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2025

The DNA Chrysalis Hypothesis: Investigating Extreme Biomolecule Preservation to Find Dinosaur DNA

Potential Team (waiting on responses): Dr. Eske Willerslev, Dr. Sean Gulick, Dr. Ludovic Orlando, Dr. Karen Lloyd, and many more in ancient DNA, paleontology and geology

Project Overview

Current science limits ancient DNA (aDNA) recovery to ~2 million years, far short of the 66 million years since non-avian dinosaurs, which DNA has never been found for. This proposal introduces the **"DNA Chrysalis Hypothesis,"** a bold scientific expedition to test if extreme geological events, like massive asteroid impacts, created unique conditions that actively preserved biomolecules (including highly degraded DNA fragments and proteins) from the Mesozoic Era. While cloning dinosaurs isn't feasible ("not yet at least"), any discovery would revolutionize our understanding of molecular preservation and enable unprecedentedly accurate, immersive educational and entertainment experiences, alongside breakthroughs in biotech and medicine. Perhaps even the resurrection and de-extinction of Dinosaurs.

Hypothesis: The "Molecular Chrysalis"

We hypothesize that catastrophic events, such as the Chicxulub meteor impact, could have caused **instantaneous encapsulation** of organic matter within chemically inert, non-porous mineral matrices (e.g., silicates, zeolites) formed by rapid cooling and hydrothermal precipitation. This process, akin to Pompeii's exceptional preservation [3], would have:

1. **Rapidly Dehydrated** biomolecules, halting hydrolysis.
2. **Chemically Stabilized** them within a protective mineral shield.
3. **Shielded from Radiation** by deep geological burial.

This active entombment could theoretically extend biomolecule survival far beyond current limits, allowing us to search for minute, authenticated mtDNA fragments from terrestrial or shallow-marine organisms.

Methodology

1. **Targeted Site Identification:** We'll use advanced seismic imaging to pinpoint specific, dense mineral inclusions within the Chicxulub crater's peak ring and in deep-sea polar basins (Arctic/Antarctic continental shelves) showing rapid, massive sedimentation from the K-Pg boundary [5].
2. **Advanced Sample Retrieval:** State-of-the-art deep-sea coring technology (e.g., IODP vessels) will retrieve pristine samples under strict cold-chain and aseptic conditions [6].
3. **Optimized Biomolecule Extraction:** In an ultra-clean lab, we'll use a novel, multi-stage approach including **cryo-pulverization** and **targeted mineral dissolution** with gentle

chelating agents. This aims to "uncage" biomolecules without damage [8].

4. **High-Throughput Analysis & Authentication:** Samples undergo shotgun sequencing and mass spectrometry. Dr. Orlando's team will use advanced bioinformatics to analyze DNA damage patterns [9], phylogenetically place fragments (looking for avian-related sequences from deep time) [10], and rigorously screen for modern contamination [9]. Dr. Lloyd will interpret the microbial context.

Expected Outcomes & Significance

- **Pushing Empirical Limits:** Potential recovery of authenticated biomolecules older than 2 million years would fundamentally revise DNA degradation models [1, 2].
- **Unprecedented Insights:** Molecular data would reveal biodiversity and environmental conditions of deep-time ecosystems, including the K-Pg boundary.
- **Novel Preservation Mechanisms:** Discoveries could inform future strategies for ultra-long-term biomolecule and data storage. With applications to medicine and biotech.
- **Transformative for Education & Entertainment:** While living dinosaurs are not feasible “yet” , recovered biomolecular data (e.g., protein sequences for color, DNA fragments for relationships) would enable **unprecedentedly accurate digital models, animatronics, and immersive experiences** for museums, theme parks, and media. The real-life scientific quest itself offers a compelling narrative for global audiences. Perhaps a real “Jurassic Park” if navigated ethically and properly.

Justification

This proposal is a scientifically rigorous, ambitious endeavor to explore the outer boundaries of molecular preservation. By combining cutting-edge marine geophysics, advanced paleogenetics, and sophisticated bioinformatics, we aim to gain fundamental knowledge about biomolecule stability and Earth's ancient history. The potential for a paradigm shift in understanding life's molecular record, coupled with unique opportunities for public engagement, makes this a truly transformative project.

References:

[1] Allentoft et al., 2012, Proc. R. Soc. B. [2] Pedersen et al., 2022, Nature. [3] Scorrano et al., 2022, Scientific Reports. [4] Willerslev & Cooper, 2005, Proc. R. Soc. B. [5] Morgan et al., 2016, Science. [6] Poinar & Shapiro, 2017, Ancient DNA: The New Science of the Past. [7] Dabney et al., 2013, Nature. [8] Proposed conceptual method. [9] Hofreiter et al., 2001, Nature Reviews Genetics. [10] Orlando et al., 2013, Nature. [11] Cann et al., 1987, Nature.