The Clean Paper

WHAT THE PAPER SAYS · WHAT IT DOESN'T · WHY IT MATTERS

Rikodin burbushin New Mexico ya sa babin ƙarshe na dinosaur ya fi rikitarwa

Wani bincike a Science ya sake tantance shekarun Naashoibito Member a New Mexico zuwa 'yan dubban shekaru ɗari na ƙarshe kafin tasirin asteroid. Wannan yana da muhimmanci domin mafi yawan ingantacciyar shaidar dinosaur na ƙarshen Cretaceous ta fito ne daga arewa. Sabon rikodin kudu yana nuna cewa yammacin Arewacin Amurka har yanzu yana da fauna na dinosaur masu bambanci daga yanki zuwa yanki kusa da ƙarshen, maimakon wata ƙungiya guda iri ɗaya da ke dusashewa. Ba ya tabbatar cewa duk ecosystems na dinosaur a duniya suna bunƙasa har tasirin; yana nuna yadda rikodin fossil na yanki zai iya sa labarin duniya ya zama mai santsi fiye da gaskiya.

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Shaida daga kudu kusa da ƙarshen zamanin dinosaur

Sau da yawa ana ba da labarin dinosaur na ƙarshe ta hanyar Great Plains na arewa: Montana, Dakotas, da duniyar Hell Creek. Wannan rikodin ya yi kyau har ya zama sananne, kuma abin da ya saba mana wani lokaci yana sa mu ɗauka cewa shi ne cikakken labarin. Amma burbushin halittu ba su rarrabu daidai ba, domin tarihi bai tanadar mana da kundin bayanai mai kyau ba.

Wata sabuwar takarda a *Science* ta ƙara muhimmiyar shaida daga kudu. Marubutan sun nazarci Naashoibito Member a San Juan Basin na New Mexico, wani sashen duwatsu mai ɗauke da burbushin halittu wanda aka yi ta muhawara kan shekarunsa shekaru da dama. Idan burbushin sun fi tsufa sosai, ba za su faɗa mana da yawa game da lokutan ƙarshe kafin tasirin asteroid ba. Idan kuwa sun fito ne daga ƙarshen Cretaceous sosai, suna da muhimmanci ƙwarai.

Amsar takardar ita ce ta biyu. Ta amfani da sabbin hanyoyin tantance shekaru da **magnetostratigraphy**, ƙungiyar ta yi hujjar cewa manyan matakan duwatsun da ke ɗauke da dinosaur a Naashoibito Member suna cikin kusan **shekaru 340,000** kafin iyakar Cretaceous-Paleogene. Wannan ya sanya dinosaur na New Mexico kusa da ƙarshen sosai har za su iya taimaka wa tsohuwar tambaya: shin dinosaur sun riga sun shiga dogon koma baya, ko kuwa yawancin tsarin halittu na yankuna daban-daban har yanzu suna da bambancin halittu lokacin da asteroid ya iso?

Amsar da ta fi hankali ba ita ce “duk dinosaur suna cikin ƙoshin lafiya, sai kawai bam” ba. Wannan jimla tana da kyau a kunne, amma ba ta da ladabi ga shaidar. Amsar da ta fi dacewa ta fi ƙuntata amma ta fi amfani: a yammacin Arewacin Amurka, wani rikodin kudu da aka tsara shekarunsa da kyau yana goyon bayan hoton al’ummomin dinosaur na ƙarshen zamani da har yanzu suka bambanta daga yanki zuwa yanki, ba wata ƙungiya guda mai ƙarancin bambanci da ke dusashewa ko’ina lokaci guda ba.

Wannan ya isa. Ba sai an ƙara masa hayaniya ba.

Bisti/De-Na-Zin Wilderness a New Mexico, wani badlands landscape a cikin babban yankin San Juan Basin. Hoton yana ba da yanayi ne kawai, ba shaida daga takardar *Science* ba: hujjar binciken ta dogara ne da matakan duwatsu masu burbushin halittu da aka tantance shekarunsu, ba da shimfidar wuri ba.

Bob Wick / BLM California CC BY 2.0

Me ake nufi da “cikin shekaru 340,000” a nan?

An kiyasta lokacin tasirin asteroid da iyakar Cretaceous-Paleogene da kusan **shekaru miliyan 66.052 da suka wuce**. Tambayar ita ce inda duwatsun da ke ɗauke da burbushin halittu suke dangane da wannan iyaka.

Marubutan ba su tantance shekarun ƙasusuwan dinosaur kai tsaye sannan suka ce an rufe magana ba. Sun tantance shekarun ƙwayoyin ma’adinan volcanic, musamman sanidine, daga sandstone a cikin sashen Naashoibito ta amfani da **$^{40}Ar/^{39}Ar$ geochronology**, sannan suka haɗa waɗannan kwanakin da **magnetostratigraphy**: rikodin juyawar filin maganadisun Duniya da aka adana a cikin duwatsu.

A takaice: samfur ɗaya ya ba da iyakar shekarun ajiya ta **shekaru miliyan 66.87 ± 0.04**, wani samfur mai ɗauke da dinosaur kuma ya ba da **shekaru miliyan 66.38 ± 0.08**, sannan tsarin maganadisu ya sanya ɓangaren sama na sashen cikin lokacin reversed polarity na ƙarshe a Cretaceous. Haɗe, waɗannan ƙuntatawa suna sanya manyan matakan da ke ɗauke da dinosaur kusa sosai da iyakar. Agogon geology ne, ba stopwatch ba, amma ya yi daidai sosai har ya canza yadda ake kallon batun.

Abin da marubutan suka yi

Kungiyar ta hada nau'ikan aiki biyu da suke bukatar juna. Na farko, sun kara tsaurara shekarun Naashoibito Member. Wannan unit din yana saman tsofaffin duwatsun Campanian kuma kasa da duwatsun farkon Paleocene, amma ainihin shekarunsa ya kasance abin muhawara: wasu fassarorin baya sun sanya shi kusan shekaru miliyan 70–69 da suka wuce, wasu suka ce yana daga karshen Cretaceous sosai, wasu kalilan ma suka tura wasu sassan rikodin zuwa Paleocene. Marubutan sun auna sassan duwatsu, suka dauki samfurori daga wuraren da ke dauke da dinosaur, suka tantance detrital sanidine grains da hanyoyin $^{40}Ar/^{39}Ar$, sannan suka danganta sashen da sanannun lokutan magnetic polarity.

Na biyu, sun tambayi yadda fauna din yake idan aka duba shi cikin yanayinsa. Sun tattara bayanan samuwar vertebrates na kasa da na ruwa daga yammacin Arewacin Amurka a cikin Campanian, Maastrichtian da farkon Paleocene, sannan suka yi amfani da hanyoyin ecology da biogeography don gwada ko fauna sun bambanta daga yanki zuwa yanki ko kuma sun zama iri daya. Muhimmin kalma a nan ita ce **provinciality**: wato ko yankuna daban-daban suna da al'ummomin halittu masu bambanci, maimakon dabbobi iri daya ko'ina.

Wannan yana da muhimmanci saboda wani nau'in labarin karshen dinosaur yana cewa yammacin Arewacin Amurka ya kara zama iri daya a Maastrichtian, tare da raguwar bambancin yankuna da fauna mai yawo ko'ina. Tsari mai dan bambanci kuma mai kama da juna zai fi sauki a dauka cewa yana da rauni tun kafin asteroid. Tsari mai rarrabuwar yanki yana ba da wani labari daban.

Abin da suka gano

Tantance shekarun shi ne mahimmin hinge. Samfuran Naashoibito guda biyu masu dauke da dinosaur suna da kuntatawar shekarun late Maastrichtian. Wani samfur na sandstone, H08-Sand-08, ya ba da iyakar shekarun ajiya ta **shekaru miliyan 66.87 $\pm$ 0.04**. Samfur daga "34-Bone Site", wanda ke dauke da wani bangare na skeleton na lambeosaurine hadrosaur, ya ba da iyakar shekarun ajiya ta **shekaru miliyan 66.38 $\pm$ 0.08**. Idan aka hada wannan da rikodin magnetic polarity, marubutan suna sanya manyan matakan Naashoibito da ke dauke da dinosaur cikin kusan **shekaru 340,000** na iyakar K-Pg.

Hakan yana sanya rikodin San Juan Basin kusan a lokaci guda da sanannun fauna na Hell Creek da ke arewa. Haka kuma yana raba dinosaur na Naashoibito da fauna na Nacimiento na farkon Paleocene da kusan **shekaru 700,000**, abin da ke da muhimmanci domin ba wanda yake son a sanya dinosaur wadanda ba tsuntsaye ba a bangaren da bai dace ba na iyakar extinction. Hakan zai zama rikici a bayanai, kuma zai kasance kuskure.

Sakamakon ecology shi ne rabin labarin na biyu. A cikin lokutan karshen Cretaceous da suka bincika, marubutan sun sami shaida ta **bioprovinces biyu** a yammacin Arewacin Amurka. Idan aka binciki dinosaur su kadai, sun rabu zuwa bioprovinces biyu a duk lokutan latest Cretaceous da binciken ya duba. Takardar tana cewa wadannan bambance-bambancen yankuna ba su rushe kawai su zama fauna guda iri daya ba kafin tasirin asteroid.

Abin da ke jagorantar tsarin ba kawai layi ne daga arewa zuwa kudu ba. Bincikensu ya nuna **zafin jiki** a matsayin babban abin da ke tsara wadannan bioprovinces a Cretaceous, yayin da geography ke taka rawa ta biyu. Yankunan kudu masu zafi na iya fifita wasu dabbobi, kamar sauropods, yayin da yankunan arewa masu sanyi suka fifita wasu, kamar hadrosaurines. Ma'anar ba ita ce kowace province ta fi kowace lafiya ba. Ma'anar ita ce taswirar karshen

Cretaceous har yanzu tana da tsarin yankuna.

Abin da wannan *ba* ya tabbatar

- Ba ya tabbatar cewa dinosaur a ko'ina a duniya suna bunƙasa har asteroid ya bugi Duniya. Marubutan sun bayyana cewa wannan har yanzu hoto ne da ya fi dogara da Arewacin Amurka.
- Ba ya goge shaidar koma baya a wasu groups, yankuna ko wasu analyses. Yana ƙalubalantar labari mai laushi da ke cewa duk nahiyar ta bi hanya guda, ba kowane yiwuwar nau'in matsin lamba kafin extinction ba.
- Ba ya nuna asteroid bai da muhimmanci. Tasirin asteroid har yanzu shi ne babban abin da ya faru a iyakar; wannan takarda tana tambayar irin ecosystems da aka bugawa.
- Ba ya sa New Mexico ya zama cikakkiyar taga ga dukan duniya. Yana ƙara muhimmin bayanai point daga kudu a rikodin da wuraren arewa suka mamaye.
- Ba ya sa "sun bunƙasa har lokacin tasiri" ya zama amintaccen kanun labarai. Wannan shi ne faɗaɗa da'awar zuwa iyakarta, ba mafi tsarkin sakamakon ba.

Yaya ƙarfin shaidar yake?

Game da shekarun matakan Naashoibito masu dinosaur, shaidar da ke cikin babban rubutun ta yi ƙarfi sosai har ta canza muhawarar. Marubutan sun haɗa kwanakin radioisotopic daga detrital sanidine grains da magnetostratigraphy, kuma mahimman kwanakin suna dacewa da fassarar latest Cretaceous. Takardar kuma ta yi mu'amala kai tsaye da tsohuwar muhawara kan ko waɗannan burbushin sun fi tsufa sosai, latest Cretaceous ne, ko ma Paleocene.

Har yanzu akwai wani caveat na fasaha. Cikakken bayani na geochronology, fassarar magnetic da bayanai tables suna cikin supplementary materials na *Science*. Babban takardar tana bayar da muhimman da'awa da lambobi, amma a final publication pass ya dace a sake duba supplement kafin a ɗauki kowane methodological detail a matsayin abin da aka rufe gaba ɗaya.

Ga babban da'awar ecology, shaidar tana da amfani kuma tana nuna hanya, amma ta fi dogaro da model. Marubutan sun yi amfani da occurrence datasets, clustering da resampling don infer bioprovinces. Waɗannan kayan aiki sun dace da tambayar, amma hakan yana nufin sakamakon ya dogara da yadda aka samfurci burbushin, taxonomic assignments, rabon lokaci, da yadda ake kula da absences. Fossil record bayanai ne da wasu haƙoransu suka ɓace.

Saboda haka, karatun da ya fi aminci ya kasu biyu: rikodin New Mexico na gaske ne kuma muhimmin rikodin kudu na late Cretaceous; ƙarshe cewa yammacin Arewacin Amurka ya riƙe tsarin fauna na yankuna kusa da ƙarshen yana da kyakkyawan goyon bayan analyses ɗin marubutan; amma bai kamata a yi tsalle daga wannan zuwa da'awar lafiyar dinosaur a duniya baki ɗaya ba.

Me ya sa yake da muhimmanci

Tsohuwar muhawara kan koma bayan dinosaur ba batun dinosaur kaɗai ba ce. Batun yadda muke ɗora nauyi a kan fossil record guda ɗaya ne.

Idan mafi kyawun rikodin ƙarshen Cretaceous ya fito daga northern Great Plains, yana da sauƙi a bar wannan rikodin ya wakilci nahiyar, sannan a bar nahiyar ta wakilci duniya. Hakan yana da sauƙi. Amma haka ne wani tsarin yanki yake iya zama labarin duniya ba tare da samun tikiti ba.

Sakamakon New Mexico ya sa labarin ya daina zama mai santsi. Yana cewa: ku kalli kudu. Ga wani unit mai dinosaur kusa da iyakar. Ga fauna da ba su kwafi na arewa kawai ba. Ga shaida cewa zafin jiki da ecology na yanki har yanzu suna da muhimmanci a ƙarshen wasan.

Wannan ba ya rage masifar asteroid. A wata hanya ma, yana sa masifar ta fi kaifi. Tasirin bai zo ne a ƙarshen ecosystem guda da aka sauƙaƙa ba. Ya bugi jerin duniyoyin yankuna da har yanzu suke da tsarin kansu.

Akwai kuma darasi mai shiru a takardar. Kyakkyawan dating yana canza labari. Tarin burbushin da ba a san shekarunsa da kyau ba na iya zama jita-jita mai ƙasusuwa. Da zarar ka sanya shi a madaidaicin sashe na agogon geology, burbushin iri ɗaya ya zama shaida.

Takaitaccen bayani mai tsabta

Wani bincike a *Science* ya sake nazarin Naashoibito Member a New Mexico, wani unit mai dinosaur wanda aka daɓe ana muhawara kan shekarunsa. Ta amfani da $^{40}Ar/^{39}Ar$ dating na detrital sanidine da magnetostratigraphy, marubutan sun ƙuntata manyan matakan da ke ɗauke da dinosaur zuwa cikin kusan shekaru 340,000 na iyakar Cretaceous-Paleogene, wanda ya sanya su cikin dinosaur waɗanda ba tsuntsaye ba na ƙarshe da aka sani a Arewacin Amurka kuma kusan a lokaci guda da fauna na Hell Creek da ke arewa. Sannan sun yi amfani da analyses na ecology da biogeography na occurrences na vertebrates a yammacin Arewacin Amurka don cewa fauna na ƙarshen Cretaceous sun ci gaba da kasancewa masu tsarin yanki: dinosaur sun rabu zuwa bioprovinces biyu, kuma zafin jiki yana bayyana a matsayin babban abin da ya jagoranci waɗannan bambance-bambance. Sakamakon yana ƙalubalantar ra'ayin cewa fauna na dinosaur guda mai ƙarancin bambanci ya rufe nahiyar yana dusashewa daidai kafin tasirin asteroid. Ba ya tabbatar da lafiyar dinosaur a duniya baki ɗaya, ba ya warware duk muhawarar decline, kuma ba ya nuna duk dinosaur sun bunƙasa har ƙarshen. Yana nuna cewa rikodin kudu da aka fi tantance shekarunsa yana sa labarin ƙarshe na Arewacin Amurka ya fi zama na yankuna, ya fi tsari, kuma ya rage zama labari mai santsi guda ɗaya.

Binciken No-BS

Abin da takardar ta nuna: Matakan Naashoibito Member masu dinosaur a New Mexico daga latest Cretaceous ne, mai yiwuwa cikin kusan shekaru 340,000 na iyakar K-Pg, kuma rikodin vertebrates na yammacin Arewacin Amurka yana goyon bayan ci gaba da bioprovinces na yankuna kusa da ƙarshen.

Abin da yake yiwuwa amma ba a tabbatar ba: Cewa yawancin ecosystems na dinosaur har yanzu suna da ƙarfi kafin tasirin asteroid; cewa zafin jiki ya taimaka wajen riƙe duniyoyin fauna na arewa da kudu daban; cewa tsohon labarin mai sauƙi continent-wide decline ya yi santsi fiye da yadda bayanai suke nuna.

Abin da ba ya nuna: Cewa dinosaur a ko'ina suna bunƙasa; cewa babu groups ko yankuna da ke decline; cewa asteroid ba shi ne babban trigger na extinction ba; cewa New Mexico kaɗai ya sake rubuta ƙarshen Cretaceous na duniya.

Babban limitations: Fossil record na yanki; provinciality nazari mai dogaro da model; sampling biases na bur-bushin; cikakken geochronology da occurrence methods suna buƙatar final check da supplementary materials na *Science*.

Nawa ne amincewar da mai karatu na gama gari ya kamata ya yi? Mai girma cewa New Mexico yanzu yana ba da muhimmin rikodin dinosaur daga kudu na late Cretaceous. Kyakkyawa cewa yammacin Arewacin Amurka ya ci gaba da samun tsarin fauna na yankuna kusa da ƙarshen. Ƙasa cewa za a iya matse wannan zuwa "dinosaur suna lafiya ko'ina har asteroid." Sakamakon na gaske ya fi wannan kyau: babin ƙarshe ba labari guda madaidaici na duk nahiyar ba ne.

Majiyoyi

Flynn et al., Late-surviving New Mexican dinosaurs illuminate high end-Cretaceous diversity and provinciality, Science 390, 400-404 (2025)
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