THE RELATIVE IMPORTANCE OF PREBIOTIC SYNTHESIS ON
THE EARTH AND INPUT FROM COMETS AND METEORITES

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We have been studying the prebiotic synthesis of hydrogen cyanide and formaldehyde
by the action of electric discharges on various model primitive atmospheres containing
CH₄, CO and CO₂. Photochemical production rates would also have been important
and have been calculated for HCN and H₂CO. A reasonable rate of synthesis of
amino acids from these sources is about 10 n moles cm⁻²yr⁻¹ or 0.10 moles cm⁻² in 10⁷
yrs. This would give a concentration of 3 x 10⁻⁴ M in an ocean of the present size (300
liters cm⁻²). The amino acids cannot accumulate over a longer period because the
entire ocean passes through the 350°C submarine vents in 10⁷ yrs, which
decomposes all the organic compounds.

A number of workers have calculated the influx of comets and meteorites on the
primitive earth, both as a destructive process for organic compounds and for any life
that was present, as well as a source of organic compounds. Some of the amino acids
from the meteorite proposed to have hit the earth 65 x 10⁶ yrs ago have been detected
at the Cretaceous/Tertiary boundary sediments.

The problem with proposing a large scale input of organic compounds from meteorites
and comets is that they must survive passage through the atmosphere and impact.
There are some processes that would allow survival such as showers of centimeter to
meter sized meteorites and various aerodynamic braking processes for larger objects.
Even if a significant amount of the organic material survived impact, the destructive
processes in the hydrothermal vents would remove these compounds on the average
in 10⁷ yrs or less. If it is assumed that the input rate was sufficient to overcome these
destructive processes, then too much carbon and water, especially from comets, would
have been added to the surface of the earth. We conclude that while some organic
material was added to the earth from comets and meteorites, the amount available
from these sources at a given time was only a few percent of that from earth based
syntheses.