Did Earth's multicellular life depend on plate tectonics?

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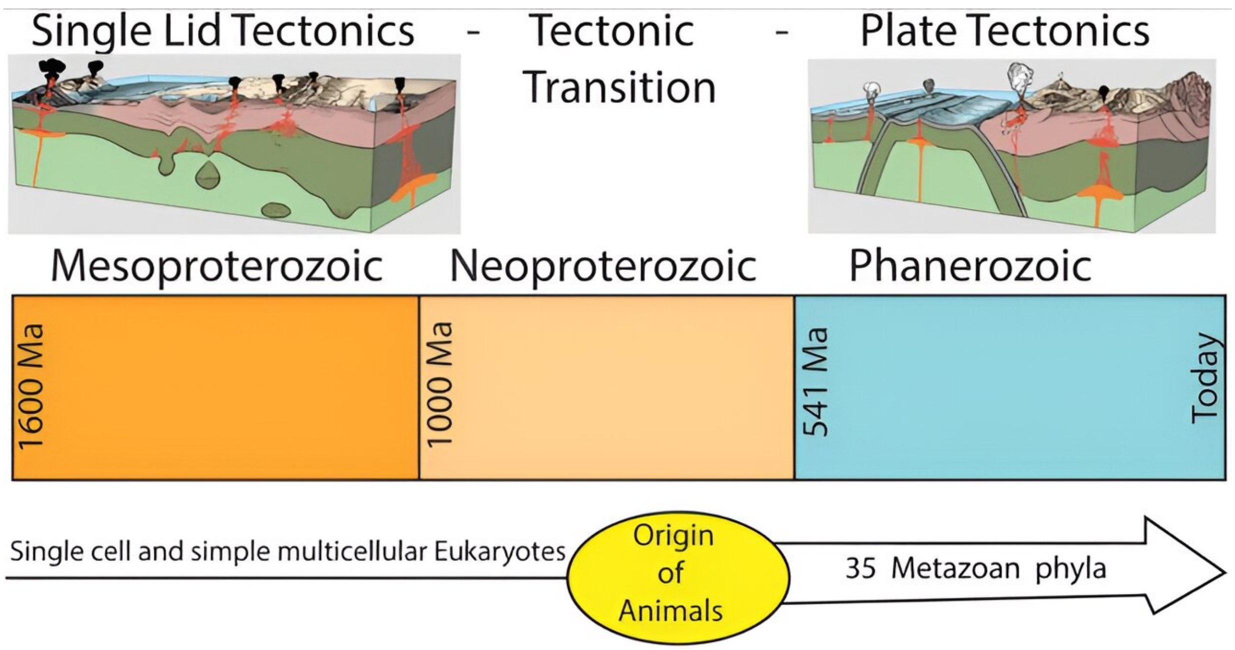

Graphic depicting the last 1.6 billion years of Earth's tectonic history. Credit: *Scientific Reports* (2024). DOI: 10.1038/s41598-024-54700-x

How did complex life emerge and evolve on the Earth and what does this mean for finding life beyond Earth?

This is what a recent study published in *Scientific Reports* hopes to address, as a pair of researchers investigated how plate tectonics, oceans, and continents are responsible for the emergence and evolution of complex life across our planet and how this could address the Fermi Paradox while attempting to improve the Drake Equation regarding why we haven't found life in the universe and the parameters for finding life, respectively.

This study holds the potential to help researchers better understand the criterion for finding life beyond Earth, specifically pertaining to the geological processes exhibited on Earth.

Here, Universe Today discusses this study with Dr. Taras Gerya, who is a professor of earth sciences at the Swiss Federal Institute of Technology (ETH-Zurich) and co-author of the study, regarding the motivation behind the study, significant results, follow-up studies, what this means for the Drake Equation, and the study's implications for finding life beyond Earth.

So, what was the motivation behind this study?

Dr. Gerya tells Universe Today, "It was motivated by the Fermi Paradox ("Where is everybody?") pointing out that the Drake Equation typically predicts that there are from 1,000 to 100,000,000 actively communicating civilizations in our galaxy, which is too optimistic of an estimate. We tried to figure out what may need to be corrected in this equation to make the prediction with the Drake Equation more realistic."

For the study, the research duo compared two types of planetary tectonic processes: single lid (also called stagnant lid) and plate tectonics. Single lid refers to a planetary body that does not exhibit plate tectonics and cannot be broken into separate plates that exhibit movement by sliding towards each other (convergent), sliding past each other (transform), or slide away from each other (divergent).

This lack of plate tectonic activity is often attributed to a planetary body's lid being too strong and dense to be broken apart. In the end, the researchers estimated that 75% of planetary bodies that exhibit active convection within their interiors do not exhibit plate tectonics and possess single lid tectonics, with Earth being the only planet that exhibits plate tectonics. Therefore, they concluded that single lid tectonics "is likely to dominate the tectonic styles of active silicate bodies in our galaxy," according to the study.

Additionally, the researchers investigated how planetary continents and oceans contribute to the evolution of intelligent life and technological civilizations. They noted the significance of life first evolving in oceans due to them being shielded from harmful space weather with single-celled life thriving in the oceans for the first few billion years of Earth's history.

However, the researchers also emphasize how dry land provides a myriad of benefits for the evolution of intelligent life, including adaptations to various terrains, such as eyes and new senses, which contributed to animals evolving for speed to hunt among other biological assets that enabled life to adapt to the various terrestrial environments across the planet.

In the end, the researchers concluded dry land helped contribute to the evolution of intelligent life across the planet, including abstract thinking, technology, and science. Therefore, what were the most significant results from this study, and what follow-up studies are currently in the works or being planned?

Dr. Gerya tells Universe Today, "That very special condition (>500 million years coexistence of continents, oceans, and plate tectonics) is needed on a planet with a primitive life in order to develop an intelligent technological communicative life. This condition is very rarely realized: only