is often paired with the word of the sky (*al-Sama'* or *al-Samawat*). Information about the creation of the universe in al-Qur'an is not systematically arranged and collected in a single fragment. This is basically because al-Qur'an is not a scientific script that is systematically and coherently explaining the certain natural phenomenon. Allah said creating the universe by using not only the word of *khalaqa*, but also using other words such as *Ja'ala*, *Bada'a*, *Fathara*, *Shana'a*, *Amara*, and *Nasya'a* which have basically the same meaning, creation, but their real meaning is not necessarily the same. The word of the earth is repeatedly mentioned in al-Qur'an. It also shows how important the position of the earth in the universe for life. The earth is the only planet in the solar system which has water, (Gibney, 2014) its atmosphere is rich in oxygen, (Nun, 1968) it has silica-rich rocks like granite, ocean and continental crust structures and magnetic field (Stacey & Davis, 2008).

The word of "*Samâwati wa al-Ardhi*" which means the Sky and the Earth also exists in Q.S. Al-Anbiya': 30. The explanation shows that in the beginning, the two were a unity (ratqan) and then separated. This explanation is probably relevant to the concept of modern cosmology. Our understanding of the evolution of the universe is based on the Friedman-Robertson-Walker (FRW) cosmological model, or what is commonly referred to as the big bang model. The key to this theory is the notion that the universe was originated from singularities and then continuously expands (Kolb & Turner, 1989; Disalle, 2006; Plebański & Krasiński, 2006). During the expansion, galaxies mutually move away from each other. This theory is reinforced by the results of observations made by Hubble (1929). Nevertheless, this theory still remains many questions (Lal & Joseph, 2010), but the big bang theory can be considered as a relatively satisfying theory to answer fundamental questions about the history of the universe (Fox, 2002).

Several interpretations that have been explained attempt to elucidate the process of creating the universe and the earth. However, it was still found that there were several confusing concepts in the identification between the creation of the universe, earth and or other celestial objects. For example, some interpretations said that in the early formation, the universe consisted of water (Ash-Shiddiqy, 1995; Katsir, 1969). In fact, according to modern cosmological theory, the early era of the formation of the universe was called the very early universe, which was the interval between Planck time to the era which was dominated by radiation. At this time, molecules such as water have not yet formed, even protons and neutrons as constituents of atoms were still in the formation stage (Chow, 2008). Ibn Katsir interpreted that in the early stages of the formation of the universe, the material of the universe consisted of dukhân (Katsir, 1969).

This interpretation might be relevant to star formation and star systems. Through telescope observations, there are interstellar clouds called nebulae. This interstellar cloud consists of hydrogen molecules and some carbon-based molecules. Therefore, these clouds are also referred to as molecular clouds. Through gravitational interactions, the clouds then become "seeds" of new stars (Gargaud, Martin, López-García, Montmerle, & Pascal, 2012).

How long was the universe created? Al-Qur'an presents in many verses that God created the universe, both the sky and the earth, as long as six days (*Fî Sittati Ayyâm*). Verses of al-Qur'an that explain the creation of the earth including Q.S. As-Sajadah: 4. Some tafsir experts try to interpret the period of creation in physical time units (Al-Qurthubi, 1952; Uddin, 1995). However, according to researchers that the aim of mentioning time in numbers in these verses is to show that the creation of the earth took place gradually and periodically. In general, the earth was created through two stages. Firstly, when the earth was in 4.56 Giga years old, it was completely dry, no atmosphere and no oceans, and it was filled with enstatite-like chondrite material. Secondly, asteroids consisting of carbon chondrites hit the earth which then made the earth to have oceans and atmosphere (Maruyama & Ebisuzaki, 2017).

The Structure of the Earth

The shape of the earth is basically not really a sphere. However, for the sake of geodetic calculations and other analyzes the earth can be considered spherical (Stacey & Davis, 2008). One of the words of Allah in Q.S. Luqman: 29 shows that the earth is round or a sphere. The verse says: "*Do you not see that Allah causes the night to enter the day and causes the day to enter the night and has subjected the sun and the moon, each running [its course] for a specified term and that Allah, with whatever you do, is Acquainted?*". In the above verse, there is a phrase "*causes the day to enter the night*". This sentence can be interpreted that there is a gradual and slow change from the night to the day and vice versa. This phenomenon can only occur if the earth is round. If the earth is flat, then there are definitely drastic or sudden changes from the night to the day and from the day to the night.

Al-Qur'an also reveals that the shape of the earth is round through the Q.S. Al-Zumar: 5, which means: "*He created the heaven and the earth with the Truth; He rolls the night over the daytime, and He rolls the daytime over the night, and He has subjected the sun and the moon, each of them running to a stated term. Verily He is The Ever-Mighty, The Superb Forgiver*". The above verse uses the word "*kawwara*". In Arabic "*kawwara*" means overlapping or circular, like a turban cloth which is rolled on the head. Overlapping or circular events which alternate day and night can only occur if the earth is round. From the two verses above it can be understood that according to al-Qur'an the shape of the earth is round.

Meanwhile, al-Qur'an also explains that the earth has seven layers, as the word of God in the Q.S. Al-Thalaq: 12 and Al-Mulk: 3. The mention of this layer probably does not refer to the physical layer that can be investigated scientifically. The mention of the number of layers is explicitly intended to ignite human curiosity about the structure of the earth. The earth itself composed of four main layers which consist of: the inner core of the earth which is solid, the outer core is liquid, the earth's mantle and the crust of the earth as the outer layer of the earth. The outer layer has a thickness of 40 km or about 0.63% of the earth's radius. Earth's crust consists of continental crust and an oceanic crust that "floats" above the earth's mantle (Romanowicz, 2008).

As a result of the current structure of the earth, the earth is very suitable and comfortable for human life. Allah says in Q.S. Al-Mu'min: 64, it means: "*Allah is He who made the earth for you a resting place and the heaven as a roof and shaped you, then made your shapes nice and provided you with good things This is Allah your Lord. So blessed is Allah, the Lord of the entire world*". The heaven (sky) as a roof shows that space above the earth's crust is a protective shield for human life. As a result of the structure of the earth in such a way, the earth has two principles to protect life from celestial objects which could be dangerous at any time. The shields are the magnetic field and the earth's atmosphere. Magnetic fields are generated by the motion of iron-rich fluids within the earth's core layer (Buffet, 2000). The magnetic field generated by the earth's core can withstand the earth from solar storms (Tarduno, Cotrell, Watkeys, Hofmann, Doubrovine, Mamajek, Liu, Sibeck, Neukrich & Usui, 2010) which can interfere our survival (Hrushesky, Sothern, Du-Quiton, Quiton, Rietveld & Boon, 2011; Skjærvø, Fossøy& Røskaft, 2015).

Tectonics and Volcanism

Plate tectonics theory is a modern geological theory that is able to explain various earth phenomena such as earthquakes, volcanic eruptions, mountain formation and continental movements. Tectonic theory can be summarized in the following points: (1) Plates are pieces of the lithosphere . (2) An Earth's plate can consist of oceanic and continental crust. (3) Earth's plates are composed of hard and strong rocks. (4) A plate floats above a layer of hot, plastic-filled asthenosphere. (5) The plate moves horizontally and little vertically. (6) The boundary between plates is an active tectonic area and is the most dominant place for volcanoes and earthquakes. (7) Plate tectonics move at speeds between 1 and 16 cm/year (Saunders, 1972; Oreskes, 2003; Thompson & Turk. 1997).

Some verses talk about the earth-shaking, including Q.S. Ar-Raad: 31; Q.S. An-Nahl: 15; Q.S. Al-Anbiya: 31; Q.S. Al-Waaqiah: 4, Al-Muzammil: 14, Al-Fajr: 21; Al-Zalzalah: 1 and Al-A'raf: 155. Earthquakes are caused by several processes, including earthquakes occur due to the release of rock stress due to tectonic processes and magma intrusion from within (Thompson & Turk. 1997).

Earthquakes will be very difficult to explain without understanding the plate tectonic process (Dumoulin, Berecovici & Wessel, 1998). Although earthquakes occur randomly, the earth's crust which consists of plates causes earthquakes to be localized at several points on the earth's surface. The location mostly occurs in the boundary area between plates, faults or fractures (Kagan & Jackson, 2011). Most of the verses in al-Qur'an describe earthquakes as destructive warnings or phenomena. It is intended to encourage us to think, both to explain earthquakes as phenomena and anticipate the destructive effects they cause.

Wegner (1912) proposed the theory of the presence of a supercontinent called Pangea (Nance & Murphy, 2013). Then the single giant plate spreads out to fill the hemisphere. Some evidence has been provided to support this theory, including: (1) the suitability of the margins of the African and South American plates (Meservey, 1971), (2) the same age of rocks between regions on the continent (Schenk, 1971), (3) the discovery of similar fossils on different continents (Sousa, 2016) and (4) traces of climate change (Li, de Figueroa, Le, & Park, 2015).

Mountain formation is shown in Q.S. Al-Hijr: 19, meaning: "*And the earth We spread out, and placed therein firm mountains, and caused to grow therein all kinds of things in due proportion*". According to Ibn Abbas Sa'id ibn Jubair, Ikrimah, Abu Malik, Mujahid, Al-Hakam ibn Uyaynah, Al-Hasan ibn Muhammad, Abu Saleh, and Qatadah, this verse shows that all creation, including the creation of mountains, is carried out proportionally (Katsir, 1969). The meaning of proportions can also be extended, that the events of mountain formation do not occur randomly, but systematically and can be explained sequentially. The formation of volcanoes can be explained simply through plate tectonic theory. In some places, the earth's plates can move away from each other due to the rise in the material of the earth's mantle to the surface and then push and/or press the plates. Meanwhile, on the other hand, the plate's side crash into other plates. This process occurs continuously and very slow (Parrifit & Wilson, 2008). In this area, many volcanoes come up.

The formation of mountains allows humans to take the mineral resources of the earth to be utilized in human life. In Q.S. Al-A'raf: 74, means: "*Remember how you were made the heirs of 'Ad and settled in the land, capable of building mansions in the valleys and carving out homes in the mountains. Therefore, remember the favours of Allah and do not spread mischief in the land* ". Although Ibn Kathir interpreted this verse as the story of the 'Ad (Katsir, 1969), this verse also shows that the mountains were created to support human life. The formation of mountains is very closely related to plate tectonics. The formation of mountains is the implication of plate tectonic processes. All mineral resources, gas and their appearance are determined by tectonic and environmental processes. Therefore, it can be concluded that the existence of tectonic processes is to support life and to improve human welfare. This is reinforced by Q.S. Al-Fatir: 27, which means,

"*Do you not see that Allah sends down rain from the sky with which We bring forth fruits of various colours? Similarly, in the mountains there are streaks of various shades including white, red, jet-black rocks*". Lava rocks in the mountains are black (Garcia, Weis, Swibbard, Ito & Pietruszka, 2015.) and colourful ones are caused by alterations in rocks.

Al-Qur'an also explains explicitly that mountains were created to withstand the earth from shaking. As in Q.S. An-Nahl: 15, means: "*He has placed into the earth firm mountains, so it does not shake with you, as well as rivers, and pathways so you may find your way*.", and Q.S. Al-Anbiyaa: 31, means: "*And We have placed firm mountains upon the Earth so it does not shake with them, and made in it broad pathways so they may find their way*". As an implication of the plate tectonic process, mountains can be connected to seismic processes both directly and indirectly. Plate movement can be simplified as a process of transfer of material and heat under the earth's plates called a convection process. Material displacement in this process caused by the differences in temperature, pressure and density. The main pressure difference comes from the temperature gradient from the atmosphere to the centre of the earth. The difference in pressure causes the material in the earth to be pushed to the surface (Zobin, 2003). Fractures of the earth's plates and volcanoes allow for a thermodynamic balance between the atmosphere and the earth's interior. This balance is needed because the earth's core continues to produce heat through nuclear reactions. The volcanoes act as pores that maintain balance to prevent simultaneous explosions of the earth's crust due to enormous pressure from within. Piece of Q.S. An-Nahl: 15, means, "*And He planted mountains* ..." possibly related to the principle of isostasy. The topography of the earth's surface is closely related to changes in crust thickness. The basic principle is that mountains which are higher than other surfaces have "roots" that protrude downward in an effort to achieve hydrostatic balance (Dutton, 1882). Whereas in the paradigm of modern isostation, the topography is also related to buoyancy and lithospheric density (Gvirtzman, Fecenna & Becker, 2016). Mooney, Ritsema & Hwang (2012) proposed a model the relationship between the frequency of earthquake's occurrence and lithosphere thickness in both lower crust and sub-crustal lithosphere. The results of the model show that the thicker the layer of the crust with material that "protrudes" downward has the fewer earthquake's frequency. However, the frequency of the earthquake is also related to the physical properties of the crust, such as density, strength and temperature. Therefore, the existence of mountains with higher topography is intended to create balance and suppress the earthquakes.

Conclusions

Al-Qur'an describes the modern geoscience, especially on the subject of the earth's creation, the structure of the earth and the phenomenon of tectonics-volcanism.

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Q.S. Al-Anbiya' (21): 30, 31.

Q.S. Al-Zumar (39): 5

Q.S. As-Sajadah (32): 4

Q.S. Al-Thalaq (65): 12

Q.S. Al-Fajr (89): 21;

Q.S. Al-Fatir (35): 27

Q.S. Al-Fushshilat (41): 9-12.

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Q.S. Al-Waaqiah (56): 4,

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