

**October 25, 2021**

## **News and Notes**

Before going on with this week's posting, which will be first in a series on the history of the Earth, here are some news items that I thought were interesting.

### **Landslides and Really Bad Weather**

California is expected to experience severe landslides due to heavy rainfall from a "bomb cyclone", here are some stories:

- [Record-breaking "bomb cyclone" floods parts of Northern California.](#)
- [Satellite Imagery Shows the Staggering Bomb Cyclone Hitting the West Coast.](#)
- [Rain, flooding and mudslides: California storms fueled by 'bomb cyclone' headed for East Coast](#)

### **Energy News**

- It could be a cold winter: [EIA forecasts U.S. winter natural gas bills will be 30% higher than last winter.](#)
- Using [horizontal drilling](#) to improve oil extraction in the Permian Basin shales of Texas: [Drilling and completion improvements support Permian Basin hydrocarbon production.](#)
- Also from the U.S. Energy Information Administration (USEIA): [Winter Fuels Outlook](#), prices in North America are likely to go up as supply is tightened. More from the USEIA [here](#).

### **Gold and Mining**

- [Scientists propose new 'salty' non-toxic gold extraction process](#); it doesn't use cyanide.
- When money become worthless, people turn to gold: [Venezuelans Break Off Flakes of Gold to Pay for Meals, Haircuts.](#)
- People want physical metal, not just paper: [What happens when the world's key metal exchange has no metal?](#)
- [Nickel price surges to highest in seven years as supply dwindles.](#)
- Environmental concerns [blocking development of a new mine in Minnesota.](#)

## Active Volcanoes

- [Etna](#) (Sicily, Italy),
- [La Palma](#) (Canary Islands, Spain),
- [Suwanose-jima](#) (Ryukyu Islands, Japan),
- [Manam](#) (Papua New Guinea),
- [Yasur](#) (Tanna Island, Vanuatu),
- In the United States: [Kilauea](#) (Hawai'i) and [Semisopchnoi](#) (Aleutian Islands, Alaska),
- [Fuego](#) (Guatemala),
- [Nevado del Ruiz](#) (Colombia),
- In Ecuador: [Sangay](#) and [Reventador](#),
- [Sabancaya](#) (Peru),
- [Worldwide Volcano News and Updates](#).

## Earthquakes

- [M 6.2 - 21 km SSE of Yilan, Taiwan](#).
- [M 4.7 - 160 km W of Langlois, Oregon](#).
- [Major tremors strike island of Rhodes as vibrations felt as far as Israel](#).
- [M 4.5 - Crete, Greece](#).
- [Rocky Mountain House, Alberta earthquake](#), also [here](#).
- [New Zealand's Ardern keeps going as earthquake disrupts live event](#), also [here](#).
- [M 5.4 - Federated States of Micronesia region](#).
- Indonesia: [Dampit](#) and [Pundong](#).
- [Earthquakes in Canada](#).
- [Latest Earthquakes - USGS](#).

## Other News

- Looking for a Christmas gift: [Dramatic Nevada scenery featured in 2022 Nevada Geology photo calendar](#). Funds raised are used to support the University of Nevada, Reno's Nevada Bureau of Mines and Geology.
  - Geochemistry: [Evidence of Ancient Life Was Discovered Inside a Ruby](#).
  - Congratulations to New Zealand geologist Henry Dillon for winning the inaugural Maptek Geology Challenge by solving a complex data challenge: [Maptek Geology challenge winner solves data complexity problem](#).
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## Ages of the Earth - The Hadean Eon

I am going to run a series of posts on the ages of the Earth, beginning with the earliest unit of geological time, the Hadean Eon.

First, let's look at a good representation the Geological Time Scale that shows the relative lengths of time for the various divisions of the Time Scale.

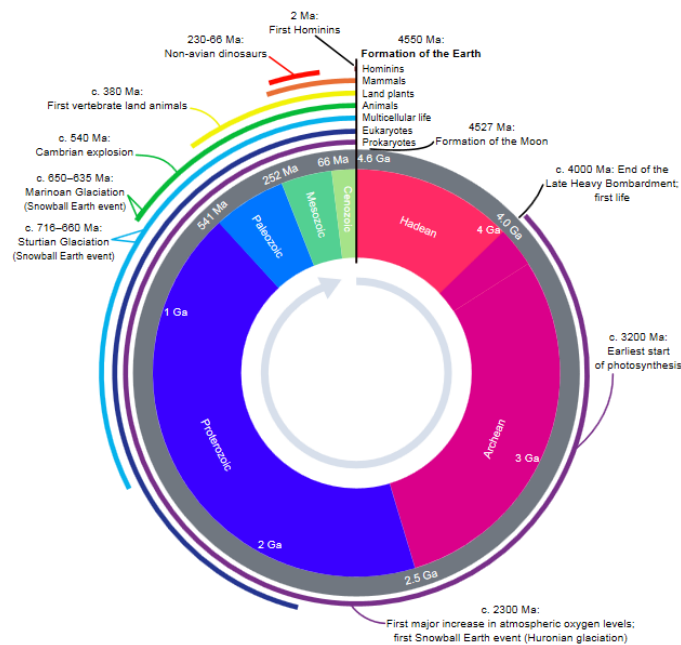


Figure 1 - Geological Time Scale Clock

Credit: [Woudloper](#), public domain

As you can see, the Hadean Eon encompasses the first 600 million years of the Earth's existence, a time period longer than the current age of complex life, the Phanerozoic Eon. Much of what we know about the earliest history of the Earth is based upon observation of stellar nebulae and the behavior of that material. Also, much of the standard scientific story on the origins of the Earth and indeed the entire Solar System is speculative in nature and awaits further research to flesh it out or recast it in the light of new evidence.

The early history of the Earth can be divided into four main chapters:

1. The **Early Accretionary Era** when the material that made up the Sun, the Earth and the other planets coalesced into their early forms.

2. The **Separation Era** where the heavier elements making up the Earth, such as iron, separated out to form the Earth's core. This is the origin of the Earth's magnetic field.
3. The **Birth of the Moon**, where a collision with another planetary body tore out a huge chunk of material that coalesced into the Moon.
4. The **Late Heavy Bombardment Era** where a wave of meteors, asteroids, and comets pelted the Earth, adding important materials such as water.

Let's look at these events

### Early Accretionary Era



Figure 2 - Comets Kick up Dust in the Helix Nebula

[Credit: NASA, public domain](#)

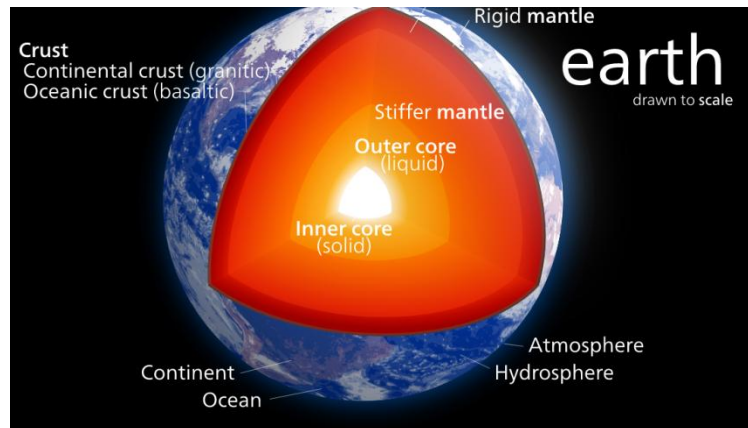
Around 5 billion years ago, things began to happen within the stellar nebula that would later become our Solar System. First, much of the matter in that nebula, especially the hydrogen and helium, coalesced into the star we call the Sun. Then, the early planets began to form. The [core accretion hypothesis](#) describes this process.

This early period was quite chaotic, Jupiter's orbit was not firmly established and, in its wanderings, a planet that had formed between Mars and Jupiter was broken up into the asteroid belt. As well, there may have been another, smaller, planet in a chaotic orbit that brought it in close proximity to the early Earth. We'll discuss the fate of that body later.

The accretion of material into each of the planets involved what was probably a steady bombardment of material. Most of the material that made up the Earth accumulated during this early accretionary era.

As each particle or chunk of rock struck the growing Earth, it imparted a bit of kinetic energy that became heat. Eventually enough heat built up to melt the accumulated material. This set the stage for next Era.

## Separation Era



**Figure 3 - Layers of the Earth**

**Credit: [Kelvinsong](#), [Creative Commons Attribution-Share Alike 3.0 Unported](#) license**

Once the Earth became a molten ball of rock, heavy elements, such as iron and nickel, began to separate out of the molten mass. Under the influence of gravity, the heavy metal material dropped to the centre of the earth and the lighter minerals floated out to outside, forming [a series of layers](#) inside the Earth.

Once the iron-nickel core of the Earth formed, the interplay of the solid core, liquid core and surrounding mantle created a geo-dynamo that in turn led to the creation a [magnetic field](#) around the Earth.

## Birth of the Moon



**Figure 4 - The Moon**

**Credit: [Lakshyajit2002](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license.**

The [current most common hypotheses](#) for the birth of the Earth's moon involves the near collision of the Earth with a wandering planet roughly the size of Mars. This near miss pulled out a string of material that eventually coalesced into the moon. This near miss [also tilted the Earth on its axis](#), eventually giving rise to the [Seasons](#). Another effect of the creation of the Moon was to stabilize the Earth's wobble. Also, [the Moon is largely responsible for tides](#) in the ocean. There is some thought that the Moon was [absolutely necessary for development of life on the Earth](#).

### **Late Heavy Bombardment Era**



**Figure 5 - Late Heavy Bombardment**  
[Credit: Earth Blog, September 27, 2016](#)

The final Era in the Hadean was the [Late Heavy Bombardment Era](#). While subsequent erosion and plate movement have removed almost all traces of this Era from the surfaces of Venus and the Earth, its effects can be seen on Mercury, Mars and the Moon.

The cause of the Late Heavy Bombardment appears to be in the chaotic conditions in the Solar System at the time. As described in the [Nice Model](#) of the early solar system, the orbits of the outer planets, Jupiter, Saturn, Uranus and Neptune had not yet stabilized at that time. As their orbits moved around, they disturbed asteroids in the zone between Jupiter and Mars as well as comets in the [Oort Cloud](#). The new orbits of these disturbed meteors, asteroids, comets and minor planets brought them into the [Inner Solar System](#), where they crashed into Mercury, Venus, the Earth, the Moon and Mars as well as impacting the outer planets and their moons. [Some of these bodies](#) continue to come into the inner part of the Solar System to this day.

There is a lot of speculation about the effect of the Late Heavy Bombardment Era in bringing certain critical materials to the Earth. Some think that it was during this time, [comets brought water](#) to the Earth. Others believe that these comets brought the [building blocks of life](#) or even

the earliest forms of life itself, as in the [Panspermia Hypotheses](#). Professor Chandra Wickramasinghe is an advocate of this hypothesis and [he discusses it in a lecture here](#).

Speaking of YouTube, there is a good discussion of the Late Heavy Bombardment on [The Entire History of the Earth](#) Channel: [The Mystery of the Late Heavy Bombardment](#).

### **Standard Caveat**

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.