Big Bang of life: unique composition of organic molecules at >3.95 Ga

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The earliest life on Earth may have appeared at approximately 4.0 billion years ago (Ga) based on analyses of molecular clocks. However, there is no evidence of early life between 4.0 and 3.7 Ga. The type of the earliest life is also unknown. Here, we report that organic molecules derived from the earliest life have been detected from the oldest shallow-sea sedimentary rocks from Labrador, Canada, the age of which is >3.95 Ga. These molecules have two unique features: (1) branched alkanes (methyl- and ethyl-) and squalane exclusively dominate in these rocks; (2) *n*-alkanes and branched alkanes possess strong even-over-odd predominance in the number of carbons. These features have not been found in strata younger than 3.5 Ga. Among these molecules, it is difficult for squalane to be produced by non-biological processes. The dominance of squalane, which is derived from squalene, a constituent of archaeal lipid and precursor of both eukaryotic (sterol) and prokaryotic (hopanoid) lipids, suggests that this is a fundamental organic molecule of life common to all three domains, i.e., prokaryotes, archaea, and eukaryotes. This unique composition changed to a more normal composition between >3.95 Ga and 3.48 Ga. This change looks like dawn of the universe, i.e. Big Bang, because the unique type of life that occurred during this first short period of <0.5 billion years was followed by the current type of life that has persisted for >3.5 billion years. Giant impact of asteroids on Earth occurred between 4.03 and 3.85 Ga (Late Heavy Bombardment) evidenced by ages of impact craters of the moon. Those impacts could have eradicated the early life found in Labrador followed by emergence of the current type of life on Earth.

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