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Paleogenomics: amalgamation of earth and life sciences

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The history of life and the earth can be studied using the clues contained in geological strata, fossils, and genomes. The former two have been explored to some extent, but the value of historical information engraved in our genomes started to be appreciated only recently. With a wealth of genome sequence data, together with a reliable phylogenetic tree and a simple logic, it is possible to reconstruct ancient genomes (DNA sequences, gene contents, and gene orders) of the common ancestors between any extant organisms, allowing us to trace down through every branch of the Tree of Life back to the last common ancestor of all life. The reconstructed genome can then be used to deduce the ancestral metabolic pathways, developmental cascades, and other features of the genome, such as GC content. Those programmes and features may directly reflect the traits of the hypothetical ancestors and indirectly reflect the ancient environments that they inhabited. The inferred metabolic pathways may also help predict the chemical fossils that can be preserved, and help identify the metaloproteins that might have left certain atomic fossils, such as Fe, Cu, V, Mo, etc. When integrated with the clues obtained from strata and fossils, these pieces of information shall prove useful to gain insight into the interactions between life and environments at any time in the past.