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Archaeological and Paleobiological Problems with the Case for the Extraterrestrial Younger Dryas Impact Event

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Abstract

The proposed Younger Dryas extraterrestrial impact event makes several straightforward, testable predictions about the fate of living systems in North America at the onset of the Younger Dryas. Here we address three derivative hypotheses related to the archaeological and paleobiological records of this time period. We suggest that the archaeological and paleobiological records of the time period fail to support these predictions.

For a hypothesized mechanism to provide a plausible explanation for an observed phenomenon two basic criteria of science must be met. First, the initial results that inspired the hypothesis must be replicated and verified by independent research groups, and second, derivative hypotheses must be tested in order to provide support or to falsify the primary idea. Arguably, these are especially important criteria for hypotheses as controversial, and if true, game-changing, as the ideas presented by Firestone. However, to date many believe these basic conditions have not been met (see Surovell et al., 2009).

As archaeologists we are particularly concerned with the implications of the extraterrestrial impact (ET impact) hypothesis for the archaeological record of North America. In this paper (Firestone 2009), and others in the same vein (Firestone et al., 2007, Kennett et al., 2009a, Kennett et al., 2009b) Firestone outlines several claims concerning the Paleoindian record. The ET impact is claimed to have caused a continent-wide environmental collapse and extensive groundcover burning from the impact and superheated ejecta, which in turn resulted in the extinction of the North American megafauna and the Clovis Paleoindians.

The evidence presented by Firestone and colleagues is controversial and fails to convincingly support these derivative archaeological hypotheses.

At its heart, the ET impact hypothesis is a clear, simple, and testable hypothesis: around 12.9 ka an extraterrestrial body of some description impacted the North American continent causing the extinction of the megafauna and the Clovis Paleoindians, and triggering the onset of the Younger Dryas. There are numerous testable hypotheses that follow this contention, but here we concentrate on three basic predictions concerning living systems in North America at the onset of the Younger Dryas: 1) The ET impact caused the sudden, catastrophic collapse of human populations in North America at the YD boundary; 2) the ET impact caused the extinction of late Pleistocene North American megafauna; and 3) the ET impact resulted in these extinctions by causing a continent-wide firestorm that is detectable in the 'black mat' layers across North America. We address each of these in turn.

1) There is no convincing evidence of a human population collapse in North America at the YD boundary (Buchanan et al., 2008). On the contrary, statistical analyses of prehistoric demography suggest populations remained intact, and transitioned relatively smoothly into the Younger Dryas (Buchanan et al., 2008). The cultural changes instigated by the onset of the Younger Dryas in western North America (from Clovis to Folsom) are clear in the archaeological record, but rather than a hiatus, there is population continuity and a clear historical, phylogenetic relationship between these archaeological cultures. Moreover, recent research indicates a considerable temporal and spatial overlap between Clovis and Folsom cultures in northern regions of western North America, contradicting the idea of a catastrophic Clovis collapse (Buchanan et al., n.d.).

2) The late Pleistocene megafaunal extinction, as indicated by its name, was a size-selective extinction event, heavily biased toward large body sized species (Lyons et al., 2004). Exactly how a continent-wide immolation, as described by Firestone, would selectively target such species, while avoiding other megafaunal species such as bison and humans, as well as the vast majority smaller-sized North American mammals is unclear. Surely the extinction profile of a continent-scale firestorm event would be more widespread and less selective. While Firestone rejects human agency as a cause of the megafaunal extinction, the consistent pattern repeated across the planet at very different times throughout

prehistory, of human colonization followed by size-selective extinctions (i.e., Australia, ~40-45 ka, Americas, ~13 ka, and the Pacific Islands, ~3 ka), clearly points toward human agency as a primary casual factor (Lyons et al., 2004, Surovell et al., 2005).

3) There is no convincing evidence for a continent-wide firestorm in Younger Dryas aged sediments (Marlon et al., 2009). Much less intensive burning events, both anthropogenic and natural fire regimes, preserve for thousands of years under the right preservation conditions. These include evidence of intentional landscape modification through the use of fire dating as far back as ~40-50 ka in Africa and Australia (Smith, 2007). In North America Paleoindian hearths or fire pits, thermal features used for no longer than a few hours, dating to before the Younger Dryas are rare, but do preserve in the archaeological record (e.g., Haury et al., 1959, Haynes and Huckell, 2007). If evidence of such ephemeral, localized burning events are visible archaeologically, why wouldn't a continent-wide catastrophic firestorm of the magnitude predicted by the ET impact hypothesis leave a more conspicuous stratigraphic record? While elsewhere it has been argued that the black mat itself is evidence of such a burning event (Firestone et al., 2007), this interpretation contradicts decades of geological research and is highly controversial (Haynes, 2008, Marlon et al., 2009).

The extraterrestrial impact hypothesis is an interesting idea, and scientists need to be open-minded, however, to date there does not seem to be any convincing empirical evidence from either the archaeological or paleobiological records to support some of the basic predictions of the hypothesis.

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