Robert Nunes

G203 Lecture Notes

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Periods of Geologic Time:

Hadean (Highlights)

Origin of the Earth and Moon

Accretion and Differentiation of Earth

Origin of Earth's atmosphere and oceans

Origin of early crust on Earth

Very little geologic record (almost no rocks)

Early, intense bombardment of Earth

The simple model:

1. A portion of a huge "molecular cloud" collapses. As it collapses it forms a disk of gas and dust called a nebula.

Image of Orion Nebula found at: http://www.kencroswell.com/OrionNebula.jpg

2. Most of the gas and dust migrates inward to create a hot luminous center called a Protostar.

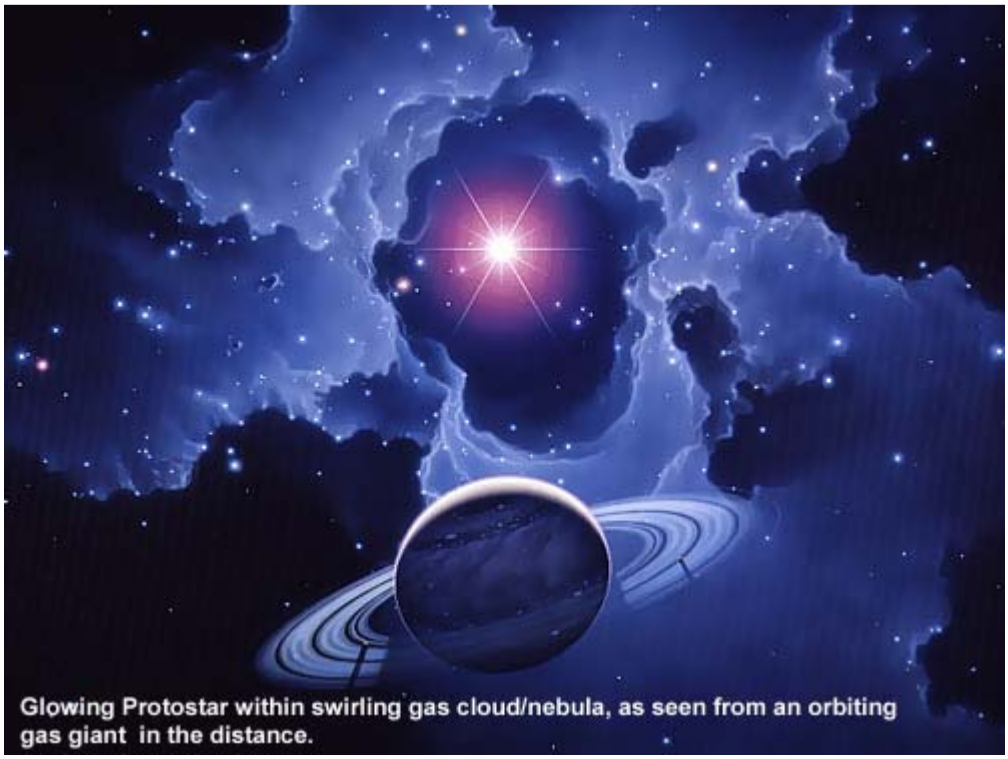

Image found at: http://www.williamsclass.com/EighthScienceWork/ImagesEighth/Protostar.jpg

3. The star "turns on" and the protoplanetary nebula dissipates leaving behind leftover building material that did not make it into the star (planets, moons, asteroids and comets).

Molecular clouds – cold, dense areas in interstellar medium.

We see ovoid and disk shaped protoplanetary nebulae inside the star forming regions of the Orion Nebula.

Most of our planetary nebula wound up making the sun. The most abundant elements are: H, He, C, O, N, Ne, Si, Al, Na, K, Ca, Fe, Mg, and S.

These elements form molecules. Their phase (solid, liquid, and gas) depends on the pressure and temperature at their position in the nebula. One element can be part of several different molecules.

Most meteorites are derived from parent bodies in the asteroid belt. It is clear that these are building blocks that never made it into a larger (planetary) body.

There are many different types of meteorites and many ways of classification:

Chrondrite – agglomerate (never melted)

All others – igneous (impact breccias)

Chrondrules – molten droplets in space

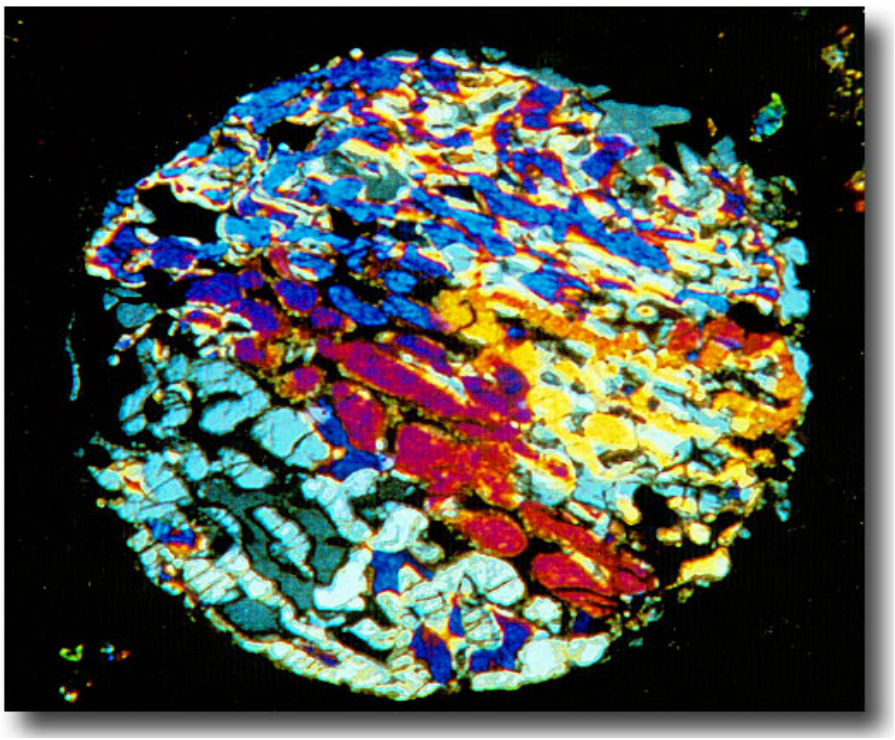

Image found at: http://www.meteorite-times.com/Back_Links/2005/October/AllendeChondrule_3.jpg

Earth consists of a differentiated core (FeNi – metal)

Mantle – ultramafic rock

Crust – mafic and felsic rock

The bulk of the Earth is chrondritic

How old is the Earth?

Oldest Earth rock is 3.96 b.y. old.

Oldest mineral grain (zircon) is 4.4 b.y. old.

Oldest lunar rock is ~4.4 b.y. old.

Core formation of the Earth can be dated indirectly at ~4.5 b.y. old

Most differentiated meteorites are ~4.55 b.y. old.

We are missing ~ 500 m.y. of Earth's rock record.

We look at the ancient surfaces of mercury, mars and the moon to see what the earths early history was like.

The Hadean earth would have experienced a period of intense bombardment!