Attempted rescue of the impact model for the origin of the moon

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There have been four proposed mechanisms for the formation of the moon. Three are considered disproven: (1) the fission theory, in which the moon separated from the earth during rotation, (2) the capture theory, in which the earth captured a wandering moon, and (3) the condensation theory, in which the earth and moon formed from the condensation of the same dust cloud during the formation of the solar system.[1] Another proposed mechanism is that the moon formed after a collision between the earth and a Mars-sized object that ejected debris out to the current orbit of the moon (figure 1). The debris coalesced forming the moon and the earth. This mechanism was accepted in the late 20th century, not because of the merits of the theory but because of the shortcomings of the other three theories.[2] The 'giant impact hypothesis' has now dominated for over 30 years, but not without major problems for which revised models have been suggested.[3]

Problem that the moon is too similar to the earth

Since the geochemical properties of the moon are so similar to those of the earth, the giant impact hypothesis has run into problems.[4] The moon should have a similar composition to the impactor, which should be much different than that of the earth. Numerous computer models have been applied to figure out why the earth and moon are so similar.[5–7]

Like most geophysical and astrophysical models, these models are simplified. However, with enough tries, a 'good' model was developed

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Figure 1. An artist's conception of a Mars-sized body slamming into the earth to form the moon

to better explain the moon's size, orbital angular momentum, and overall composition. But with more precise isotopic measurements, such as oxygen isotopes, the rocks of the moon and Earth are too much alike. Such a 'coincidence' has produced a modern crisis:

> "This has created a modern crisis in the giant impact concept: if more than half of the moon's material came from the impactor, how can the moon's isotopes be nearly identical to the earth's?"[8]

Crisis 'solved' by more computer simulations

After numerous computer simulations, some scientists now think they have solved the crisis by postulating the Mars-sized object hit a 'magma ocean' on the early Earth.[9] In this way, more of the earth material would end up forming the moon. Most models of Earth's formation postulate a mantle magma ocean caused by the gravitational potential energy of numerous planetesimals transformed into heat. And because a magma ocean is supposed to have more liquid FeO, which accounts for the enrichment of FeO on the moon by a factor of two, it 'solves' the problem of higher FeO content on the moon.

In the new simulation with a magma ocean, 70% of the moon would be Earth material, instead of the 40% from previous models. Melosh thinks that the greater proportion of Earth material ejected to form the moon may still not be good enough to explain nearly identical isotopes:

> "Although the work of Hosono *et al.* is an important step towards understanding why the earth and moon are so isotopically similar, it does not wholly resolve the problem. The large changes they report from modifying the SPH code appear to be at odds with the previous validation of the SPH method. The thermodynamic description of the melt used by Hosono *et al.* must also be improved in future work, to incorporate better thermodynamic models that are valid over the entire range of pressures and temperatures involved in the impact."[10]

The SPH (Smooth-Particle Hydrodynamic) code includes a "complex necessarily 3D geometry of self-gravitating fluids flowing at supersonic speeds."[10] And Hosono *et al.* modified it. It would be very difficult to get such a process correct, which is one reason why Melosh is skeptical.

Other problems for the origin of the moon revealed

Hosono *et al*. state that the many models to explain the problems for the naturalistic origin of the moon are *ad hoc*, with several glaring problems remaining:

> "It should be noted that in all of these models rather ad hoc assumptions are made about the mechanics of GI [giant impact] to explain the chemical similarities between the moon and Earth. It is therefore difficult to explain the angular momentum of the Earth-Moon system in these models."[11]

Further, the planetary scientists say that the moon lacks an iron-rich core, which may present a problem in explaining the ancient magnetic field of the moon.

Creation science implications

So much research and effort put into explaining the origin of the moon shows just how desperate naturalistic scientists are to explain its origins. Numerous computer simulations with different assumptions and variables once in a while come up with a close solution, such as the one by Hosono *et al*. These researchers claim that previous models were *ad hoc*, but the commentary by Melosh indicates that the Hosono *et al.* model is also *ad hoc*.

The numerous computer gyrations are really showing that a naturalistic origin of the moon is extremely difficult, if not impossible. The best explanation is given by the Word of God: "And God made two great lights" (Genesis 1:16–18).

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