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Paleogenomics: a review

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Paleogenomics concerns reconstruction of genome sequences of past life. It may be achieved by sequencing ancient DNA preserved in fossils or by comparisons of genome sequences of living organisms. The former approach is restricted in time scale (0-1 Ma), but allows us to have a direct grasp of past genomes. The latter approach is indirect, but allows us to infer the genome sequence of the last common ancestor between any living organisms, and to theoretically go back in time to the origins of life (0-4 Ga). Although theories for this approach have existed at least since 1963, and a number of reconstructions of ancestral gene sequences or even resurrection of ancient proteins have been achieved since then, no one appears to have reconstructed a full genome sequence for a hypothetical ancestor that existed in the geological past. In the context of earth and planetary sciences, the reconstructed genome sequences of past life shall be a basis for understanding the interplay between life and environments throughout earth history. This is because they can be used to deduce ancestral metabolic pathways, developmental cascades, and other genomic features (such as GC content), that reflect the environmental status at the time.