The earliest history of the Earth

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The Earth began life as submicrometer fractal dust grains in an accretion disk bathed in a sea of nebular gas dominated by hydrogen, helium and oxygen. The grains experienced gentle collisions and gradually accreted into larger particles. Eventually asteroidal sized objects were formed and then a few of them grew at the expense of others into planetary embyos. The final stages of accretion involved planetary scale collisions culminating in a Mars-sized object colliding with an almost full-sized Earth in the Moon forming event. This entire process took 30-50 million years.

These violent collisions led to serial magma oceans that repeatedly melted the Earth to hundreds and then thousands of kilometers, effectively sterilizing the surface. In between these collisions, the magma oceans may have solidified. After final solidification several lines of evidence (ancient zircons formed at granitic temperatures, $^{129}Xe/^{132}Xe$ ratios differing in MORB and the atmosphere) suggest that outgassing of the oceans and atmosphere had substantially occurred by 4.4Ga.

The origin of Earth's water remains a subject of debate. Comets and asteroids were long postulated to be the sources of Earth's water. However, their isotopic properties are inconsistent with many isotopic properties of the Earth, and their contribution to Earth's water budget must be minor. A possible source of Earth's water is adsorption of water onto fractal grains in the accretion disk and retention during accretion. If that is correct, all of the rocky planets with the possible exception of Mercuty must have accreted "wet".

The source of organic material leading to life remains unknown. The magma ocean events would have destroyed complex organics. The two main hypotheses are self organization of complex organics, perhaps using clays as templates, and delivery of complex organics from organic-rich asteroids and comets.