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Is the Moon's Orbit "Ringing" from an Asteroid Collision Event which Triggered the Flood?

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Abstract

We use ordinary Newtonian orbital mechanics to explore the possibility that near side lunar maria are giant impact basins left over from a catastrophic impact event that caused the present orbital configuration of the moon. We hypothesize that this collision was responsible for triggering the Noahic Flood. The results show that a collision of an asteroid swarm equivalent to a single ~80 km diameter rocky asteroid moving at parabolic velocity was sufficient to cause the present radial orbital oscillations of the moon, assuming that the orbit was originally circular.

Keywords

Noahic Flood, Asteroids, Mare, Lunar impacts, Astronomical catastrophes

Introduction

A major cause of the universal Flood undoubtedly included massive volcanic and seismic activity. A major constituent of volcanic plumes is ordinary water vapor. Volcanic eruptions are followed by heavy precipitation. I suggest this was a major source of floodwater. I have long considered the possibility that such activity could have been initiated by catastrophic bombardment by asteroids or cometary bodies striking the earth. In a related scenario, catastrophic plate tectonics (CPT) is a viable cause of the universal Flood (Austin, Baumgardner, Humphreys, Snelling, Vardiman, & Wise, 1994). Such an asteroid bombardment could very well be the trigger that cracked the ocean floor adjacent to the supercontinent setting the CPT event in motion (Snelling, 2007; Spencer 1998b).

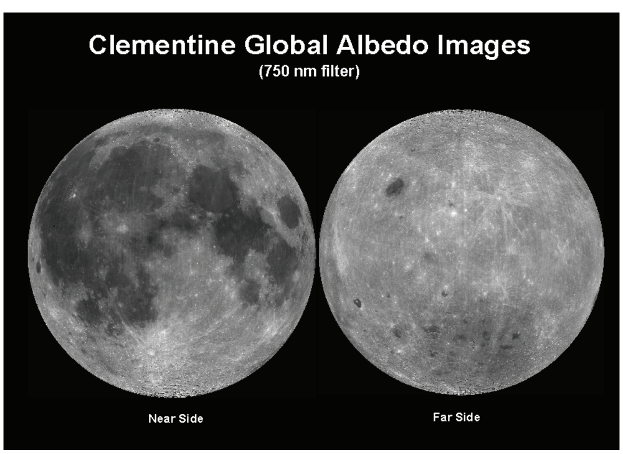

Figure 1. The near and far side of the moon, Clementine Space Craft, JPL.

The Distribution of Lunar Mare

Lunar maria are basaltic flood plains resulting from lava flows filling giant (140 to ~2500 km) crater-like basins. They are thought to result from asteroids striking the surface of the moon and subsequent volcanism (Melosh, 1996). Some 31% of the near side surface area of the moon is taken up by mare, while only 2.5% of the far side surface is covered by mare (Gillis & Spudis, 1996). Twenty-three of these objects litter the near side. See the accompanying Figure 1.

There are two notable maria on the far side of the moon, Mare Orientale and the Aitkin Basin. Orientale has a distinctive bull's eye appearance, which lends strong evidence to its asteroid origin. Its inner ring is 300 km in diameter while its outer ring is 900 km in diameter. The largest maria are Oceanus Procellarum on the near side and the Aitken Basin which is near the south pole on the far side. Both are larger than 2000 km in diameter. Aitken is believed to be due to an oblique impactor and has a strange ragged shape. I conclude from the distribution of the maria, except for the two notable exceptions on the far side, that asteroids hit preferentially on one side of the moon—the side facing the earth. I explore here the idea that this was due to a catastrophic impact by a single asteroid swarm that struck not only the moon, but also the earth, initiating the Flood. The massive bombardment on the near side of the moon attests to such an event.

Uniformitarian Formation of the Moon

The usual uniformitarian history of the moon is recounted in any modern day astronomy text (for example, Freedman & Kaufmann, 2007). The moon's formation is believed to be caused by a 2× mars mass planet striking the earth with a glancing collision. The scattered crustal debris from this event regathered following the collision to produce the present moon about 4.6 billion years (Gyr) ago. This was followed by a period of intense bombardment creating the lunar highlands. Large asteroids supposedly struck the moon between 4.0 and 4.4 Gyr gouging out the mare basins. Within the next Gyr or so, magma surfaced through cracks and fissures from hundreds of kilometers deep filling the basins and thus hardening to form mare. Isotopic results give dates of about 3.5 Gyr (3.1 to 3.8 Gyr) for the crystallization of the mare. This interval was followed by a period of very light bombardment which includes the present.

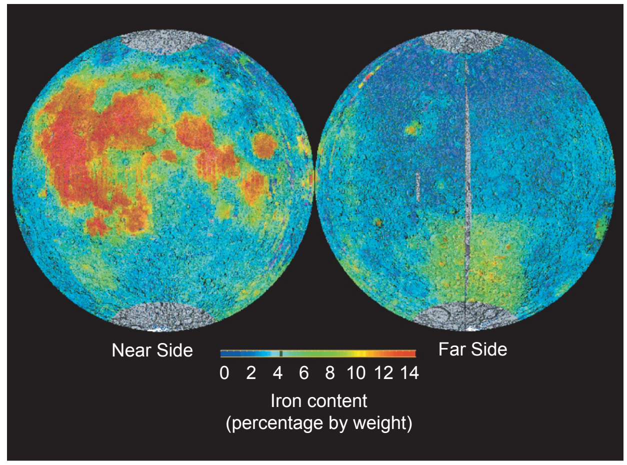

Figure 2. Iron distribution on the moon matches the position of the mare and gives evidence of their origin by irony meteoroids, Clementine Space Craft, JPL.

Creationary Comments

Highland rocks are largely anorthosite of isotopic ages from 4 to 4.3 Gyr. They are not quite as old as oldest rocks known. In a creationary context and assuming the RATE hypothesis (Vardiman, Snelling, & Chaffin, 2005), if accelerated decay began on Day 3 (at the creation of the earth), the moon was not created until Day 4, the isotopic ages would show that its "oldest" rocks underwent less decay than earth rocks. As far as lunar maria basalts, whose isotopic ages are 3.1–3.8 Gyr, we suggest in this article that they may arise from collateral materials from asteroids that blasted the earth at the outset of the Noahic Flood. Accelerated decay is indicated by their isotopic age. Mixing of young materials from the asteroids with old lunar materials is also possible. Mixing can produce an apparent isochron (radioisotopic age) that has an average aggregate age of the original material.

The Time Frame of the Collision Event

However, the problem still stands. Why is the near side of the moon populated with scars of a large meteorite bombardment while the far side is not? *Why would asteroids strike the moon preferentially one side of the moon over the course of a half a billion years?* It is most likely that we are observing the aftermath of a single event, a single swarm or a single large asteroid or planetoid that broke up (possibly due to tidal forces as it approached the earth) and pieces of it stuck the moon in one episode. Since the period of the moon's sidereal rotation is 27.3 days and the mare cover only about a 70% spread across the lunar surface, the maximum time interval for this event would be about 10 days. I prefer a much shorter time frame. An interesting image of the moon was obtained from the Clementine mission (Figure 2). It shows that the heaviest mineral iron concentrations match the *mare on the near side.* Since meteors are known to be largely composed of iron, is it possible that the object or swarm of objects that struck the moon partially liquefied, filling the newly made mare basins, all in one event? Thus, the entire formation of the mare could have occurred over a span of a few days—the time it took the molten rock to crystallize.

The Lunar Cataclysm Hypothesis

A similar, albeit old age, hypothesis, similar to our own is the *Cataclysm Hypothesis* (http://www.lpl.arizona.edu/SIC/impact_cratering/lunar_cataclysm/Lunar_Cataclsm_Page):

> Analyses of lunar samples collected by Apollo astronauts revealed a surprising feature: the crust of the Moon seems to have been severely heated ~3.9 billion years ago, metamorphosing the rocks in it. Scientists (Tera, Papanstassiou, & Wasserburg, 1974) suggested this metamorphic event may have been created by a large number of asteroid and/or cometary collisions in a brief pulse of time, <200 million years, in what was called the lunar cataclysm.
>
> If a lunar cataclysm really occurred, then lots of impact melted rocks with that same age should also exist. And, indeed, additional analyses of impact melts collected by Apollo astronauts revealed a range of impact ages, but, significantly, none older than 3.8 Ga (Dalrymple & Ryder, 1993; 1996). This also seemed to imply a lunar cataclysm ~3.9 Ga, which completely destroyed or metamorphosed impact melts produced by older impact events.

This cataclysm was to have produced a massive bombardment of the earth's surface. Recent samples, beginning 1981, have been found on earth, which are very similar to the Apollo rocks. These are believed to be debris from meteorites that were delivered to the earth from impact events on the moon. The ages revealed that none were older than 3.85 Ga (Dalrymple & Ryder, 1993, 1996). This also seemed to imply a

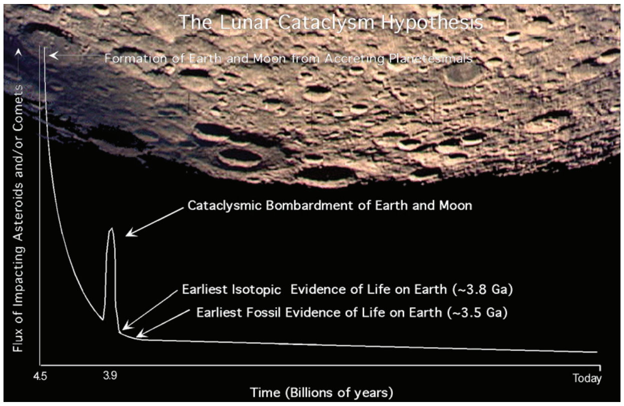

Figure 3. Lunar Cataclysm Theory. Large crater features up to 1000 km in diameter apparently result from the cataclysm that covered a brief interval of Geologic time. (http://www.lpl.arizona.edu/SIC/impact_cratering/lunar_cataclysm/Lunar_Cataclsm_Page): Permission: Data Manager - Maria Schuchardt at mariams@pirl.lpl.arizona.edu

lunar cataclysm ~3.9 Ga, which completely destroyed or metamorphosed impact melts produced by older impact events. While we do not accept these absolute ages, we do believe that these rocks are associated with their lunar counterparts and may arise from the same event. This seems to lend credibility to the claims of our article. See Figure 3.

The Moon's Orbit

The moon has a low eccentricity (e=0.05490) elliptical orbit. It can be well represented as a circular orbit undergoing radial oscillations. Such a configuration can result from a small oscillation Newtonian orbit that is caused by a sudden perturbation such as an asteroid strike. This type of orbit is of interest here since the period of radial oscillation, the "ringing" component possibly caused by the collision, has the same angular frequency as the periodic revolution of the angular component. The two motions, radial and angular combined, result in an orbit that appears to be an off centered circular orbit. Such an orbit is essentially identical to the present low eccentricity orbit. Is the perturbation that caused this "ringing" in the moon's orbit an asteroid collision? Is the moon's orbit a major clue from our creator that such an event actually took place? Could a swarm of asteroids have struck the earth in the past with the moon suffering impacts as "collateral damage" (see Figure 4)?

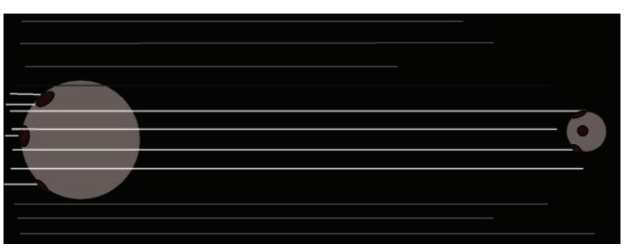

Figure 4. The moon was collateral damage.

The Supernatural Cause

The existence of such orbital streams of asteroids has no present day counterpart. Belts of such debris do exist following the orbits of present and former comets but they contain only micron-sized dust and ice particles which result in meteor showers when the earth passes through them. Asteroids and Kuiper belt objects mostly follow fairly low eccentricity, low inclination orbits. Of course, the multitudes of crater features on the solid surfaces of rocky and icy "worlds" in the solar system (planets, moons, dwarf planets, asteroids and comet cores; Faulkner, 1999; Spencer, 1994) attests to the possible former existence of asteroids in highly elliptical orbits. However, we are not advocating a *naturalistic* or *accidental* cause for the Flood. We are proposing that God created the object or swarm of objects for the purpose of initiating the Flood, for the judgment of mankind for his gross sin and willful disobedience. There was a supernatural cause to the hypothesized event, if indeed, the event took place.

The Theory of Small Oscillations Orbits

Let us review the Newtonian mechanics theory of small oscillation orbits (Symon, 1971). The force due to gravity is a conservative one and a central force which we represent by $\boldsymbol{F(r)}$, so we may write,

$$\vec{F}(r) = -\vec{\nabla} V$$
$$\vec{\nabla} \times \vec{F} = 0$$
$$V = -\int \vec{F}(r) \bullet d\vec{r}.$$

where V is the gravitational potential. Since, the torque, N, is zero,

$$\vec{N} = \vec{r} \times F(r)\hat{r} = \frac{dL}{dt}$$

where L is the orbital angular momentum, the orbit of a two body system is confined to a plane, where r and θ are the plane polar coordinates:

$$L = mr^2\dot{\theta} = \text{constant} \tag{1}$$

The radial acceleration in the plane is,

$$\vec{a} = (\ddot{r} - r\dot{\theta}^2)\hat{r} \tag{2}$$

From (1) and (2) we write:

$$F(r) = m\ddot{r} - \frac{L^2}{mr^3}$$

The effective potential,

$$V_{eff} = -\int (F(r) - \frac{L^2}{mr^3})dr$$

$$V_{eff} = V(r) + \frac{L^2}{2mr^2}$$

For gravitation,

$$V = -\frac{K}{r},\ K = GMm$$

$$V_{eff} = \frac{-K}{r} + \frac{L^2}{2mr^2},$$

where m is the mass of the moon, 7.353×10^{22} kg and M is the earth's mass, 81.301 m.

Minimizing this potential, and solving for r_0, the radius of minimum energy, a circular orbit, for this,

$$\frac{d^2V_{eff}}{dr^2} > 0$$

The frequency of radial oscillations is

$$\omega_r = \sqrt{\frac{\frac{d^2V_{eff}}{dr^2}\Big|_{r=r_0}}{m}} = \sqrt{\frac{K}{mr_0^3}}$$

From the angular momentum for a circular orbit we obtain the period angular motion,

$$\omega_\theta = \sqrt{\frac{K}{mr_0^3}}$$

so $\omega_\theta = \omega_\gamma$, the period of radial oscillations is the same as the period of the "circular motion." Thus, the motion is that of an off-centered circle.

A well known and easily derived relation between energy and eccentricity is:

$$E = \frac{mK^2}{2L^2}(e^2 - 1) = \frac{GMm}{2r_0}(e^2 - 1)$$

where $r_0 = 384{,}401{,}000$ m.

Calculating E for $e=0.05490$ and for $e=0$ and subtracting the two, we obtain the energy above the ground state for the present lunar orbit, $\Delta E = 1.14943\times10^{26}$ J.

The parabolic velocity, v_e, for our asteroid in the vicinity of the earth's orbit is 42,000 m/s. From,

$$\frac{1}{2}m_a v_e^2 = \Delta E$$

we obtain a combined asteroid mass, $m_a = 5.8\times10^{18}$ kg. We assumed an asteroid density of 3.0 g/cm^2 (rocky asteroids). The lunar density is 3.341 g/cm^2. From this we obtain an asteroid diameter of ~44 km if *all* the impactor kinetic energy goes into orbital energy. Further, if we divide the asteroid it up into 23 fragments (the number of nearside mare: see the next section for a thorough discussion), the average size would be ~15 km. This is a major asteroid in its own right. Such an asteroid would produce a 550 km diameter mare which is well within the normal range of average sizes of maria (140 to ~2500 km). It is of interest that this result immediately fits into the realm of possibility. A better agreement arises when we consider that much of the expended work goes into "internal energy" to create a crater and possibly induce a lava flow or melt. The remaining energy would become orbital energy. Here we introduce a coefficient of restitution, η to evoke an inefficient energy transfer. In a collision, the relation between initial and final velocities of the two bodies is given by "Newtons' equation,"

$$(v_{2f} - v_{1f}) = -\eta(v_{2i} - v_{1i})$$

where $\eta = 1$, for an elastic collision (conservation of energy), $\eta = 0$ for a totally inelastic collision and $0 < \eta < 1$ for an inelastic collision. Using $\eta = 0.4$ (~84% of the energy loss as compared to that of a totally inelastic case), we obtain an asteroid radius of ~80 km. Coefficients of restitution of ~0.5 are regularly and arbitrarily used for asteroid collisions, so my choice of 0.4 is not unwarranted (Michel, 2006). Using $\eta = 0.5$ gives an asteroid size of ~70 km and results are very similar to the following analysis.

The Hypothesized Asteroids

If we break up the 80 km object into 23 equal sized fragments, we find that the diameter of each asteroid would be about 28 km. Such fragments striking the moon at parabolic velocity would each produce 23 basins of about 850 km in diameter and 3.6 km deep (to partially fill with lava). This nearly duplicates the average mare size. The r.m.s. mare radii on the near side is ~810 km (all data about lunar mare is from the USGS Lunar Nomenclature Database, http://arizona.usgs.gov/Flagstaff/). We used the ES2506 Impact Calculator at http://www.classzone.com/books/earth_science/terc/ content/investigations/es2506/es2506page08.cfm to calculate the impacts). Actually, the 80 km asteroid would be broken up into chunks of particular sizes to explain the actual distribution of near moon mare. However, we choose to work with the r.m.s. average in this article instead of a distribution. In addition, we have chosen η to produce a near match to the actual mean of the radii of lunar mare. But we feel that an asteroid collision is a very inefficient means of transferring orbital energy. We believe our calculation is quite reasonable. (For a 70 km object, we obtain 24.5 km fragments which make 755 km radii mare.) A coefficient of restitution would allow for "rebound" and therefore the production of mare

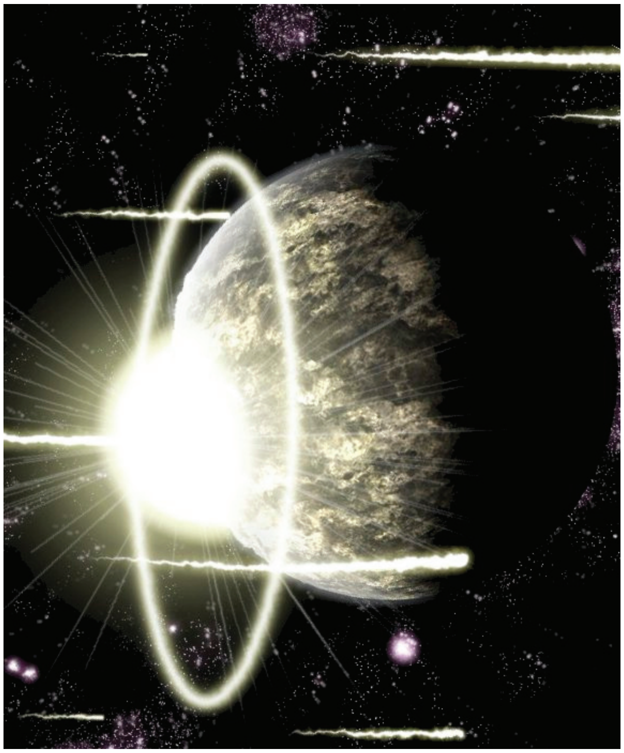

Figure 5. Blast wave created by asteroid collision.

"walls." These walls are termed "mountain ranges" on the moon that encircle maria to several kilometers in height. Figure 5 shows the action of a large asteroid striking the moon.

The Earth

It is also of interest here that the earth has a small eccentricity, e=0.016710219, actually smaller than the moon's. However things are not as clear as for the moon. The moon has no atmosphere or oceans to erode away craters. And the moon is close enough to the earth to maintain an orbit that is gravitationally locked. One would expect the orbit of the moon to be circular as with other celestial bodies in close locked orbits such as the 4 Galilean moons of Jupiter. One side of the moon always faces the earth except for librations due to asymmetrical mass distributions, the orbit of the moon, and perturbational effects.

A creationary objection may be that gravitationally locking is an old age phenomena. Of course we do not believe the moon's orbit just results naturalistically from proximity effects (body tides) combined with long *age*, since we believe that the solar system is young and little tidal evolution has taken place. Indeed, we believe God created the moon and earth directly and "set them in the firmament of heaven." But a circular orbit would be a reasonable choice for such a configuration. The process of "setting" could refer to a constant radius orbit to maintain constant effects. It is also the lowest energy orbit and is an energy efficient orbit and an orbit of highest stability. This would seem the likely choice due to moon's close proximity to the earth. The placement of the moon gyrostabilizes the earth, thus preventing it from changing its spin axis. This aids in maintaining the earth's seasons.

The situation for the earth's orbit about the sun is quite different. There is a relatively large distance between the sun and earth and little gravitational locking or resonance effects are expected. We find no reasons for assuming that the original orbit of the earth, before the hypothesized collision, was exactly circular.

Another concern has to do with the distribution and existence of terrestrial craters. Astrons and astroblemes are roughly circular blemishes on the earth's surface. These are believed to be due to major asteroid collisions. Astrons are larger (>150 km) and are analogous to mare on the moon's surface. Astroblemes are smaller and usually more established as true terrestrial asteroid craters. About 150 astroblemes (Pilkington & Grieve, 1992) have been identified on the earth's surface and a dozen or more astrons are apparent. Notable craters (Kring & Bailey, 2007) include those in the North Sea (Silverpit crater, 600×400 km; Chatterjee, Guven, Yoshinobu, & Donofrio 2003), Sudbury, Ontario (200 km diameter), Chicxulub, Mexico (170 km), Acraman, Australia (160 km) and Vredefort, South Africa (140 km), Chesapeake Bay (90 km). Major astrons (Norman, Price, & Muo, 1977), include the west African circular bulge, China coast, Himalayas, Gulf of Mexico, Aleutian Archipelago and the Great Australian Bight. The origin of such "scars" on the earth's surface are subject to conjecture. This study is clouded by erosional effects of the flood, itself, and subsequent weathering.

Also, the distribution of astroblems and astrons are somewhat random with widely separated apparent concentrations in northern Europe, middle North America and central Australia. We suspect that the oceans also received many impacts. So there is no definite "strike zone" as the near face of the moon. If a catastrophic plate tectonics event took place, we would expect that some of the scars from an asteroid barrage would have been effectively erased and altered.

Using the same size and cross sectional number density of meteors impacting the earth as those that struck the moon's near side, we obtain about 310 collisions, each creating 740 km diameter craters. Each would produce an explosive energy of 5.4×10^{9} megatons of explosive power, or a total of 7.7×10^{11} megatons. [These effects could have been weaker if the center of the stream targeted a region well displaced from the earth as suggested by the center of the large mare on the near side of the moon (see Figure 6).] At first these figures would suggest

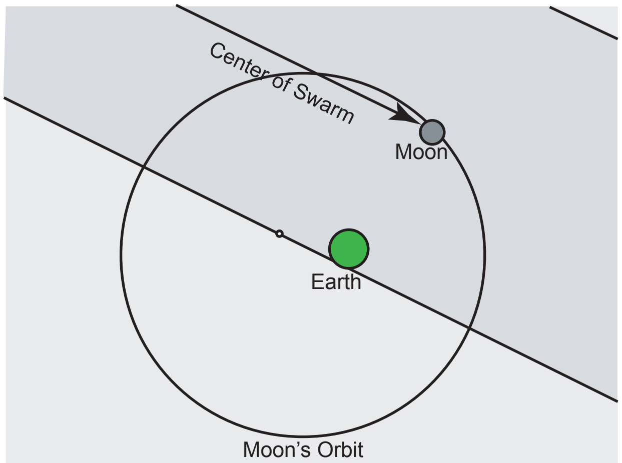

Figure 6. A collision by an asteroid stream targeted near the center of the main large mare strike zone (near Aristarchus, located at 23.7°N, 47.4°W) would mean an oblique strike with the moon in a waning gibbous position. Thus the moon would have taken a greater density of the destruction than the earth.

devastating effects (Toon, Zahnle, & Morrison, 2008) that would imperil even the Ark of Noah. However, Wayne Spencer (1998a) gives evidence that such an event (the collisions of 10km class asteroids) could have triggered the flood and that such collisions would have been survivable by Noah and the occupants of the Ark (Spencer, 1998b). He states in his abstract (Spencer, 1998b),

> There is clear evidence that impacts have occurred on Earth. To evaluate the possibility of a large number of impacts occurring during the Flood, it is important to consider their geophysical effects. The major effects include powerful shock waves that could trigger mineralogical crystal structure changes in the 400–660km depth region in the mantle. This could trigger subduction of the preflood ocean floor as suggested by Dr. John Baumgardner. A large number of impacts would also vaporize great quantities of water, some of which would condense as rain. Huge quantities of dust would be ejected by the impacts into the stratosphere. This would lead to low light levels for approximately 3 to 6 months and cold temperatures at the surface for a few months after this. Many other local and regional catastrophic effects would be produced by the impacts, including large tsunami waves, unusual winds, and possibly acid rain. It is concluded that though impacts would make the Flood more violent and more uncomfortable for Noah and his family, it would be a survivable event and is not in conflict with the chronology of the Flood as given in Genesis.

His papers lend credibility to the thesis of this paper—the Noahic Flood followed the collision event that resulted in collateral orbital effects and the distribution of mare on moon.

Conclusion

In this exploratory paper, I applied ordinary Newtonian orbital mechanics to test the possibility that the near side lunar mare are left over scars from a catastrophic impact by a swarm of asteroids. If the asymmetric distribution of mare and the orbital perturbation of the moon were caused by such asteroid impacts, I propose that this collision was responsible for triggering the Noahic Flood, since the earth would be bombarded also. *The permanent disfigurement of the moon may represent a clue from the Creator that we can not readily dismiss.* The results of our analysis are quite reasonable. I conclude that there is evidence from the moon's orbital perturbation and the corresponding bombardment on earth caused the Flood, and that this analysis should be taken as a serious possibility. I believe a detailed hydrodynamic computational simulation is warranted. Indeed, an asteroid bombardment could be the cause of the observed mare distribution on the near side of the moon and may well be the trigger that initiated the Flood event!

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