

# Problems with the naturalistic formation of Earth's inner core

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Popular articles, books, and university classrooms regularly give the impression that secular science can explain the origin of the universe as well as the eventual origin of life and the complexity of life. The nebular hypothesis is their current hope for explaining the origin of the solar system. It postulates that the solar system was formed by the collapse of a gas and dust cloud. Rarely do you hear that there is a problem with the origin of dust and gas, with how these coagulated to form planetesimals, or with how these planetesimals supposedly grew large enough for gravity to take over their formation into planets. Numerous problems with details of the solar system are commonly swept away.<sup>1</sup> In fact, similar problems occur with the formation of stars, galaxies, non-solar system planetary bodies, asteroids, and comets.

The secular literature often reveals that researchers have difficulty with almost every presumed step. Yet, they paper over these difficulties by minimizing them, ignoring them, adding a secondary hypothesis, or telling us they are working on a solution. Few seem to question whether their fundamental assumptions may be wrong. This is puzzling until we realize the question of origins is largely a worldview issue. It is a matter of faith in the secular world that an exclusively material explanation of origins actually exists if they look hard enough.

## Problems with the naturalistic origin of the solid inner core

In the nebular hypothesis, Earth eventually forms a core, mantle, and

crust (figure 1). The core begins as a liquid, with the inner core solidifying with time.<sup>2</sup> Huguet *et al.* give a simplified summary of the prevailing view of how the solid inner core formed:

“The conventional view of Earth’s inner core is that it began to crystallize at Earth’s center when the temperature dropped below the melting point of the iron alloy and has grown steadily since that time as the core continued to cool.”<sup>3</sup>

However, this explanation has at least one fundamental problem from a naturalistic point of view. For the inner core to solidify, the molecules have to pass through an energy of nucleation barrier before the first stable crystal nucleus can form.<sup>3</sup> This means that during cooling, the liquid has to become highly supersaturated before the crystals can form either with a solid ‘seed’ of the same composition for homogeneous nucleation or a ‘seed’ of some other compound. Once crystals have formed, the solidification proceeds. This key step has been neglected:

“However, to our knowledge, no previous study has considered or evaluated quantitatively the

thermodynamic barrier to nucleation in Earth’s inner core, or its consequences for inner core formation and core evolution.”<sup>3</sup>

The process of mineral nucleation is very similar to the homogenous nucleation of ice crystals from rain drops.<sup>4</sup> With few or no ice-forming particles within the clouds, water drops must cool to around  $-30^{\circ}\text{C}$  to  $-40^{\circ}\text{C}$  before ice can form. This is why water drops in deep convection (upward vertical velocity in thunderstorms) supercool to well below freezing. With some ice-forming particles, supercooling of the water drops could be below  $-10^{\circ}\text{C}$ , perhaps even down to  $-30^{\circ}\text{C}$ . Supercooled raindrops in clouds is why aircraft flying through clouds that are below freezing need to be concerned about icing on the aircraft wings and fuselage.

For the core of Earth to form the first crystals from a homogenous liquid, the temperature of the core near the centre of Earth must cool more than  $1,000^{\circ}\text{C}$  below the liquidus temperature, which presents a major problem:

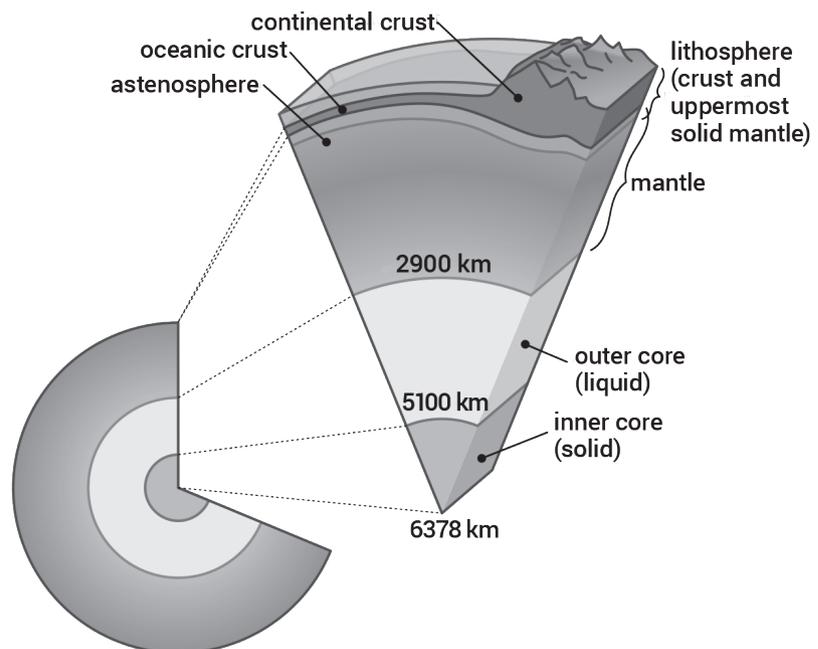


Figure 1. Schematic section of Earth's interior

“Using constraints from experiments, simulations, and theory, we show that spontaneous crystallization in a homogeneous liquid iron alloy at Earth’s core pressures requires a critical supercooling of order 1,000 K, which is too large to be a plausible mechanism for the origin of Earth’s inner core. ... yet the inner core exists: this is the nucleation paradox.”<sup>3</sup>

### Attempted rescue by another hypothesis

Scientists regularly remain quiet about a paradox in their perspective until some researcher or group of researchers thinks they have a potential solution to the problem. The paradox of the naturalistic solidification of the inner core is a case in point. The researchers consider several mechanisms, all with caveats. They then look to the lower mantle for a solution:

“In the absence of a plausible internal mechanism for producing a substrate [for nucleation] that could substantially lower the nucleation barrier for solid iron near Earth’s center, it is necessary to consider how such a substrate might be introduced to the core from above.”<sup>5</sup>

The scientists settle on the idea that heterogeneous solidification of other metals that have a lower energy barrier could have somehow been added to the core. These other metals would have originated from the lower mantle.

The main difficulty with this idea is another type of metal would have to drop from the lower mantle and sink to the centre of Earth before it is dissolved in the hot core. This is very difficult.<sup>5</sup> The scientists suggest a large nugget of metal, one on the order of 10–100 m or more in diameter, could possibly sink all the way through the core to the centre of Earth before it is completely dissolved. But, even

then, such a metal substrate would still have a small but significant nucleation barrier. The problem grows if they consider how such a large body of solid metal formed in the mantle and how it broke off into the core:

“Potentially an even more serious obstacle to a metallic nugget’s delivery to the deep core is to survive dissolution at the top of the core while the nugget is descending through the mantle by Stokes flow ... . If the base of the mantle is solid, it will be highly viscous, and a metallic body would have to be quite large in order to descend rapidly enough through the mantle’s base to avoid complete dissolution.”<sup>6</sup>

None of these mechanisms seems plausible.

### Inner core nucleation paradox spills over into origin of Earth’s magnetic field

A further problem is that the growth of the inner core is considered to be the primary driver or energy source for Earth’s ‘geodynamo’ by causing convection in the liquid outer core. The existence of the magnetic field for millions and billions of years is a long-standing problem for naturalistic explanations.<sup>7</sup> If the inner, solid core cannot form, the dynamo hypothesis becomes implausible.

### Creation science implications

Rescuing hypotheses upon close examination do not rescue. Naturalism cannot explain why Earth has a solid core and a geomagnetic field. It can only observe that there is one. Since God created it that way, creation scientists do not have a paradox. Furthermore, the observed decrease in the magnetic field is exactly what a young earth creation would predict. Straightforward physics reveals that as an electric current circulates around the

liquid outer core, the current decreases with time due to electrical resistance. It is this circulating electric current that causes Earth’s magnetic field, which would also decrease with time. And, because the magnetic field could not have been too strong in the past without disastrous results, it indicates that Earth is young.<sup>7</sup>

### References

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3. Huguet *et al.*, ref. 2, p. 9.
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