

The Moon and Plate Tectonics: Why we are alone.

The existence of a large Moon in orbit around the Earth and its implications for the origin and nature of life have been a subject of considerable discussion. With the Hartmann/Davis models for the catastrophic origin of the Moon by glancing collision, it has become clear that our Moon is a rare celestial object and that few Earth-like planets could have produced such a chance outcome during their assembly. If, therefore, aspects of the Moon's existence strongly impact on the origin and development of life, then we may be able to explain why life (as we know it) might be rare in the Universe.

The bulk of arguments about the Moon relate to its effect on the orbital dynamics of the Earth-Moon system (which is stabilised against spin-axis inclination variations, unlike Mars), and to the tidal influence on ecosystems (developing broad coastal flats with regular currents, water-depth variations, and monthly cycles).

None of these are compelling arguments for the origin or nature of life. Instead, we look here at plate tectonics as an essential engine for maintaining the continent/ocean duality on Earth, which enabled advanced life to emerge on land and develop to a tool-using electro-mechanical civilisation (our definition of "advanced life"?).

Others have speculated that the heat pulse due to the Lunar-originating impact was the trigger to start plate tectonics but we show that this is a minor effect of timing. Instead, the enabling factor is the removal of ~70% of the primordial crust of the Earth to a position in orbit 400,000 km overhead. If that crust were returned and replaced on Earth it would fill the ocean basins with wall-to-wall continent. This would choke plate tectonics, as on Venus, and displace the oceans to flood the land to a depth of several km.

Without plate tectonics, new mountain belts could not form. Earth would be a Waterworld with occasional shield volcanoes emerging briefly above the waves. If regular catastrophic convective overturn occurred, as on Venus, life would have a precarious foothold indeed. There may be many habitable worlds, but they are likely to be Waterworlds where swimming or flying creatures might evolve significant intelligence, but would be unlikely to progress to discover fire, electricity, computers, radio, and rockets.