Neptune

Basic Characteristics:

* **Ice Giant**
  + Significantly more massive
  + Consists mostly of volatile materials (Oxygen, Carbon)
  + Much colder atmospheres (72 K)
* Mass: 17 EM (Earth Mass)
* Size: 4 times of Earth size
* 30 AU from the Sun
* **Atmosphere:**
  + Temperature:
    - Neptune’s measured heat flux implies that it is still cooling.
    - Temperature at 0.1 bar: 51.7 K (-221.45 C)
    - Temperature at 1 bar: 71.5 K (-201.65 C)
    - Temperature at 2.3 bar: 101 K (-172.15 C)
    - Temperature at 6.3 bar: 135 K (-138.15 C)
  + Wind speeds: 0-580 m/s
  + Possess H-He abundant atmosphere.
  + **Visible Atmosphere:**
    - Molecular hydrogen (H2) - 80.0% (3.2%)
    - Helium (He) - 19.0% (3.2%)
    - Methane (CH4) - 1.5% (0.5%)
    - Methane condenses at pressures below 1.5 Bar, so probably forms the haze and clouds.
  + Vortexes comparable to those seen on Jupiter.
  + Dynamic atmosphere (Features appearing and disappearing regularly)
* Rotation period of about 16.11 Hours
* **Magnetic Field:**
  + Multi-polar magnetic field.
  + Convective and electrically conductive region
    - With of ~20% of planet radius.
    - Exists underneath outer H-He atmosphere envelope.
  + Deep interior below the dynamo region is stably stratified or in a state of thermal-buoyancy driven by turbulent convection.
* **Formation:**
  + formation Neptune has been a long-standing problem for planet formation theory.
    - Standard planet formation model:
      * slow planetary growth is expected to occur at large radial distances where the solid surface density is lower, and the accretion rate of planetesimals is significantly smaller.
      * forming the planets in situ (on site/locally) requires extremely high solid surface densities.
      * forming the planets in situ requires extremely high solid surface densities.
  + Due to the long accretion times at large radial distances, the formation process is too slow to reach rapid gas accretion.
  + However, since the mass of H-He in Neptune inferred from structure models is estimated to be a couple of (M) it implies that gas accretion has already begun, and this requires that the gas disk disappears at a very specific time, to prevent further gas accretion onto the planets.
  + **Giant Impacts:**
    - Head-on collisions have enough energy to mix large fractions of the core.
      * Depositing mass and energy in the deep interior
      * Could explain the adiabatic temperature profile.
        + Larger flux
        + Higher moment of inertia value

Summary should include the main argument of the article, theories and methodologies and a conclusion.

This article delves into the distinctive features of Neptune, recognized as an “Ice Giant” within our solar system.

COMPOSITION

Neptune exhibits very distinctive characteristics that set it apart from the other planets within our solar system. As an Ice Giant, it stands out due to its large mass of 17 times Earth (Helled, Nettelmann, 2020)! It is comprised of mostly volatile materials, like Oxygen and Carbon (Helled, Nettelmann, 2020). It is also a very large planet, it is the fourth largest in the solar system and four times the size of Earth (Helled, Nettelmann, 2020)! Its Atmosphere also accentuates its distinctiveness. Temperatures may range from 135 K (-138.15 C) to 71.5 K (-201.65 C) from 1 Bar to 6.3 Bar respectively (Helled, Nettelmann, 2020). It is mostly made up of Molecular Hydrogen (80.0%), Helium (19.0%), and Methane (1.5%) (Helled, Nettelmann, 2020). We know that Methane condenses at pressures below 1.5 Bar, so it is speculated that this forms the haze and clouds of the planet (Helled, Nettelmann, 2020).

MAGNETIC FIELD

Neptune’s magnetic field is characterized by a multi-polar structure. Within the planets atmosphere there is a convective and electrically conductive region, covering around 20% of its radius (Helled, Nettelmann, 2020). This region is situated beneath the previously mentioned Hydrogen and Helium abundant atmosphere envelope (Helled, Nettelmann, 2020). It is believed that this region is crucial for the generation and sustainability of the magnetic field (Helled, Nettelmann, 2020). Dynamo models based on Voyager’s magnetic field date suggest that in the deep interior exists a region that is stably stratified or in a state of thermal-buoyancy driven turbulent convection (Helled, Nettelmann, 2020).

FORMATION

A hypothesis for Neptune formation proposes a head-on collision occurred. This could explain Neptune’s “more convective and mixed” interior (Helled, Nettelmann, 2020). The collision has potential to penetrate the deep interior of the planet, eliminating distinct layers and has the possibility to erode the core. It would align with the measured heat flux and inferred moment of inertia (Helled, Nettelmann, 2020).

THERMAL EVOLUTION

CONCLUSION

Neptune represents a unique class of planets within our solar system, yet we know very little about it. It is clearly a mysterious planet in terms of its formation, and internal structures.

(Helled, Nettelmann, 2020)

Helled, R., Nettelmann, N., &amp; Guillot, T. (2020, March 25). Uranus and Neptune: Origin, evolution and internal structure - space science reviews. SpringerLink. <https://link.springer.com/article/10.1007/s11214-020-00660-3#Sec8>