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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
1	Soft tissues and associated structures	Bone marrow	Amphibia; Amphibia	Anura: Rana pueyoi (ANF-0016, MGS 26217); Salamandridae: Triton sp.	Libros Biota	Spain	Europe	Cenozoic	Neogene	10 (Tortonian, Late Miocene)	SEM; TEM		EDS	McNamara et al.	2006
2	Soft tissues and associated structures	Medullary bone (female-specific)	Dinosauria	Tiranosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM; SEM	CH		Schweitzer, Wittmeyer & Horner	2005
3	Soft tissues and associated structures	Medullary bone (female-specific)	Dinosauria	Tiranosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM; SEM; TC	CH; IF		Schweitzer et al.	2016
4	Soft tissues and associated structures	Medullary bone (female-specific)	Avialae	Avimaia schweitzerae (IVPP V25371)	Xiagou Formation, Yumen, Gansu	China	Asia	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	SEM; CL; CT Scan		EDS	Bailleul et al.	2019
5	Soft tissues and associated structures	Fibromuscular tissue	Amphibia	Salamandridae: Chelotriton sp (MNCN 12555)	Ribesalbes Lagerstätte, near Castellón de la Plana	Spain	Europe	Cenozoic	Neogene	18 (Burdigalian, Early Miocene)	SEM; TEM		EDS	McNamara et al.	2010
6	Soft tissues and associated structures	Fibromuscular tissue	Avialae	Enantiornithine (STM10-12)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM (TLM); SEM	CH	EDS	Bailleul et al.	2020b
7	Soft tissues and associated structures	Fibrocartilaginous or cartilaginous tissue	Avialae	Confuciusornis sanctus (MES-NJU 57002)	Yixian Formation, Sihetun, Liaoning	China	Asia	Mesozoic	Cretaceous	125,7-113,0 (Barremian-Aptian, Early Cretaceous)	SEM; micro-CT		EDS; FTIR; XANES; SRS-XRF; ToF-SIMS	Jiang et al.	2017
8	Soft tissues and associated structures	Fibrocartilaginous or cartilaginous tissue	Dinosauria	Hypacrosaurus stebingeri (MOR 548)	Two Medicine Formation, Alberta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	HQ; IHQ		Bailleul et al.	2020a
9	Soft tissues and associated structures	Fibrocartilaginous or cartilaginous tissue	Dinosauria	Caudipteryx (STM4-3)	Yixian Formation, near Chaoyang City, Dapingfang Town	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM; SEM-EDS; TEM	CH		Zheng et al.	2021
10	Soft tissues and associated structures	Connective tissue, including tendons and ligaments	Reptilia	Mosasauria: Prognathodon sp. (IRSNB 1624)	Ciply Phosphatic Chalk, Mons Basin	Belgium	Europe	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	SEM; OM; TEM; CLSM	IF; PCR	EDS; FTIR; proton NMR	Lindgren et al.	2011
11	Soft tissues and associated structures	Connective tissue, including tendons and ligaments	Avialae	Confuciusornis sanctus (MES-NJU 57002)	Yixian Formation, Sihetun, Liaoning	China	Asia	Mesozoic	Cretaceous	125,7-113,0 (Barremian-Aptian, Early Cretaceous)	SEM; micro-CT		EDS; FTIR; XANES; SRS-XRF; ToF-SIMS	Jiang et al.	2017
12	Soft tissues and associated structures	Connective tissue, including tendons and ligaments	Dinosauria	Edmontosaurus annectens (SRHS-DU-2 to -306)	Standing Rock Hadrosaur Site, Hell Creek Formation, Corson County, South Dakota	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); FESEM-EDS		XRD	Ullmann, Pandya & Nellermoe	2019
13	Soft tissues and associated structures	Epidermal tissue	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDX; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
14	Soft tissues and associated structures	Epidermal tissue	Dinosauria	Hadrosauridae (YPMPU 016969)	Bearpaw Shale Formation, Crawford Ranch, Wheatland County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (PLM); SEM		EDS; RS	Fabbri et al.	2020
15	Soft tissues and associated structures	Mammillary layer (eggshell)	Avialae	Avimaia schweitzerae (IVPP V25371)	Xiagou Formation, Yumen, Gansu	China	Asia	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	SEM; micro-CL; CT Scan		EDS	Bailleul et al.	2019
16	Soft tissues and associated structures	Ovarian follicle perifollicular membrane	Avialae	Enantiornithine (STM10-12)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM (TLM); SEM	CH	EDS	Bailleul et al.	2020b
17	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Indet.	Nemegt Basin, Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM		CP	Nowicki et al.	1972
18	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM		XRF	Pawlicki & Nowogrodzka-Zagórska	1998
19	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Tiranosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); SEM			Schweitzer et al.	2005a
20	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); FESEM	ELISA; IHQ; WB	ATR-FTIR; ToF-SIMS; LC-MS/MS	Schweitzer et al.	2009
21	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 555); Tyrannosaurus rex (MOR 1125); Tyrannosaurus rex (MOR 1126); Tyrannosaurus rex (MOR 1128); Brachylophosaurus canadensis (MOR 2598); ceratopsídeo indet. (MOR 10857)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Valley County	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 866.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); SEM; TEM; nano-TC	CH; IHQ	ToF-SIMS	Schweitzer et al.	2025
22	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tiranosaurus rex (MOR 555); Tiranosaurus rex (FMNH-PR-2081); Triceratops horridus (MOR 699); Tiranosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 794)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation; Hell Creek Formation, Garfield County; Lower Judith River Formation	USA; USA; USA; USA; USA	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 68–70 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 78 (Campanian, Late Cretaceous)	SEM; TEM			Schweitzer, Wittmeyer & Horner	2007

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
23	Soft tissues and associated structures	Blood vessel–like structures	Amphibia	Salamandridae: Chelotriton sp (MNCN 12555)	Ribesalbes Lagerstätte, near Castellón de la Plana	Spain	Europe	Cenozoic	Neogene	18 (Burdigalian, Early Miocene)	SEM; TEM		EDS	McNamara et al.	2010
24	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria; Dinosauria	Terópode indet. (BRM P2002.4.1); Ceratopsidae (BMR P2006.4.1); Thescelosaurus sp. (BMR P2006. 4.309)	Hell Creek Formation, Montana	USA; USA; USA	North America; North America; North America	Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM-EDS			Peterson, Lenczewski & Scherer	2010
25	Soft tissues and associated structures	Blood vessel–like structures	Reptilia	Mosasauria: Prognathodon sp. (IRSNB 1624)	Ciply Phosphatic Chalk, Mons Basin	Belgium	Europe	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM; CLSM	IF; PCR	EDS; FTIR; proton NMR	Lindgren et al.	2011
26	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)			SAXS; FTIR; μ-XRF; μ-XANES	Boatman et al.	2014
27	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM	IHQ	SR-FTIR; EDS; μ-XRF; μ-XANES	Boatman et al.	2019
28	Soft tissues and associated structures	Blood vessel–like structures	Testudines	Pelomedusoides incertae sedis (CCMFC01)	Calenturitas Coal Mine, La Jagua de Ibirico town, Cesar Department	Colombia	South America	Cenozoic	Paleogene	56 (Paleocene–Eocene)	OM (TLM, PLM); EFM			Cadena & Schweitzer	2014
29	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		IFI	HPLC; HRMS	Cleland et al.	2015
30	Soft tissues and associated structures	Blood vessel–like structures	Testudines; Testudines; Testudines	Allaeochelys crassesculpta (SMF ME-2449); Mongolemys elegans (IGM-90/42); Podocnemididae indet. (UR-CP-0043)	Messel Pit, Darmstadt; Nemegt Formation, Bugin Tsav, Gobi Desert; Repartidora locality, La Victoria Formation, Tatacoa Desert	Germany; Mongolia; Colombia	Europe; Asia; South America	Cenozoic; Mesozoic; Cenozoic	Paleogene; Cretaceous; Neogene	48 (Middle Eocene, Paleogene); 80,0 (Campanian, Late Cretaceous); 13,6 (Serravallian, Middle Miocene)	OM (TLM); FESEM-BSE; SEM-EDS			Cadena	2016
31	Soft tissues and associated structures	Blood vessel–like structures	Testudines; Testudines; Testudines	Allaeochelys crassesculpta (SMF ME-2449); Mongolemys elegans (IGM-90/42); Podocnemididae indet. (UR-CP-0043)	Messel Pit, Darmstadt; Nemegt Formation, Bugin Tsav, Gobi Desert; Repartidora locality, La Victoria Formation, Tatacoa Desert	Germany; Mongolia; Colombia	Europe; Asia; South America	Cenozoic; Mesozoic; Cenozoic	Paleogene; Cretaceous; Neogene	48 (Middle Eocene, Paleogene); 80,0 (Campanian, Late Cretaceous); 13,6 (Serravallian, Middle Miocene)	OM (TLM, PLM); SEM-EDS			Cadena	2020
32	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Triceratops horridus	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; VPSEM			Armitage	2016

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33	Soft tissues and associated structures	Blood vessel–like structures	Amphibia	Temnospondyli: Eryops sp.	-	USA	North America	Paleozoic	Permian	298,9-293,5 (Cisuralian, Early Permian)	OM; Fotografia XP; EFM			Armitage	2025
34	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaur canadensis (MOR 2598); Brachylophosaur canadensis (MOR 2967)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Phillips County	USA; USA; USA	North America; North America; North America	Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 72,1-66,0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM, PLM); SEM; TEM	CH; IHQ		Schweitzer, Moyer & Zheng	2016
35	Soft tissues and associated structures	Blood vessel–like structures	Reptilia; Reptilia; Reptilia	Nothosauria: Nothosaurus cf. marchicus (WNoZ/s/7/166); Nothosauria: Nothosaurus cf. marchicus (SUT-MG/F/Tvert/15); Archosauromorpha: Protanystropheus sp. (SUT-MG/F/Tvert/2)	Żyglin quarry, Miasteczko Śląskie Town; Gogolin Formation, Gogolin Town; Gogolin Formation, Gogolin Town	Poland	Europe	Mesozoic	Triassic	251,2-247,2 (Olenekian, Early Triassic)	ESEM-EDS		XRD; FTIR; ToF-SIMS; XPS	Surmik et al.	2016
36	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria	Homalocephale calathocercos (MPC-D 100/1201); Edmontosaurus regalis (UAMES 52615)	Nemegt Formation, Western Sayr, Nemegt; Price Creek Formation, Colville River, Alaska	Mongolia; USA	Asia; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM); SEM-EDS; AFM; FESEM		XRPD; FTIR; ToF-SIMS	Surmik et al.	2023
37	Soft tissues and associated structures	Blood vessel–like structures	Reptilia	Nothosauria: Nothosaurus cf. marchicus (SUT-MG/f/98)	Gogolin Formation, Gogolin Quarry, Opole Silesia	Poland	Europe	Mesozoic	Triassic	247,2-242 (Anisian, Middle Triassic)	SEM; ESEM-EDS		ToF-SIMS	Surmik, Rothschild & Pawlicki	2017
38	Soft tissues and associated structures	Blood vessel–like structures	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	FESEM; TEM; FIB-SEM		XRD; XRF; ToF-SIMS	Plet et al.	2017
39	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria; Dinosauria; Dinosauria	Apatosaurus sp. (BYU681-16782); Diplodocidae (SMA G44/96-1); Allosaurus fragilis (YPM 48); Heyuannia huangi (NMNS CYN-2004-DINO-05)	Morrison Formation, Colorado; Howe-St. Quarry, Wyoming; Carbon County, Wyoming; Yuanpu Formation, Jiangxi	USA; USA; USA; China	North America; North America; North America; Asia	Mesozoic; Mesozoic; Mesozoic; Mesozoic	Jurassic; Jurassic; Jurassic; Cretaceous	154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 72,1-66,0 (Maastrichtian, Late Cretaceous)	OM		RS	Wiemann et al.	2018

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40	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Edmontosaurus annectens (SRHS-DU-2 to -306)	Standing Rock Hadrosaur Site, Hell Creek Formation, Corson County, Dakota do Sul	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); FESEM-EDS		XRD	Ullmann, Pandya & Nellermoe	2019
41	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Triceratops horridus (HCTH-02, 03, HCTR-11, HCTV-22 e HCTF-39)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); DIC; UVFL; SEM; TEM	CH		Armitage & Solliday	2020
42	Soft tissues and associated structures	Blood vessel–like structures	Avialae	Enantiornithine (STM10-12)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM (TLM); SEM	CH	EDS	Bailleul et al.	2020b
43	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Hadrosauridae (YPMPU 016969)	Bearpaw Shale Formation, Crawford Ranch, Wheatland County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (PLM); SEM		EDS; RS	Fabbri et al.	2020
44	Soft tissues and associated structures	Blood vessel–like structures	Mammalia	Mysticeti (BFW, SP08-20, SP08-22, SP08-23, SP08-31, SP08-32, SP08-34a, SP08-34b)	Pisco Formation	Peru	South America	Cenozoic	Neogene	9,6-4,5 (Middle–Late Miocene)	SEM-EDS		FPLC; BCA; XRD; UV-Vis; MALDI-ToF; LC-MS/MS	Boskovic et al.	2021
45	Soft tissues and associated structures	Blood vessel–like structures	Avialae	Struthio sp (IVPP V 25336)	Liushu Formation, Linxia Basin, Tibetan Plateau, Nalesi town, Dongxiang County, Shuang-gong-bei village	China	Asia	Cenozoic	Neogene	10,0-7,2 (Tortonian, Late Miocene)	OM (TLM, PLM); SEM			Li et al.	2021
46	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Dreadnoughtus schrani (MPM-PV 1156)	Cerro Fortaleza Formation, east bank of the Río La Leona, Santa Cruz Province	Argentina	South America	Mesozoic	Cretaceous	76,0-70,0 (Campanian-Maastrichtian, Late Cretaceous)	OM (TLM, PLM)	IF; ELISA	XRD; LA-ICPMS	Schroeter et al.	2022
47	Soft tissues and associated structures	Blood vessel–like structures	Testudines; Testudines; Testudines; Testudines; Reptilia; Reptilia	Euclastes (RU-EFP-00018); Taphrosphys (RU-EFP-00002, 02175, 02222 e 04162); tartaruga indet. (RU-EFP-02295), tartaruga indet. (RU-EFP-04161-8); Crocodylomorpha: Thoracosaurus neocesariensis (RU-EFP-00006); Crocodylomorpha indet. (RU-EFP-00030)	Hornerstown Formation, Jean and Ric Edelman Fossil Park, Mantua Township, New Jersey	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Cenozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Paleogene; Cretaceous; Cretaceous;	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 66,0-61,6 (Danian, Early Paleogene); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	SEM-EDS; FESEM	PAGE; ELISA; IF	XRD	Voegele et al.	2022

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48	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Hadrosauridae (MOR 2967, MOR 2990-32)	Judith River Formation, near Malta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)			Ullmann & Schweitzer	2023
49	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria	Triceratops horridus	Hell Creek Formation, Dawson County, Glendive city, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); SEM			Cruz & Armitage	2024
50	Soft tissues and associated structures	Blood vessel–like structures	Testudines; Testudines; Testudines; Testudines; Testudines; Mammalia; Mammalia; Mammalia	Tartaruga indet. (F47, F101); tartaruga indet. (F08-87); tartaruga indet. (F15); tartaruga indet. (F19-06); tartaruga indet. (F19-27, F19-50); mamífero indet. (F19-10, F19-18, F19-28); Merycoidodontoidea (F08-77); Brontotheriidae (F08-915-R, F08-08, F08-09, F08-10, F08-80).	Brule Formation, Wyoming; Chamberlain Pass Formation; Chadron Formation, Wyoming; Sharps Formation, South Dakota; Sharps Formation, South Dakota; Sharps Formation, South Dakota; Chadron Formation, Wyoming; Chadron Formation, Wyoming	USA; USA; USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America; North America; North America	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene	33,9-23,0 (Oligocene); 56,0-33,9 (Eocene); 56,0-33,9 (Eocene); 33,9-23,0 (Oligocene); 33,9-23,0 (Oligocene); 33,9-23,0 (Oligocene); 56,0-33,9 (Eocene); 56,0-33,9 (Eocene)	OM (TLM); Fotografia XP		XRD	Gallucci et al.	2024
51	Soft tissues and associated structures	Blood vessel–like structures	Mammalia	Paroxacron valdense (UM-DAM1-278, -279), (UM-DAM1-280 a -282) e (UM-DAM1-283)	Phosphorites du Quercy, Dams, near Caylus	France	Europe	Cenozoic	Paleogene	42,0-24,0 (Late Eocene)	OM (TLM); SEM-EDS			Wu et al.	2024a
52	Soft tissues and associated structures	Blood vessel–like structures	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	IHQ	RR	Long et al.	2025

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
53	Soft tissues and associated structures	Blood vessel–like structures	Fish; Fish; Fish; Fish; Fish; Fish; Fish	Psammosteus sp. (NUFV 1587); Bothriolepis sp. (ANSP não catalogado); Bothriolepidae indet. (NUFV 1586); Gyracanthus sherwoodi (ANSP não catalogado); Holoptychius sp. (ANSP 23543); Megalichthys mullisoni (ANSP 21165); Hyneria lindae (ANSP 25034)	Fm. Nordstrand Point, site NV2K11, Nunavut; Fm. Catskill, localidade Powys Curve, Pennsylvania; Fm. Fram, site NV0403, Ellesmere Island, Nunavut; Fm. Catskill, Red Hill, Pennsylvania; Fm. Catskill, Tioga Rest Stop, Pennsylvania; Fm. Catskill, Red Hill, Pennsylvania; Fm. Catskill, Red Hill, Pennsylvania.	Canada; USA; Canada; USA; USA; USA	North America; North America; North America; North America; North America; North America; North America	Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic	Devonian; Devonian; Devonian; Devonian; Devonian; Devonian; Devonian	375,0 (Frasnian, Late Devonian); 361,0 (Famennian, Late Devonian); 378,0 (Frasnian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian)	OM (TLM); FESEM		EDS	Rogoff & Ullmann (2025)	2025
54	Soft tissues and associated structures	Venous valves	Dinosauria	Triceratops horridus (HCTH-02, 03, HCTR-11, HCTV-22 e HCTF-39)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); DIC; UVFL; SEM; TEM	CH			2020
55	Soft tissues and associated structures	Nerve fibers	Dinosauria	Triceratops horridus (HCTH-02, 03, HCTR-11, HCTV-22 e HCTF-39)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); DIC; UVFL; SEM; TEM	CH		Armitage & Solliday	2020
56	Soft tissues and associated structures	Nerve fibers	Dinosauria	Triceratops horridus (HCTC-31)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM)			Armitage	2021
57	Soft tissues and associated structures	Nerve fibers	Amphibia	Temnospondyli: Cacops sp.	Richards Spur locality, Dolese Brothers Limestone Quarry, Lawton, Oklahoma	USA	North America	Paleozoic	Permian	Early Permian	OM (PLM)			Armitage	2023
58	Soft tissues and associated structures	Nerve fibers	Dinosauria	Triceratops horridus	Hell Creek Formation, Dawson County, Glendive city, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); SEM			Cruz & Armitage	2024
59	Soft tissues and associated structures	Sharpey's fibers	Amphibia	Temnospondyli: Eryops sp.	-	USA	North America	Paleozoic	Permian	298,9-293,5 (Cisuralian, Early Permian)	OM; Fotografia XP; EFM			Armitage	2025
60	Cells and their biocomponents	Osteocytes	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM			Pawlicki, Dkorbel & Kubiak	1963
61	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Indet.	Nemegt Basin, Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM		CP	Nowicki et al.	1972

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62	Cells and their biocomponents	Osteocytes	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); SEM			Pawlicki	1976
63	Cells and their biocomponents	Osteocytes	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	FM	CH		Pawlicki	1977a
64	Cells and their biocomponents	Osteocytes	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM			Pawlicki	1978a
65	Cells and their biocomponents	Osteocytes	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM			Pawlicki	1978b
66	Cells and their biocomponents	Osteocytes	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM			Pawlicki	1984b
67	Cells and their biocomponents	Osteocytes	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM			Pawlicki	1984c
68	Cells and their biocomponents	Osteocytes	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; TEM			Pawlicki	1985
69	Cells and their biocomponents	Osteocytes	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM; FM	IHQ		Pawlicki	1995
70	Cells and their biocomponents	Osteocytes	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); SEM			Schweitzer et al.	2005a
71	Cells and their biocomponents	Osteocytes	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tiranosaurus rex (MOR 555); Tiranosaurus rex (FMNH-PR-2081); Triceratops horridus (MOR 699); Tiranosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 794)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation; Hell Creek Formation; Hell Creek Formation, Garfield County; Lower Judith River Formation	USA; USA; USA; USA; USA	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 70,0-68,0 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 78,0 (Campanian, Late Cretaceous)	SEM; TEM			Schweitzer, Wittmeyer & Horner	2007
72	Cells and their biocomponents	Osteocytes	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	OM (TLM); FESEM	ELISA; IHQ; WB	ATR-FTIR; ToF-SIMS; LC-MS/MS	Schweitzer et al.	2009
73	Cells and their biocomponents	Osteocytes	Reptilia	Mosasauria: Prognathodon sp. (IRSNB 1624)	Ciply Phosphatic Chalk, Mons Basin	Belgium	Europe	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM; CLSM	IF; PCR	EDS; FTIR; proton NMR	Lindgren et al.	2011
74	Cells and their biocomponents	Osteocytes	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	SEM; TEM; FM	IFI; HQ	MS/MS	Schweitzer et al.	2013

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
75	Cells and their biocomponents	Osteocytes	Testudines; Testudines; Testudines; Testudines; Testudines; Testudines; Testudines	Annemis sp.; Mongolemys elegans (NCSUPL01 to -03); Bothremydidae; Trionychidae; Podocnemididae; Rhinoclemmys sp. (NCSUPL05 e -09); Podocnemididae	Indet.; Indet.; North Carolina; North Carolina; La Venta; Indet.; Bogotá Formation	Mongolia; Mongolia; USA; USA; Colombia; Panama; Colombia	Asia; Asia; North America; North America; South America; Central America; South America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Cenozoic; Cenozoic; Cenozoic	Jurassic; Cretaceous; Cretaceous; Cretaceous; Paleogene; Neogene; Neogene	150,0 (Kimmeridgian, Late Jurassic); 80,0 (Campanian, Late Cretaceous); 80,0 (Campanian, Late Cretaceous); 80,0 (Campanian, Late Cretaceous); 55,0 (Ypresian, Early Eocene); 23,0 (Aquitanian, Early Miocene); 13,0 (Serravallian, Middle Miocene)	OM (TLM, PLM); FM			Cadena & Schweitzer	2012
76	Cells and their biocomponents	Osteocytes	Testudines	Pelomedusoides incertae sedis (CCMFC01)	Calenturitas Coal Mine, La Jagua de Ibirico town, Cesar Department	Colombia	South America	Cenozoic	Paleogene	56 (Paleocene–Eocene)	OM (TLM, PLM); EFM			Cadena & Schweitzer	2014
77	Cells and their biocomponents	Osteocytes	Dinosauria	Triceratops horridus (HCTH-01, 02, 03, 04, 05, HCTR-11, HCTV-22)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM			Armitage & Anderson	2013
78	Cells and their biocomponents	Osteocytes	Dinosauria	Triceratops horridus	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM			Armitage & Anderson	2014
79	Cells and their biocomponents	Osteocytes	Testudines	Mongolemys elegans (IGM-90/11)	Nemegt Formation, Bugin Tsav locality, Ömnögov Aimag, Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	80,0 (Campanian, Late Cretaceous)	OM (TLM)			Cadena, Ksepka & Norell	2013
80	Cells and their biocomponents	Osteocytes	Dinosauria	Triceratops horridus	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; VPSEM			Armitage	2016
81	Cells and their biocomponents	Osteocytes	Amphibia	Temnospondyli: Eryops sp.	-	USA	North America	Paleozoic	Permian	298,9-293,5 (Cisuralian, Early Permian)	OM; Fotografia XP; EFM			Armitage	2025
82	Cells and their biocomponents	Osteocytes	Testudines; Testudines; Testudines	Allaeochelys crassesculpta (SMF ME-2449); Mongolemys elegans (IGM-90/42); Podocnemididae indet. (UR-CP-0043)	Messel Pit, Darmstadt; Nemegt Formation, Bugin Tsav, Gobi Desert; Repartidora locality, La Victoria Formation, Tatacoa Desert	Germany; Mongolia; Colombia	Europe; Asia; South America	Cenozoic; Mesozoic; Cenozoic	Paleogene; Cretaceous; Neogene	48 (Middle Eocene, Paleogene); 80,0 (Campanian, Late Cretaceous); 13,6 (Serravallian, Middle Miocene)	OM (TLM); FESEM-BSE; SEM-EDS			Cadena	2016

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
83	Cells and their biocomponents	Osteocytes	Testudines; Testudines; Testudines	Allaeochelys crassesculpta (SMF ME-2449); Mongolemys elegans (IGM-90/42); Podocnemididae indet. (UR-CP-0043)	Messel Pit, Darmstadt; Nemegt Formation, Bugin Tsav, Gobi Desert; Repartidora locality, La Victoria Formation, Tatacoa Desert	Germany; Mongolia; Colombia	Europe; Asia; South America	Cenozoic; Mesozoic; Cenozoic	Paleogene; Cretaceous; Neogene	48 (Middle Eocene, Paleogene); 80,0 (Campanian, Late Cretaceous); 13,6 (Serravallian, Middle Miocene)	OM (TLM, PLM); SEM-EDS			Cadena	2020
84	Cells and their biocomponents	Osteocytes	Dinosauria; Dinosauria; Dinosauria; Dinosauria	Apatosaurus sp. (BYU681-16782); Diplodocidae (SMA G44/96-1); Allosaurus fragilis (YPM 48); Heyuannia huangi (NMNS CYN-2004-DINO-05)	Morrison Formation, Colorado; Howe-St. Quarry, Wyoming; Carbon County, Wyoming; Yuanpu Formation, Jiangxi	USA; USA; USA; China	North America; North America; North America; Asia	Mesozoic; Mesozoic; Mesozoic; Mesozoic	Jurassic; Jurassic; Jurassic; Cretaceous	154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 72,1-66,0 (Maastrichtian, Late Cretaceous)	OM		RS	Wiemann et al.	2018
85	Cells and their biocomponents	Osteocytes	Dinosauria	Edmontosaurus annectens (SRHS-DU-2 to -306)	Standing Rock Hadrosaur Site, Hell Creek Formation, Corson County, Dakota do Sul	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); FESEM-EDS		XRD	Ullmann, Pandya & Nellermoe	2019
86	Cells and their biocomponents	Osteocytes	Dinosauria	Triceratops horridus (HCTH-02, 03, HCTR-11, HCTV-22 e HCTF-39)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM); DIC; UVFL; SEM; TEM	CH		Armitage & Solliday	2020
87	Cells and their biocomponents	Osteocytes	Dinosauria	Hadrosauridae (YPMPU 016969)	Bearpaw Shale Formation, Crawford Ranch, Wheatland County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (PLM); SEM		EDS; RS	Fabbri et al.	2020

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88	Cells and their biocomponents	Osteocytes	Fish; Testudines; Reptilia; Reptilia; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Actinopterygii: Anchiacipenser acanthaspis (UALVP 56592, UALVP 56596); Tartaruga: Basilemys sp. (UALVP 59613); Crocodylomorpha: Crocodylia indet. (UALVP 59615); Crocodylomorpha: Leidyosuchus canadensis (UALVP 59616); Dinossauro cf. Euoplocephalus tutus (UALVP 56607); Panoplosaurus mirus (UALVP 10); Mercuriceratops gemini (UALVP 54559); Chasmosaurus belli (UALVP 52613); Chasmosaurus sp. (UALVP 55926); Centrosaurus apertus (UALVP 55794); Styracosaurus albertensis (UALVP 52612, UALVP 55900); Hadrosauridae indet. (UALVP 59614); Prosaurolophus maximus (UALVP 55880); Gorgosaurus libratus (UALVP 10, UALVP 49500), Ornithomimus edmontonicus (UALVP 52531); Saurornitholestes langstoni (UALVP 55700); Latenivenatrix mcmasterae (UALVP 55804)	Dinosaur Park Formation, Alberta	Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada; Canada	North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)			van der Reest & Currie	2020

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89	Cells and their biocomponents	Osteocytes	Mammalia	Mysticeti (BFW, SP08-20, SP08-22, SP08-23, SP08-31, SP08-32, SP08-34a, SP08-34b)	Pisco Formation	Peru	South America	Cenozoic	Neogene	9,6-4,5 (Middle–Late Miocene)	SEM-EDS		FPLC; BCA; XRD; UV-Vis; MALDI-ToF; LC-MS/MS	Boskovic et al.	2021
90	Cells and their biocomponents	Osteocytes	Avialae	Struthio sp (IVPP V 25336)	Liushu Formation, Linxia Basin, Tibetan Plateau, Nalesi town, Dongxiang County, Shuang-gong-bei village	China	Asia	Cenozoic	Neogene	10,0-7,2 (Tortonian, Late Miocene)	OM (TLM, PLM); SEM			Li et al.	2021
91	Cells and their biocomponents	Osteocytes	Dinosauria	Dreadnoughtus schrani (MPM-PV 1156)	Cerro Fortaleza Formation, east bank of the Río La Leona, Santa Cruz Province	Argentina	South America	Mesozoic	Cretaceous	76,0-70,0 (Campanian-Maastrichtian, Late Cretaceous)	OM (TLM, PLM)	IF; ELISA	XRD; LA-ICPMS	Schroeter et al.	2022
92	Cells and their biocomponents	Osteocytes	Testudines; Testudines; Testudines; Testudines; Reptilia; Reptilia	Euclastes (RU-EFP-00018); Taphrosphys (RU-EFP-00002, 02175, 02222 e 04162); tartaruga indet. (RU-EFP-02295), tartaruga indet. (RU-EFP-04161-8); Crocodylomorpha: Thoracosaurus neocesariensis (RU-EFP-00006); Crocodylomorpha indet. (RU-EFP-00030)	Hornerstown Formation, Jean and Ric Edelman Fossil Park, Mantua Township, New Jersey	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Cenozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Paleogene; Cretaceous; Cretaceous;	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 66,0-61,6 (Danian, Early Paleogene); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	SEM-EDS; FESEM	PAGE; ELISA; IF	XRD	Voegele et al.	2022
93	Cells and their biocomponents	Osteocytes	Dinosauria; Dinosauria	Homalocephale calathocercos (MPC-D 100/1201); Edmontosaurus regalis (UAMES 52615)	Nemegt Formation, Western Sayr, Nemegt; Price Creek Formation, Colville River, Alaska	Mongolia; USA	Asia; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM); SEM-EDS; AFM; FESEM		XRPD; FTIR; ToF-SIMS	Surmik et al.	2023
94	Cells and their biocomponents	Osteocytes	Dinosauria	Hadrosauridae (MOR 2967, MOR 2990-32)	Judith River Formation, near Malta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)			Ullmann & Schweitzer	2023
95	Cells and their biocomponents	Osteocytes	Dinosauria	Triceratops horridus	Hell Creek Formation, Dawson County, Glendive city, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	)M (PLM); SEM			Cruz & Armitage	2024

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96	Cells and their biocomponents	Osteocytes	Testudines; Testudines; Testudines; Testudines; Testudines; Mammalia; Mammalia; Mammalia	Tartaruga indet. (F47, F101); tartaruga indet. (F08-87); tartaruga indet. (F15); tartaruga indet. (F19-06); tartaruga indet. (F19-27, F19-50); mamífero indet. (F19-10, F19-18, F19-28); Merycoidodontoidea (F08-77); Brontotheriidae (F08-915-R, F08-08, F08-09, F08-10, F08-80).	Brule Formation, Wyoming; Chamberlain Pass Formation; Chadron Formation, Wyoming; Sharps Formation, South Dakota; Sharps Formation, South Dakota; Sharps Formation, South Dakota; Chadron Formation, Wyoming; Chadron Formation, Wyoming	USA; USA; USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America; North America; North America	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene	38,0-33,9 (Late Eocene) a 33,9-23,0 (Oligocene)	OM (TLM); Fotografia XP		XRD	Gallucci et al.	2024
97	Cells and their biocomponents	Osteocytes	Mammalia	Paroxacron valdense (UM-DAM1-278, -279), (UM-DAM1-280 a -282) e (UM-DAM1-283)	Phosphorites du Quercy, Dams, near Caylus	France	Europe	Cenozoic	Paleogene	42,0-24,0 (Late Eocene)	OM (TLM); SEM-EDS			Wu et al.	2024a
98	Cells and their biocomponents	Osteocytes	Amphibia	Temnospondyli: Eryops sp.	-	USA	North America	Paleozoic	Permian	298,9-293,5 (Cisuralian, Early Permian)	OM; Fotografia XP; EFM			Armitage	2025
99	Cells and their biocomponents	Osteocytes	Fish; Fish; Fish; Fish; Fish; Fish; Fish	Psammosteus sp. (NUFV 1587); Bothriolepis sp. (ANSP não catalogado); Bothriolepidae indet. (NUFV 1586); Gyracanthus sherwoodi (ANSP não catalogado); Holoptychius sp. (ANSP 23543); Megalichthys mullisoni (ANSP 21165); Hyneria lindae (ANSP 25034)	Fm. Nordstrand Point, site NV2K11, Nunavut; Fm. Catskill, localidade Powys Curve, Pennsylvania; Fm. Fram, site NV0403, Ellesmere Island, Nunavut; Fm. Catskill, Red Hill, Pennsylvania; Fm. Catskill, Tioga Rest Stop, Pennsylvania; Fm. Catskill, Red Hill, Pennsylvania; Fm. Catskill, Red Hill, Pennsylvania.	Canada; USA; Canada; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America; North America	Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic; Paleozoic	Devonian; Devonian; Devonian; Devonian; Devonian; Devonian; Devonian	375,0 (Frasnian, Late Devonian); 361,0 (Famennian, Late Devonian); 378,0 (Frasnian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian); 361,0 (Famennian, Late Devonian)	OM (TLM); FESEM		EDS	Rogoff & Ullmann (2025)	2025
100	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM		XRF	Pawlicki & Nowogrodzka-Zagórska	1998

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
101	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria	Tyrannosaurus rex (MOR 555)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM		EDS	Schweitzer & Horner	1999
102	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria	Beipiaosaurus inexpectus	Yixian Formation, Liaoning Province	China	Asia	Mesozoic	Cretaceous	125,7-121,4 (Barremian, Early Cretaceous)	OM; TC			Yao, Zhang & Tang	2002
103	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, , Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM); SEM			Schweitzer et al.	2005a
104	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tiranosaurus rex (MOR 555); Tiranosaurus rex (FMNH-PR-2081); Triceratops horridus (MOR 699); Tiranosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 794)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation; Hell Creek Formation, Garfield County; Lower Judith River Formation	USA; USA; USA; USA; USA	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	67-66.5 (Maastrichtian, Late Cretaceous); 67-66.5 (Maastrichtian, Late Cretaceous); 70-68 (Maastrichtian, Late Cretaceous); 67-66.5 (Maastrichtian, Late Cretaceous); 78 (Campanian, Late Cretaceous)	SEM; TEM			Schweitzer, Wittmeyer & Horner	2007
105	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Amphibia	Chelotriton sp (MNCN 12555)	Ribesalbes Lagerstätte, near Castellón de la Plana	Spain	Europe	Cenozoic	Neogene	18 (Burdigalian, Early Miocene)	SEM; TEM		EDS	McNamara et al.	2010
106	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Teropoda indet. (NHMUK R12562); Hadrosauridae (NHMUK R4249, NHMUK R4243); Hadrosauridae (NHMUK R4864); dinossauro indet. (NHMUK R4493); Ceratopsidae (NHMUK R4484)	Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta; Lance Formation, Alberta; Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta	Canada; Canada; USA; Canada; Canada	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	83,6-66,0 (Campanian-Maastrichtian, Late Cretaceous)	SEM; SEM-FIB; TEM		EDS; ToF-SIMS; EELS	Bertazzo et al.	2015

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
107	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	FESEM; TEM; FIB-SEM		XRD; XRF; ToF-SIMS	Plet et al.	2017
108	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Reptilia	Nothosauria: Nothosaurus cf. marchicus (SUT-MG/f/98)	Gogolin Formation, Gogolin Quarry, Opole Silesia	Poland	Europe	Mesozoic	Triassic	247,2-242 (Anisian, Middle Triassic)	SEM; ESEM-EDS		ToF-SIMS	Surmik, Rothschild & Pawlicki	2017
109	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Avialae	Struthio sp (IVPP V 25336)	Liushu Formation, Linxia Basin, Tibetan Plateau, Nalesi town, Dongxiang County, Shuang-gong-bei village	China	Asia	Cenozoic	Neogene	10,0-7,2 (Tortonian, Late Miocene)	OM (TLM, PLM); SEM			Li et al.	2021
110	Cells and their biocomponents	Red, round, nucleated microstructures consistent in size and morphology with red blood cells (RBCs)	Dinosauria	Telmatosaurus transsylvanicus (LPB [FGGUB] R. 1305)	Sînpetru Formation, Sibişel River, Haţeg Basin	Romania	Europe	Mesozoic	Cretaceous	70-68 (Maastrichtian, Late Cretaceous)	SEM			Chandrasinghe et al.	2025
111	Cells and their biocomponents	Keratinocytes	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
112	Cells and their biocomponents	Keratinocytes	Reptilia	Plesiosauria: Indet. (MH 7)	Posidonia Shale, Posidonienschiefer Formation, near Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	OM (TLM); SEM; TEM		EDS; EBSD; FTIR; ToF-SIMS	Marx et al.	2025
113	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Indet. (LEIUG 115562); Indet. (MGUH 28.929)	Crato Formation; Fur Formation	Brazil; Denmark	South America; Europe	Mesozoic; Cenozoic	Cretaceous; Paleogene	131-120 (Hauterivian, Early Cretaceous); 56,0-47,8 (Ypresian, Eocene)	OM; ESEM-EDS; TEM			Vinther et al.	2008
114	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Dinosauria	Anchiornis huxleyi (BMNHC PH828)	Tiaojishan Formation, Daxishan site, Jianchang County, Liaoning Province	China	Asia	Mesozoic	Jurassic	165,0-149,2 (Callovian-Kimmeridgian, Late Jurassic)	SEM-EDS; TEM			Li et al.	2010
115	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Reptilia	Mosasauria: Platecarpus tympaniticus (LACM 128319)	Smoky Hill Chalk Member, Niobrara Chalk Formation, Kansas	USA	North America	Mesozoic	Cretaceous	88,0-80,0 (Coniacian-Campanian, Late Cretaceous)	OM; SEM-EDS; Fotografia FUV			Lindgren et al.	2010

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
116	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Indet. (SMF-ME 3850)	Messel Oil Shale, near Darmstadt	Germany	Europe	Cenozoic	Paleogene	56,0-41,2 (Ypresian-Lutetian, Eocene)	ESEM-EDS			Vinther et al.	2010
117	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Dinosauria; Dinosauria; Dinosauria; Avialae	Pennaraptora (IVPP V15388B); Sinosauropteryx sp. (IVPP V14202); Sinornithosaurus (IVPP V12811); Confuciusornis (IVPP V13171)	Jehol Group, Liaoning	China	Asia	Mesozoic	Cretaceous	131-120 (Hauterivian, Early Cretaceous)	OM; SEM		EDS	Zhang et al.	2010
118	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Dinosauria	Archaeopteryx lithographica (MB.Av.100)	Solnhofen Lagerstätte	Germany	Europe	Mesozoic	Jurassic	154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic)	OM; SEM-EDS			Carney et al.	2012
119	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Dinosauria	Microraptor sp. (BMNHC PH881)	Jiufotang Formation, Lamadong, Jianchang County, Liaoning province	China	Asia	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	SEM; TEM			Li et al.	2012
120	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Indet. (5-1003)	Fur Formation	Denmark	Europe	Cenozoic	Paleogene	55,0 (Ypresian, Early Eocene)	OM; SEM		SRS-XRF	Field et al.	2013
121	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Indet. (SMF ME 3850)	Messel Oil Shale, near Darmstadt	Germany	Europe	Cenozoic	Paleogene	56,0-41,2 (Ypresian-Lutetian, Eocene);	OM; ESEM; SEM-FIB		EPMA; EDS	Vitek et al.	2013

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
122	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Testudines; Reptilia; Reptilia; Reptilia; Reptilia; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Avialae; Avialae; Avialae; Avialae	Tartaruga indet. (PKUP V1070); Squamata: Yabeinosaurus sp. (PKUP V1059); Squamata: Xianglong zhaoi (PMOL 000666); Pterosauria: Indet. (PMOL AP00022); Pterosauria: cf. Jianchangnathus robustus (BMNHC PH000988); Psittacosaurus lujiatunensis (PKUP V1050, PKUP V1051); Sinosauropteryx (IVPP 14202); Beipiaosaurus inexpectus (BMNHC PH000911); Caudipteryx zoui (PMOL AD00020); Microraptor (BMNHC PH881); Anchiornis huxleyi (BMNHC PH828); Archaeopteryx (MB.Av.100); ave Confuciusornis sanctus (CUGB G20070001); Enantiornithes indet. (CUGB G20120001, CUGB P1201); Ornithurae indet. (CUGB G20100053); Inkayacu paracasensis (MUSM 1444)	Tiaojishan Formation; Yixian Formation; Yixian Formation; Jiufotang Formation; Tiaojishan Formation; Yixian Formation; Yixian Formation; Yixian Formation; Yixian Formation; Yixian Formation; Tiaojishan Formation; Solnhofen Lagerstätte; Yixian Formation; Yixian Formationy; Jiufotang Formation; Jiufotang Formation; Otuma Formation	China; China; China; China; China; China; China; China; China; China; China; China; Germany; China; China; China; China; Peru	Asia; Asia; Asia; Asia; Asia; Asia; Asia; Asia; Asia; Asia; Asia; Asia; Europe; Asia; Asia; Asia; Asia; South America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Cenozoic	Jurassic; Cretaceous; Cretaceous; Cretaceous; Jurassic; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Jurassic; Jurassic; Cretaceous; Cretaceous; Cretaceous; Paleogene	168,2-154,0 (Middle–Late Jurassic); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 121,4-113,0 (Aptian, Early Cretaceous); 168,2-154,0 (Middle–Late Jurassic); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 168,2-154,0 (Middle–Late Jurassic); 149,0-145,0 (Tithonian, Late Jurassic); 129,7-124 (Barremian, Early Cretaceous); 129,7-124 (Barremian, Early Cretaceous); 121,4-113,0 (Aptian, Early Cretaceous); 41,2-19,5 (Eocene-Miocene)	SEM			Li et al.	2014

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123	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae; Avialae; Avialae; Amphibia; Amphibia; Amphibia; Amphibia; Mammalia; Mammalia; Fish	ave Indet. (SMF-ME 3850); Messelornis (SMF-ME11402a); ave Indet. (FUM-N2275); Anura: Palaeobatrachus (SMF-ME11390a); Anura: Pipidae (MU 41-13); Anura: Pipidae (MU 32-2A/B); Anura: Pelobates (PW 2005- 5034-LS_GDKE); morcego Hassianycteris (SMF-ME11407b); morcego Palaeochiropteryx (SMF-ME11406a); Cyclostomata	Messel; Messel; Fur Formation; Messel; Mush Valley; Mush Valley; Enspel Formation; Messel; Messel; Francis Creek Shale, Mazon Creek	Germany; Germany; Denmark; Germany; Ethiopia; Ethiopia; Germany; Germany; Germany; USA	Europe; Europe; Europe; Europe; Africa; Africa; Europe; Europe; Europe; North America	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Paleozoic	Paleogene; Paleogene; Paleogene; Paleogene; Neogene; Neogene; Paleogene; Paleogene; Carboniferous	56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-47,8 (Ypresian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 23,0-20,4 (Aquitanian, Early Miocene); 23,0-20,4 (Aquitanian, Early Miocene); 27,8-23,0 (Chattian, Oligocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 315,2-307 (Moscovian, Carboniferous)	SEM		ToF-SIMS	Colleary et al.	2015
124	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Coliiformes (AMNH FARB 30806)	Green River Formation, Wyoming	USA	North America	Cenozoic	Paleogene	50,0 (Ypresian, Early Eocene)	ESEM-EDS		XAS; SRS-XRF	Egerton et al.	2015
125	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Fish; Fish	Mayomyzon pieckoensis (LEIUG123268, ROMV56806, ROMV56788a, ROM56828b, ROMV56800a,b, PF10788a,b, PF5687, PF5688, PF15382); Myxinikela siroka (PF15373a,b)	Mazon Creek Lagerstätte, Francis Creek Shale Member, Illinois	USA	North America	Paleozoic	Carboniferous	315,7-303,7 (Moscovian-Kasimovian, Late Carboniferous)	OM (PLM); SEM-EDS		ToF-SIMS	Gabbott et al.	2016
126	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Amphibia	Anura: Indet. (MNCN 63663)	Libros Biota, Libros Gypsum Unit, near Teruel	Spain	Europe	Cenozoic	Neogene	11,6-5,3 (Tortonian-Messinian, Late Miocene)	SEM; TEM		Py-GC/MS; FTIR; ToF-SIMS	McNamara et al.	2016
127	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Eoconfuciusornis sp. (STM 7-144)	Jehol Group, Huajiying Formation, Fengning, Hebei	China	Asia	Mesozoic	Cretaceous	130,0 (Early Cretaceous)	SEM; TEM; ESEM-EDS	IHQ	ChemiSTEM	Pan et al.	2016
128	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Dinosauria	Caihong juji (PMoL-B00175)	Tiaojishan Formation, Qinglong County, Gangou city, Hebei Province	China	Asia	Mesozoic	Jurassic	161,0 (Middle–Late Jurassic)	OM; SEM-FIB			Hu et al.	2018

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129	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Confuciusornis sp. (CUGB P1401)	Dawangzhangzi Member, Yixian Formation, Fengning County, Hebei Province	China	Asia	Mesozoic	Cretaceous	122,0 (Barremian, Early Cretaceous)	SEM		ToF-SIMS; MALDI; RS	Li et al.	2018
130	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
131	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Amphibia; Amphibia; Amphibia	Anura: Pelophylax pueyoi (MNCN 63775, MNCN 63776, NMP 39449, SMF-ME-00978, MNCN 63798, MNCN 63848, MNCN 66503, NHM 49999); Salamandridae: Chelotriton sp.; Salamandridae: indet. (CNU-V-1264)	Libros Biota; Rubielos de Mora; Daohuguo	Spain; Spain; China	Europe; Europe; Asia	Cenozoic; Cenozoic; Mesozoic	Neogene; Neogene; Jurassic	11,6-5,3 (Tortonian-Messinian, Late Miocene); 15,9-11,3 (Middle Miocene); 174,7-161,5 (Middle Jurassic)	OM; SEM; FM	CH	AHPO	McNamara et al.	2018
132	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Avialae	Eocoracias brachyptera (SMF-ME 1450A)	Messel Formation	Germany	Europe	Cenozoic	Paleogene	49,0 (Early Eocene)	SEM			Babarović et al.	2019
133	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Fish; Fish; Fish; Fish	Mayomyzon peickoensis (FMNH PF 5688); Gilpichthys greenei (FMNH PF 8474); Knightia sp. (FOBU 17591); Tetraodontiformes indet. (NHMD 199838)	Mazon Creek, Illinois; Mazon Creek, Illinois; Green River Formation; Fur Formation	USA; USA; USA; Denmark	North America; North America; North America; Europe	Paleozoic; Paleozoic; Cenozoic; Cenozoic	Carboniferous; Carboniferous; Paleogene; Paleogene	330,0-298,9 (Middle–Late Carboniferous); 330,0-298,9 (Middle–Late Carboniferous); 54,0 (Ypresian, Early Eocene); 54,0 (Ypresian, Early Eocene)	SEM	CH	AHPO; SRS-XRF; XANES	Rogers et al.	2019

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
134	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Amphibia; Amphibia; Amphibia; Amphibia; Amphibia; Amphibia; Amphibia; Mammalia; Avialae; Avialae; Avialae; Reptilia; Reptilia; Reptilia; Reptilia; Dinosauria	Anura: Pelophylax pueyoi (NHML-4999, NHML-4982); Anura: Eopelobates sp. (NHMB-MB.Am. 908); Anura: Palaeobatrachus diluvianus (NHML-30271); Anura: Palaeobatrachus luedecki (NHML-35814); anfíbio caudado indet. (CNU-SAL-NN2013002P); Branchiosauridae: Apateon pedestris (NHMB-MB.Am.1220); Micromelerpetontidae: Branchierpeton amplystomus (NHMD-155208); Micromelerpetontidae: Micromelerpeton credneri (NHMB-MB.Am.1187); Mamífero: Chiroptera indet. (HMLD-Me7069); ave Indet. (HLMD-Me5472, IVPP-V13314, IVPP-V18357); Yanornis (IVPP-STM9-5); ave Protopterix (IVPP-V16525); réptil Indet. (IVPP-STM36-86, IVPP-STM36-2); Squamata indet. (CNU-VER-LB2009001); Neusticosaurus peyeri (PIMUZ-T3412); Neusticosaurus edwardsii (PIMUZ-T3749); Dinossauro Dromeosauridae (IVPP-STM5-12)	Libros Biota; Orsberg; Rott, Landsberg; Bohemia; Yanliao Biota; Saar-Nahe Basin; Messel; Messel; Jehol; Yanliao Biota; Monte San Giorgio (MSG); Jehol	Spain; Germany; Germany; Czech Republic; China; Germany; Germany; Germany; China; China; Switzerland; China	Europe; Europe; Europe; Europe; Asia; Europe; Europe; Asia; Asia; Europe; Asia	Cenozoic; Cenozoic; Cenozoic; Mesozoic; Paleozoic; Paleozoic; Paleozoic; Cenozoic; Cenozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Neogene; Neogene; Neogene; Paleogene-Neogene; Jurassic; Carboniferous-Permian; Carboniferous-Permian; Carboniferous-Permian; Paleogene; Paleogene; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Jurassic; Triassic; Cretaceous	11,6-5,3 (Tortonian-Messinian, Late Miocene); Miocene; 23,0-15,9 (Early Miocene); 27,2-20,4 (Oligo-Miocene); 174,7-154,8 (Middle–Late Jurassic); 303,7-293,5 (Late Carboniferous–Early Permian); 303,7-293,5 (Late Carboniferous–Early Permian); 48 (Middle Eocene, Paleogene); 48 (Middle Eocene, Paleogene); 130,0 (Early Cretaceous); 130,0 (Early Cretaceous); 130,0 (Early Cretaceous); 130,0 (Early Cretaceous); 130,0 (Early Cretaceous); 130,0 (Early Cretaceous); 174,7-154,8 (Middle–Late Jurassic); 247,2-237,0 (Middle Triassic); 130,0 (Early Cretaceous)	SEM		SRS-XRF	Rossi, Webb & McNamara	2020

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
135	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Testudines	Pan-Cheloniidae (DK 807)	Fur Formation, western Limfjord region	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM (PLM); FESEM; TEM		EDS; ToF-SIMS; FTIR	De La Garza et al.	2022
136	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Reptilia	Ichthyosauria: Stenopterygius sp. (UMH-A-0001, UMH-A-0002)	Posidonia Shale, Holzmaden town	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	OM; Fotografia FUV; FESEM; TEM		SRS-XRF; ToF-SIMS	De La Garza et al.	2023
137	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Reptilia	Ichthyosauria: Stenopterygius sp. (MNHNL TV344)	Schistes Carton unit, near Dudelange town	Luxembourg	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	OM (PLM); Fotografia FUV; FESEM; TEM		EDS; ToF-SIMS	Wallstedt et al.	2024
138	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Reptilia	Plesiosauria: Indet. (MH 7)	Posidonia Shale, Posidonienschiefer Formation, near Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	OM (TLM); SEM; TEM		EDS; EBSD; FTIR; ToF-SIMS	Marx et al.	2025
139	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Fish	Dastilbe crandalli (GP/2E-9378b)	Crato Formation, Araripe Basin	Brazil	South America	Mesozoic	Cretaceous	110,0 (Albian, Early Cretaceous)	OM; CM; SEM		EDS; RS; FTIR	Prado et al.	2025
140	Cells and their biocomponents	Melanophores and/or melanosomal organelles	Amphibia; Amphibia; Amphibia	Anura: Pelobatidae e Indet. (GMH CeIII 4936a-1932, GMH CeIII 4967-1932, GMH CeIII 4983-1932, GMH CeIII 6698-1932, GMH CeIII 6743-1932, GMH XXXV-11a-1970); Anura: Palaeobatrachus luedecki (NHML-OR35814); Anura: Pelophylax pueyoi (NHML-R4982, MNCN 63798)	Konservat-Lagerstätten of Geiseltal; Bechlejovice; Libros Biota	Germany; Czech Republic; Spain	Europe; Europe; Europe	Cenozoic; Cenozoic; Cenozoic	Paleogene; Paleogene; Neogene	45,0 (Middle Eocene); 33,9-27,8 (Early Oligocene); 23,0-5,3 (Miocene)	SEM		SRS-XRF	Falk et al.	2025
141	Cells and their biocomponents	Chondrocytes	Avialae	Confuciusornis sanctus (MES-NJU 57002)	Yixian Formation, Sihetun, Liaoning	China	Asia	Mesozoic	Cretaceous	125,7-113,0 (Barremian-Aptian, Early Cretaceous)	SEM; micro-CT		EDS; FTIR; XANES; SRS-XRF; ToF-SIMS	Jiang et al.	2017
142	Cells and their biocomponents	Chondrocytes	Dinosauria	Hypacrosaurus stebingeri (MOR 548)	Two Medicine Formation, Alberta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	HQ; IHQ		Bailleul et al.	2020a
143	Cells and their biocomponents	Chondrocytes	Dinosauria	Caudipteryx (STM4-3)	Yixian Formation, near Chaoyang City, Dapingfang Town	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM; SEM-EDS; TEM	CH		Zheng et al.	2021
144	Cells and their biocomponents	Chondrocytes	Mammalia	Paroxacron valdense (UM-DAM1-278, -279), (UM-DAM1-280 a -282) e (UM-DAM1-283)	Phosphorites du Quercy, Dams, near Caylus	France	Europe	Cenozoic	Paleogene	42,0-24,0 (Late Eocene)	OM (TLM); SEM-EDS			Wu et al.	2024a

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
145	Cells and their biocomponents	Oocyte	Avialae	Enantiornithine (STM10-12)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM (TLM); SEM	CH	EDS	Bailleul et al.	2020b
146	Cells and their biocomponents	Platelet	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	FESEM; TEM; FIB-SEM		XRD; XRF; ToF-SIMS	Plet et al.	2017
147	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Prossauropode	Indet.	Indet.	Indet.	Mesozoic	Triassic	208,5-201,4 (Rhaetian, Late Triassic)	TEM		XRD	Isaacs et al.	1963
148	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Equus	Benson fauna, Mendivil Ranch locality, Arizona	USA	North America	Cenozoic	Quaternary	2,5-0,7 (Early Pleistocene)	OM; SEM		CP; XRD	Wyckoff et al.	1964
149	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	SEM			Pawlicki, Dkorbel & Kubiak	1966
150	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Sauropoda indet.	Morrison Formation, Wyoming	USA	North America	Mesozoic	Jurassic	154,8-149,2 (Kimmeridgian, Late Jurassic)			HPLC	Miller & Wyckoff	1966
151	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Indet.	Nemegt Basin, Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM		CP	Nowicki et al.	1972
152	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); SEM			Pawlicki	1976
153	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Hominidae: Australopithecus robustus	Omo site	Ethiopia	Africa	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)		RIA		Lowenstein	1980
154	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Hominidae: Australopithecus robustus	Omo site	Ethiopia	Africa	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)		RIA		Lowenstein	1981
155	Biomacromolecules and/or their degradation products	Collagen	Mammalia; Testudines; Dinosauria; Fish; Fish; Dinosauria; Reptilia; Fish; Fish; Fish; Conodonta	Hominidae: Australopithecus sp.; Emys sp.; dinossauro indet.; Siluridae; Pachythrissops sp.; Cetiosaurus sp.; Ichthyosauria indet.; Holostei; Plourdosteus sp.; Wijdeaspis sp.; Indet.	Swartkrans, cave breccia; Bembridge Marls, Isle of Wight; Indet.; Indet.; Sussex; Oxfordshire; Liassic shales, Dorset; Indet.; Indet.; Spitsbergen, Svalbard; Leeds	South Africa; England; Mongolia; Russia; England; England; England; Russia; Russia; Norway; England	Africa; Europe; Asia; Eurasia; Europe; Europe; Europe; Eurasia; Eurasia; Europe; Europe	Cenozoic; Cenozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Paleozoic; Paleozoic; Paleozoic	Quaternary; Paleogene; Cretaceous; Cretaceous; Cretaceous; Jurassic; Jurassic; Triassic; Devonian; Devonian; Devonian	1,8–1,2 (Early Pleistocene); 30,0 (Rupelian, Oligocene); 70,0 (Maastrichtian, Late Cretaceous); 70,0 (Maastrichtian, Late Cretaceous); 130,0 (Hauterivian, Early Cretaceous); 170,0 (Bajocian, Middle Jurassic); 200,0 (Hettangian, Early Jurassic); 240,0 (Ladinian, Middle Triassic); 370,0 (Famennian, Late Devonian); 390,0 (Eifelian, Middle Devonian); 400,0 (Emsian, Early Devonian)	SEM	ARA	IEC	Armstrong et al.	1983

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
156	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	SEM; TEM		EDS; GC/MS; HPLC	Schweitzer et al.	1993
157	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)		SDS-PAGE	EDS; HPLC	Schweitzer et al.	1994a
158	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex	Choteau, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)		SDS-PAGE; PCR	EDS; HPLC	Schweitzer et al.	1994b
159	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	SEM-EDS; TEM; EDPA; CM	ARA	HPLC	Schweitzer et al.	1997a
160	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	68,0 (Maastrichtian, Late Cretaceous)	SEM; OM; TEM; AFM	ELISA; IHQ	ToF-SIMS	Schweitzer et al.	2007
161	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	OM (TLM); FESEM	ELISA; IHQ; WB	ATR-FTIR; ToF-SIMS; LC-MS/MS	Schweitzer et al.	2009
162	Biomacromolecules and/or their degradation products	Collagen	Avialae	Enantiornithe (MUCPv 284, 305 and 306)	Bajo de la Carpa Member, Rio Colorado Formation, Neuquén	Argentina	South America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	CM; FM; AFM	IHQ	FTIR; ToF-SIMS	Avci et al.	2005
163	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	68,0 (Maastrichtian, Late Cretaceous)			MS/MS; LC-MS/MS	Asara et al.	2007a
164	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	68,0 (Maastrichtian, Late Cretaceous)			MS/MS	Asara et al.	2007b
165	Biomacromolecules and/or their degradation products	Collagen	Avialae	Enantiornithe (MUCPv 284, 305 and 306)	Bajo de la Carpa Member, Rio Colorado Formation, Neuquén	Argentina	South America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	AFM	IF		Boyd et al.	2007
166	Biomacromolecules and/or their degradation products	Collagen	Reptilia	Ichthyosauria: Ichthyosaurus sp. (GLAHM V1180a)	Lower Lias beds, Severn Valley, Gloucestershire	England	Europe	Mesozoic	Jurassic	200,0 (Early Jurassic)	SEM-EDS			Lingham-Soliar & Wesley-Smith	2008
167	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)			LC-MS/MS	Organ et al.	2008
168	Biomacromolecules and/or their degradation products	Collagen	Mammalia; Mammalia; Mammalia; Mammalia	Bovidae (WRC10); Bovidae (WRC11); Elephantidae (WRC12); Bovidae (WRC13)	Happisburgh, Norfolk	England	Europe	Cenozoic	Quaternary	1,5 (Calabrian, Early Pleistocene)		ARA	GC; MALDI-ToF; ZooMS	Buckley & Collins	2011
169	Biomacromolecules and/or their degradation products	Collagen	Reptilia	Mosasauria: Prognathodon sp. (IRSNB 1624)	Ciply Phosphatic Chalk, Mons Basin	Belgium	Europe	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM; CLSM	IF; PCR	EDS; FTIR; proton NMR	Lindgren et al.	2011

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
170	Biomacromolecules and/or their degradation products	Collagen	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
171	Biomacromolecules and/or their degradation products	Collagen	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)			EDS; ESI-MS	San Antonio et al.	2011
172	Biomacromolecules and/or their degradation products	Collagen	Fish; Dinosauria	Eustenopteron foordi (MNHM 06-615A); Lappentosaurus madagascariensis	Indet.; Escumenac Bay, Quebec	Madagascar; Canada	Africa; North America	Paleozoic; Mesozoic	Devonian; Jurassic	382,7-358,9 (Late Devonian); 174,7-161,5 (Middle Jurassic)	TEM			Zylberberg & Laurin	2011
173	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Lufengosaurus sp. (C2019 2A233)	Upper Lufeng Formation, Lufeng County, Yunnan Province	China	Asia	Mesozoic	Jurassic	199,5-192,9 (Sinemurian, Early Jurassic)			SR-FTIR; RS	Reisz et al.	2013
174	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Camelini (NUFV 210)	Canada's High Arctic, Ellesmere Island, Nunavut	Canada	North America	Cenozoic	Neogene	3,5 (Piacenzian, Pliocene)	TC; FEG-ESEM		MALDI-ToF	Rybczynski et al.	2013
175	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)			MALDI-ToF	Boatman et al.	2014
176	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM	IHQ	SR-FTIR; EDS; μ-XRF; μ-XANES	Boatman et al.	2019
177	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Bovidae (WRC10)	Weybourne crag, West Runton, Norfolk	England	Europe	Cenozoic	Quaternary	1,5 (Early Pleistocene)			LC-MS/MS	Wadsworth & Buckley	2014
178	Biomacromolecules and/or their degradation products	Collagen	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Teropoda indet. (NHMUK R12562); Hadrosauridae (NHMUK R4249, NHMUK R4243); Hadrosauridae (NHMUK R4864); dinossauro indet. (NHMUK R4493); Ceratopsidae (NHMUK R4484)	Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta; Lance Formation, Alberta; Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta	Canada; Canada; USA; Canada; Canada	North America; North America; North America; North America; North America;	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	83,6-66,0 (Campanian-Maastrichtian, Late Cretaceous)	SEM; SEM-FIB; TEM		EDS; ToF-SIMS; EELS	Bertazzo et al.	2015
179	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		IFI	HPLC; HRMS	Cleland et al.	1968

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180	Biomacromolecules and/or their degradation products	Collagen	Testudines; Testudines; Testudines	Allaeochelys crassesculpta (SMF ME-2449); Mongolemys elegans (IGM-90/42); Podocnemididae indet. (UR-CP-0043)	Messel Pit, Darmstadt; Nemegt Formation, Bugin Tsav, Gobi Desert; Repartidora locality, La Victoria Formation, Tatacoa Desert	Germany; Mongolia; Colombia	Europe; Asia; South America	Cenozoic; Mesozoic; Cenozoic	Paleogene; Cretaceous; Neogene	48 (Middle Eocene, Paleogene); 80,0 (Campanian, Late Cretaceous); 13,6 (Serravallian, Middle Miocene)	OM (TLM); FESEM-BSE; SEM-EDS			Cadena	2016
181	Biomacromolecules and/or their degradation products	Collagen	Reptilia; Reptilia; Reptilia	Nothosauria: Nothosaurus cf. marchicus (WNoZ/s/7/166); Nothosauria: Nothosaurus cf. marchicus (SUT-MG/F/Tvert/15); Archosauromorpha: Protanystropheus sp. (SUT-MG/F/Tvert/2)	Żyglin quarry, Miasteczko Śląskie Town; Gogolin Formation, Gogolin Town; Gogolin Formation, Gogolin Town	Poland	Europe	Mesozoic	Triassic	251,2-247,2 (Olenekian, Early Triassic)	ESEM-EDS		XRD; FTIR; ToF-SIMS; XPS	Surmik et al.	2016
182	Biomacromolecules and/or their degradation products	Collagen	Dinosauria; Dinosauria	Homalocephale calathocercos (MPC-D 100/1201); Edmontosaurus regalis (UAMES 52615)	Nemegt Formation, Western Sayr, Nemegt; Price Creek Formation, Colville River, Alaska	Mongolia; USA	Asia; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM); SEM-EDS; AFM; FESEM		XRPD; FTIR; ToF-SIMS	Surmik et al.	2023
183	Biomacromolecules and/or their degradation products	Collagen	Avialae	Confuciusornis sanctus (MES-NJU 57002)	Yixian Formation, Sihetun, Liaoning	China	Asia	Mesozoic	Cretaceous	125,7-113,0 (Barremian-Aptian, Early Cretaceous)	SEM-BSE; micro-CT		EDS; FTIR; XANES; SRS-XRF; ToF-SIMS	Jiang et al.	2017
184	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Lufengosaurus sp. (CXPM Z4644)	Lufeng Formation, Dawa, Lufeng County, Yunnan Province	China	Asia	Mesozoic	Jurassic	199,5-192,9 (Sinemurian, Early Jurassic)	SR-TXM; TAM		SR-FTIR; RS	Lee et al.	2017
185	Biomacromolecules and/or their degradation products	Collagen	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	FESEM; TEM; FIB-SEM		XRD; XRF; ToF-SIMS	Plet et al.	2017
186	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		PAGE	LC-MS/MS	Schroeter et al.	2017
187	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Dreadnoughtus schrani (MPM-PV 1156)	Cerro Fortaleza Formation, east bank of the Río La Leona, Santa Cruz Province	Argentina	South America	Mesozoic	Cretaceous	76,0-70,0 (Campanian-Maastrichtian, Late Cretaceous)	OM (TLM, PLM)	IF; ELISA	XRD; LA-ICPMS	Schroeter et al.	2022
188	Biomacromolecules and/or their degradation products	Collagen	Reptilia	Nothosauria: Nothosaurus cf. marchicus (SUT-MG/f/98)	Gogolin Formation, Gogolin Quarry, Opole Silesia	Poland	Europe	Mesozoic	Triassic	247,2-242 (Anisian, Middle Triassic)	SEM; ESEM-EDS		ToF-SIMS	Surmik, Rothschild & Pawlicki	2017

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
189	Biomacromolecules and/or their degradation products	Collagen	Mammalia; Mammalia	Camelops hesternus (CMNFV 42390, CMNFV 46728); cf. Paracamelus sp. (CMN 27266, CMN 48096)	Sixtymile Area Loc. 3 (P8203), Sixtymile River, Yukon Territory; Old Crow River, Locality 29 e 11A, Yukon Territory	Canada	North America	Cenozoic	Quaternary	3,4 (Quaternary, Late Pleistocene)			LC-MS/MS; MALDI-ToF; MS/MS	Buckley, Lawless & Rybczynski	2019
190	Biomacromolecules and/or their degradation products	Collagen	Fish	Aspidorhynchidae (UR-CP-0001)	Paja Formation, Radio Lenguerke station antenna region, Zapatoga city, Santander Province	Colombia	South America	Mesozoic	Cretaceous	125,7-121,4 (Barremian, Early Cretaceous)	OM (TLM, PLM); TC; SEM-EDS		FTIR; ToF-SIMS	Alfonso-Rojas & Cadena	2020
191	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Hypacrosaurus stebingeri (MOR 548)	Two Medicine Formation, Alberta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	HQ; IHQ		Bailleul et al.	2020a
192	Biomacromolecules and/or their degradation products	Collagen	Avialae	Enantiornithine (STM10-12)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM (TLM); SEM	CH	EDS	Bailleul et al.	2020b
193	Biomacromolecules and/or their degradation products	Collagen	Fish	Indet. (BSIP 41815)	Cambay Formation, Cambay Basin, Vastan lignite mine	India	Asia	Cenozoic	Paleogene	54,0 (Ypresian, Eocene)	CLSM; XRM	IF	Py-GC×GC-TOFMS	Dutta et al.	2020
194	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Edmontosaurus annectens (SRHS-DU-231)	Standing Rock Hadrosaur Site, Corson County, South Dakota	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	OM	PAGE; ELISA; IF	LA-ICPMS	Ullmann et al.	2020
195	Biomacromolecules and/or their degradation products	Collagen	Avialae	Struthio sp (IVPP V 25336)	Liushu Formation, Linxia Basin, Tibetan Plateau, Nalesi town, Dongxiang County, Shuang-gong-bei village	China	Asia	Cenozoic	Neogene	10,0-7,2 (Tortonian, Late Miocene)	OM (TLM, PLM); SEM			Li et al.	2021
196	Biomacromolecules and/or their degradation products	Collagen	Testudines; Testudines; Testudines; Testudines; Reptilia; Reptilia	Euclastes (RU-EFP-00018); Taphrosphys (RU-EFP-00002, 02175, 02222 e 04162); tartaruga indet. (RU-EFP-02295); tartaruga indet. (RU-EFP-04161-8); Crocodylomorpha: Thoracosaurus neocesariensis (RU-EFP-00006); Crocodylomorpha indet. (RU-EFP-00030)	Hornerstown Formation, Jean and Ric Edelman Fossil Park, Mantua Township, New Jersey	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Cenozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Paleogene; Cretaceous; Cretaceous;	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous); 66,0-61,6 (Danian, Early Paleogene); 67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM); SEM	PAGE; ELISA; IF	XRD	Voegele et al.	2022
197	Biomacromolecules and/or their degradation products	Collagen	Dinosauria	Edmontosaurus sp. (UOL GEO.1)	Hell Creek Formation, Harding County, South Dakota	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	XPol		ATR-FTIR; MS; LC-MS/MS	Tuinstra et al.	2025

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
198	Biomacromolecules and/or their degradation products	Collagen	Fish; Fish; Fish; Fish	Semionotidae (DUGF/C-101); Semionotidae (DUGF/C-111, DUGF/C-113); Lepisosteidae; Osteichthyes (CUH/PPL/C/S/1, CUH/PPL/C/S/2, CUH/PPL/C/S/3)	Maleri Formation, Pranhita-Godavari (PG) valley, Telangana; Kota Formation, PG valley, Telangana; intertrappean beds, Naskal, Telangana; Siwalik sediments, Kimin Formation, Arunachal Pradesh	India; India; India; India	Asia; Asia; Asia; Asia	Mesozoic; Mesozoic; Mesozoic; Cenozoic	Triassic; Jurassic; Cretaceous; Neogene	227,0-208,5 (Norian, Late Triassic); 192,9-161,5 (Middle–Late Jurassic); 67,0-66,5 (Maastrichtian, Late Cretaceous); 3,6-2,5 (Piacenzian,Late Pliocene)			Py-GC×GC-TOFMS	Umamaheswaran et al.	2023
199	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae	Rahonavis ostromi (UA 8656)	Maevarano Formation, MAD93-18 site/locality	Madagascar	Africa	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	SEM; TEM	IHQ	XPS; ToF-SIMS	Schweitzer et al.	1999a
200	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Dinosauria	Shuvuuia deserti (IGM 100/977)	Djadokhta Formation, Ukhaa Tolgod	Mongolia	Asia	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	SEM; TEM	IHQ	ToF-SIMS	Schweitzer et al.	1999b
201	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Dinosauria	Edmontosaurus sp. (MRF-03)	Hell Creek Formation, North Dakota	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (TLM); ESEM; BSE	ARA	EDS; FTIR; Py-GC/MS; MALDI-MS; LC-ESI-MS	Manning et al.	2009
202	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae	Indet. (SMF ME 3850)	Messel shale, near Darmstadt,	Germany	Europe	Cenozoic	Paleogene	41,2-37,7 (Bartonian, Middle Eocene)	SEM; ESEM; EDS			Vinther et al.	2010
203	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Reptilia	Squamata (BHI-102B)	Green River Formation, Utah	USA	North America	Cenozoic	Paleogene	50 (Ypresian, Eocene)	OM		FTIR; XRD; SRS-XRF; Py-GC/MS	Edwards et al.	2011
204	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Dinosauria	Citipati osmolskae (MPC-D 100/979)	Djadokhta Formation	Mongolia	Asia	Mesozoic	Cretaceous	75,0 (Campanian, Late Cretaceous)	SEM-EDS; TEM	IHQ		Moyer, Zheng & Schweitzer	2016
205	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae	Eoconfuciusornis sp. (STM 7-144)	Jehol Group, Huajiying Formation, Fengning, Hebei	China	Asia	Mesozoic	Cretaceous	130,0 (Early Cretaceous)	SEM; TEM; ESEM-EDS	IHQ	ChemiSTEM	Pan et al.	2016
206	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae	Indet. (MN 7754-V)	Crato Formation, Araripe Basin, Ceará	Brazil	South America	Mesozoic	Cretaceous	120,0 (Aptian, Early Cretaceous)	OM; SEM-EDS; TEM; CLSM		FTIR	Campos et al.	2019

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207	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae; Avialae; Avialae; Avialae; Dinosauria; Dinosauria; Dinosauria	Anchiornis huxleyi (STM 0–214); Eoconfuciusornis sp. (STM7-144); Yanornis (STM9-5); Pena de voo isolada (DY 1502006); Dromaeosauridae indet. (STM5-12); Shuvuuia deserti (IGM 100/977); Citipati osmolskae (MPC-D).	Jianchang, Liaoning; Fengning, northern Hebei; Chaoyang, western Liaoning; Lunpola, Tibet; Fengning, northern Hebei; Indet.; Indet.	China; China; China; China; China; Mongolia; Mongolia	Asia; Asia; Asia; Asia; Asia; Asia; Asia	Mesozoic; Mesozoic; Mesozoic; Cenozoic; Mesozoic; Mesozoic; Mesozoic	Jurassic; Cretaceous; Cretaceous; Paleogene; Cretaceous; Cretaceous; Cretaceous	160,0 (Late Jurassic); 130,0 (Hauterivian, Early Cretaceous); 120,0 (Aptian, Early Cretaceous); 26-23 (Chattian, Oligocene); 130,0 (Hauterivian, Early Cretaceous); 75,0 (Campanian, Late Cretaceous); 75,0 (Campanian, Late Cretaceous)	SEM; TEM	IHQ	ChemiSTEM	Pan et al.	2019
208	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Fish	Tethymyxine tapirostrum (BHI 6445)	Hâdjula Lagerstätte, 10 km east of Byblos	Lebanon	Asia	Mesozoic	Cretaceous	100,5-93,9 (Cenomanian, Late Cretaceous)	TC		SRS-XRF; XANES	Miyashita et al.	2019
209	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae; Avialae; Avialae; Indet.	Enantiornithine (STM7-26); Enantiornithine (STM7-27); Ornithuromorpha (STM8-23); Indet. (TF)	Jehol Biota; Jehol Biota; Jehol Biota; Tibetan Plateau	China; China; China; China	Asia; Asia; Asia; Asia	Mesozoic; Mesozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Cretaceous; Paleogene	125,7-121,4 (Barremian, Early Cretaceous); 125,7-121,4 (Barremian, Early Cretaceous); 125,7-121,4 (Barremian, Early Cretaceous); 33,9-23,0 (Oligocene)	FESEM		ToF-SIMS; ATR-FTIR; RS	Pan et al.	2024
210	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Testudines	Tasbacka danica (MHM-K2)	Fur Formation, Ejerslev Mo-clay pit, Isle of Mors, Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	FESEM; TEM	IHQ	ToF-SIMS; FTIR	Lindgren et al.	2017
211	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
212	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Reptilia; Reptilia	Pterosauria: Anurognathidae (NJU–57003); Pterosauria: Anurognathidae (CAGS–Z070)	Yanliao Biota, Mutoudeng, Daohugou, Hebei	China	Asia	Mesozoic	Jurassic	165,3-160,0 (Callovian-Oxfordian, Middle–Late Jurassic)	SEM; FM		FTIR; LSF	Yang et al.	2019
213	Biomacromolecules and/or their degradation products	Keratins (α and/or β) and their derivatives	Avialae; Avialae	Confuciusornis (IVPP V 13171); Sinornithosaurus (IVPP V 12811)	Jehol Biota	China	Asia	Mesozoic	Cretaceous	125,7-121,4 (Barremian, Early Cretaceous)			XANES; FTIR	Slater et al.	2023a
214	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Tyrannosaurus rex (MOR 555)	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	SEM-EDS; TEM; EDPA; CM	PAGE; ELISA; WB	HPLC; UV-vis; RMN; RPE; RS	Schweitzer et al.	1997b

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215	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	OM (TLM); FESEM	ELISA; IHQ; WB	ATR-FTIR; ToF-SIMS; LC-MS/MS	Schweitzer et al.	2009
216	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Tyrannosaurus rex (MOR 1125)	Hell Creek Formation, Garfield County, Montana	USA	North America	Mesozoic	Cretaceous	68,0 (Maastrichtian, Late Cretaceous)			MS/MS	Asara et al.	2007b
217	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaur canadensis (MOR 2598); Brachylophosaur canadensis (MOR 2967)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Phillips County	USA; USA; USA	North America; North America; North America	Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 72,1-66,0 (Maastrichtian, Late Cretaceous); 80 (Campanian, Late Cretaceous)	OM (TLM, PLM); SEM; TEM	CH; IHQ		Schweitzer, Moyer & Zheng	2016
218	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Testudines	Tasbacka danica (MHM-K2)	Fur Formation, Ejerslev Mo-clay pit, Isle of Mors, Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	FESEM; TEM	IHQ	ToF-SIMS; FTIR	Lindgren et al.	2017
219	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
220	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Heyuannia huangi (ootaxon Macroolithus yaotunensis: NMNS CYN-2004-DINO-05/I)	Hongcheng Basin, Jiangxi	China	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)			HPLC-ESI-Q-TOF-MS	Wiemann et al.	2018
221	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Avialae; Avialae	Heyuannia huangi (NMNS CYN-2004-DINO-05); Microtroodontid (IGM 100/1323); Microtroodontid (MAE 14-40); Large Troodontid (AMNH FARB 6631); Large troodontid (IGM 100/1003); Deinonychus antirrhopus (AMNH 3015); Enantiornithine (IGM 100/1339), Psammornis rothschildi (ZFMK 23a:III/c/23)	Yuanpu Formation, Jiangxi; Djadochta Formation, Gobi Desert; Djadochta Formation, Gobi Desert; Djadochta Formation, Gobi Desert; Djadochta Formation, Gobi Desert; Cloverly Formation, Big Horn County, Montana; Djadochta Formation, Gobi Desert; Djokran.	China; Mongolia; Mongolia; Mongolia; Mongolia; USA; Mongolia; Algeria	Asia; Asia; Asia; Asia; Asia; North America; Asia; Africa	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM		RS	Wiemann, Yang & Norell	2018

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222	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)			RS	Long et al.	2018
223	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM	IHQ	SR-FTIR; EDS; μ-XRF; μ-XANES	Boatman et al.	2019
224	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Testudines	Pan-Cheloniidae (DK 807)	Fur Formation, western Limfjord region	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM (PLM); FESEM; TEM		EDS; ToF-SIMS; FTIR	De La Garza et al.	2022
225	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Fish	Atractosteus (MEMS201)	Messel Pit (Grube Messel), near Darmstadt	Germany	Europe	Cenozoic	Paleogene	48,0 (Ypresian, Early Eocene)	SEM-EDS		XRD; ToF-SIMS; RS	Siljeström, Neubeck & Steele	2022
226	Biomacromolecules and/or their degradation products	Hemoglobin and its derivatives (heme, porphyrins)	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Monatana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA	North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	IHQ	RR	Long et al.	2025
227	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Tyrannosaurus rex	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	SEM; TEM		EDS; GC/MS; HPLC	Schweitzer et al.	1993
228	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Tyrannosaurus rex	Hell Creek Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)		SDS-PAGE	EDS; HPLC	Schweitzer et al.	1994a
229	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Tyrannosaurus rex	Choteau, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)		SDS-PAGE; PCR	EDS; HPLC	Schweitzer et al.	1994b
230	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Tyrannosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	SEM-EDS; TEM; EDPA; CM	ARA	HPLC	Schweitzer et al.	1997a
231	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	SEM; TEM; FM	IFI; HQ	MS/MS	Schweitzer et al.	2013
232	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM; FM	IHQ		Pawlicki	1995

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
233	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Hypacrosaurus stebingeri (MOR 548)	Two Medicine Formation, Alberta, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM)	HQ; IHQ		Bailleul et al.	2020a
234	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Mammalia; Mammalia; Mammalia	Mammuthus trogontheri ("Krestovka", PIN 3491-3); M. trogontherii ("Adycha", PIN 3723-511); M. primigenius ("Chukochya", PIN 3341-737)	Krestovka River, Kolyma region, Sibéria; Adycha River, Oskhorkokh locality, Sibéria; Chukochya River, Sibéria	Russia; Russia; Russia	Eurasia; Eurasia; Eurasia	Cenozoic; Cenozoic; Cenozoic	Quaternary; Quaternary; Quaternary	2,0-1,2 (Calabrian, Early Pleistocene); 1,2-1,0 (Calabrian, Early Pleistocene); 1,0-0,6 (Calabrian, Early Pleistocene)		SS		van der Valk et al.	2021
235	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Dinosauria	Caudipteryx (STM4-3)	Yixian Formation, near Chaoyang City, Dapingfang Town	China	Asia	Mesozoic	Cretaceous	132,6-125,7 (Hauterivian, Early Cretaceous)	OM; SEM-EDS; TEM	CH		Zheng et al.	2021
236	Biomacromolecules and/or their degradation products	Intracellular compounds chemically consistent with DNA (or its chemical markers)	Testudines	Lepidochelys sp. (MUPAN-STRI-39311)	F4 facies, Chagres Formation, Chagres Sandstone Member, South section of Piña beach (Locality 620012)	Panama	Central America	Cenozoic	Neogene	7,2-5,3 (Messinian, Late Miocene)	OM (TLM); FM	CH		Cadena, Gracia & Combita-Romero	2023
237	Biomacromolecules and/or their degradation products	Lipids	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		CH		Pawlicki	1977b
238	Biomacromolecules and/or their degradation products	Lipids	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM	CH		Pawlicki	1984a
239	Biomacromolecules and/or their degradation products	Lipids	Reptilia	Pliosauridae: Pliosaurus funkei	Slottsmøya Member, Agardhfjellet Formation, Spitsbergen Island, Svalbard Archipelago	Norway	Europe	Mesozoic	Jurassic	150 (Late Jurassic)	FM		GC; FLEEMS; Microtermometria	Kihle, Hurum & Liebe	2012
240	Biomacromolecules and/or their degradation products	Lipids	Mammalia	Baleia indet.	El Cien Formation, near San Juan de la Costa, Baja California Sur	Mexico	North America	Cenozoic	Paleogene	Oligocene	OM		GC/MS; ToF-SIMS	Thiel et al.	2014

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
241	Biomacromolecules and/or their degradation products	Lipids	Reptilia; Reptilia; Reptilia	Nothosauria: Nothosaurus cf. marchicus (WNoZ/s/7/166); Nothosauria: Nothosaurus cf. marchicus (SUT-MG/F/Tvert/15); Archosauromorpha: Protanystropheus sp. (SUT-MG/F/Tvert/2)	Żyglin quarry, Miasteczko Śląskie Town; Gogolin Formation, Gogolin Town; Gogolin Formation, Gogolin Town	Poland	Europe	Mesozoic	Triassic	251,2-247,2 (Olenekian, Early Triassic)	ESEM-EDS		XRD; FTIR; ToF-SIMS; XPS	Surmik et al.	2016
242	Biomacromolecules and/or their degradation products	Lipids	Avialae	Messelirrisoridae (SMF-ME 11593)	Messel UNESCO World Heritage Site, Hessen	Germany	Europe	Cenozoic	Paleogene	48 (Middle Eocene, Cenozoic)			Py-GC/MS	O'Reilly et al.	2017
243	Biomacromolecules and/or their degradation products	Lipids	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	FESEM; TEM; FIB-SEM		XRD; XRF; ToF-SIMS	Plet et al.	2017
244	Biomacromolecules and/or their degradation products	Lipids	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
245	Biomacromolecules and/or their degradation products	Lipids	Mammalia	Apodemus atavus (GZG.W.20027b, GZG.W.17393a)	lagerstätte de Willershausen, Northeim, Baixa Saxônia	Germany	Europe	Cenozoic	Neogene	3,0 (Piacenzian, Pliocene)	ESEM-EDS		XRD; SRS-XRF; XAS; XANES; FTIR	Manning et al.	2019
246	Biomacromolecules and/or their degradation products	Lipids	Amphibia	Temnospondyli: Cacops sp.	Richards Spur locality, Dolese Brothers Limestone Quarry, Lawton, Oklahoma	USA	North America	Paleozoic	Permian	Early Permian	OM (PLM)			Armitage	2023
247	Biomacromolecules and/or their degradation products	Lipids	Dinosauria	Triceratops horridus	Hell Creek Formation, Dawson County, Glendive city, Montana	USA	North America	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	OM (PLM)			Cruz & Armitage	2024
248	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Stegosaurus sp.	-	USA	North America	Mesozoic	Jurassic	154,8-149,2 (Kimmeridgian, Late Jurassic)			CP	Abelson	1954
249	Biomacromolecules and/or their degradation products	Amino acids	Fish	Dinichthys	Ohio Black Shale, Ohio	USA	North America	Paleozoic	Devonian	360,0 (Famennian, Late Devonian)	OM (PLM)		CP	Abelson	1957
250	Biomacromolecules and/or their degradation products	Amino acids	Reptilia	Mosasauria: Mosasaurus (V67155)	Morrison Formation, Wyoming	USA	North America	Mesozoic	Cretaceous	89,8-72,1 (Coniacian-Campanian, Late Cretaceous)			HPLC	Miller & Wyckoff	1968

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
251	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Indet. (V67142); Indet. (V67146); Sauropoda (V67138); Indet. (V67148); Diplodocus (V67150)	Morrison Formation, Wyoming	USA; USA; USA; USA; USA	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Jurassic; Jurassic; Jurassic;	83,6-72,1 (Santonian-Campanian, Late Cretaceous); 72,1-66,0 (Maastrichtian, Late Cretaceous); 154,8-149,2 (Kimmeridgian, Late Jurassic); 150 (Kimmeridgian–Tithonian, Late Jurassic); 150 (Kimmeridgian–Tithonian, Late Jurassic)			HPLC	Miller & Wyckoff	1968
252	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Indet.	Nemegt Basin, Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM		CP	Nowicki et al.	1972
253	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Indet.	Formations: Kaiparowits, Hell Creek, Mesa Verde, Lance, Belly River	USA; Canada	North America; North America	Mesozoic	Cretaceous	100,5-66,0 (Cenomanian-Maastrichtian, Late Cretaceous)			GC	Wyckoff & Davidson	1976
254	Biomacromolecules and/or their degradation products	Amino acids	Mammalia; Testudines; Dinosauria; Fish; Fish; Dinosauria; Reptilia; Fish; Fish; Fish; Conodonta	Hominidae: Australopithecus sp.; Emys sp.; dinossauro indet.; Siluridae; Pachythrissops sp.; Cetiosaurus sp.; Ichthyosauria indet.; Holostei; Plourdosteus sp.; Wijdeaspis sp.; Indet.	Swartkrans, cave breccia; Bembridge Marls, Isle of Wight; Indet.; Indet.; Sussex; Oxfordshire; Liassic shales, Dorset; Indet.; Indet.; Spitsbergen, Svalbard; Leeds	South Africa; England; Mongolia; Russia; England; England; England; Russia; Russia; Norway; England	Africa; Europe; Asia; Eurasia; Europe; Europe; Europe; Eurasia; Eurasia; Europe; Europe	Cenozoic; Cenozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Paleozoic; Paleozoic; Paleozoic	Quaternary; Paleogene; Cretaceous; Cretaceous; Cretaceous; Jurassic; Jurassic; Triassic; Devonian; Devonian; Devonian	1,8–1,2 (Early Pleistocene); 30,0 (Rupelian, Oligocene); 70,0 (Maastrichtian, Late Cretaceous); 70,0 (Maastrichtian, Late Cretaceous); 130,0 (Hauterivian, Early Cretaceous); 170,0 (Bajocian, Middle Jurassic); 200,0 (Hettangian, Early Jurassic); 240,0 (Ladinian, Middle Triassic); 370,0 (Famennian, Late Devonian); 390,0 (Eifelian, Middle Devonian); 400,0 (Emsian, Early Devonian)	SEM	ARA	IEC	Armstrong et al.	1983

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
255	Biomacromolecules and/or their degradation products	Amino acids	Mammalia; Mammalia; Testudines; Mammalia	Bubalus paleokerabau (RMNH 5); Bovidae (IVAU 6); Caprotragoides sehlini (IVAU 7); Theridomorpha (RMNH 8)	Trinil site, Java; chinji town; Manchones town, Saragoça Province; Olalla locality, Calamocha city, Teruel Province	Indonesia; Pakistan; Spain; Spain	Asia; Asia; Europe; Europe	Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Paleogene	1,0 (Calabrian, Early Pleistocene); 13,0 (Serravallian, Middle Miocene); 13,0 (Serravallian, Middle Miocene); 30,0 (Rupelian, Oligocene)		ELISA; RIA		Ulrich et al.	1987
256	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus sp.; Panoplosaurus sp.; Ceratopsidae; Hadrosauridae;	Judith River Formation, Alberta	Canada	North America	Mesozoic	Cretaceous	74,0-72,1 (Campanian, Late Cretaceous)			IEC; GC; MS	Ostrom et al.	1990
257	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Seismosaurus sp.	Morrison Formation, Brushy Basin Member, Sandoval County, New Mexico	USA	North America	Mesozoic	Jurassic	150 (Kimmeridgian, Late Jurassic)			RP-HPLC	Gurley et al.	1991
258	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Macroolithus yaotunensis (ooespécie)	Pingling Formation, Nanxiong Basin, Guangdong Province	China	Asia	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)			GC	Zhao et al.	1993
259	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Teropoda indet. (NHMUK R12562); Hadrosauridae (NHMUK R4249, NHMUK R4243); Hadrosauridae (NHMUK R4864); dinossauro indet. (NHMUK R4493); Ceratopsidae (NHMUK R4484)	Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta; Lance Formation, Alberta; Dinosaur Park Formation, Alberta; Dinosaur Park Formation, Alberta	Canada; Canada; USA; Canada; Canada	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	83,6-66,0 (Campanian-Maastrichtian, Late Cretaceous)	DDC-SEM; SEM-FIB; TEM		EDS; ToF-SIMS; EELS	Bertazzo et al.	2015
260	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		IFI	HPLC; HRMS	Cleland et al.	2015
261	Biomacromolecules and/or their degradation products	Amino acids	Reptilia; Reptilia; Reptilia	Nothosauria: Nothosaurus cf. marchicus (WNoZ/s/7/166); Nothosauria: Nothosaurus cf. marchicus (SUT-MG/F/Tvert/15); Archosauromorpha: Protanystropheus sp. (SUT-MG/F/Tvert/2)	Żyglin quarry, Miasteczko Śląskie Town; Gogolin Formation, Gogolin Town; Gogolin Formation, Gogolin Town	Poland	Europe	Mesozoic	Triassic	251,2-247,2 (Olenekian, Early Triassic)	ESEM-EDS		XRD; FTIR; ToF-SIMS; XPS	Surmik et al.	2016

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
262	Biomacromolecules and/or their degradation products	Amino acids	Avialae	Confuciusornis sanctus (MES-NJU 57002)	Yixian Formation, Sihetun, Liaoning	China	Asia	Mesozoic	Cretaceous	125,7-113,0 (Barremian-Aptian, Early Cretaceous)	SEM; micro-CT		EDS; FTIR; XANES; SRS-XRF; ToF-SIMS	Jiang et al.	2017
263	Biomacromolecules and/or their degradation products	Amino acids	Reptilia	Nothosauria: Nothosaurus cf. marchicus (SUT-MG/f/98)	Gogolin Formation, Gogolin Quarry, Opole Silesia	Poland	Europe	Mesozoic	Triassic	247,2-242 (Anisian, Middle Triassic)	SEM; ESEM-EDS		ToF-SIMS	Surmik, Rothschild & Pawlicki	2017
264	Biomacromolecules and/or their degradation products	Amino acids	Reptilia; Reptilia	Pterosauria: Anurognathidae (NJU–57003); Pterosauria: Anurognathidae (CAGS–Z070)	Yanliao Biota, Mutoudeng, Daohugou, Hebei	China	Asia	Mesozoic	Jurassic	165,3-160,0 (Callovian-Oxfordian, Middle–Late Jurassic)	SEM; FM		FTIR; LSF	Yang et al.	2019
265	Biomacromolecules and/or their degradation products	Amino acids	Fish	Aspidorhynchidae (UR-CP-0001)	Paja Formation, Radio Lenguerke station antenna region, Zapatoga city, Santander Province	Colombia	South America	Mesozoic	Cretaceous	125,7-121,4 (Barremian, Early Cretaceous)	OM (TLM, PLM); TC; SEM-EDS		FTIR; ToF-SIMS	Alfonso-Rojas & Cadena	2020
266	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria; Dinosauria	Titanosauridae: oógenos Megaloolithus (DUG/LDE/P11); Fusioolithus (DUG/LDE/DR4)	Lameta Formation, Bagh-Kukshi areas of Dhar District (Madhya Pradesh) and Rahioli/Raiyoli area of Kheda District (Gujarat)	India	Asia	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	SEM-EDS; XRM		Py-GC/MS; Py-GC×GC-TOFMS	Dhiman et al.	2021
267	Biomacromolecules and/or their degradation products	Amino acids	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
268	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria; Dinosauria	Homalocephale calathocercos (MPC-D 100/1201); Edmontosaurus regalis (UAMES 52615)	Nemegt Formation, Western Sayr, Nemegt; Price Creek Formation, Colville River, Alaska	Mongolia; USA	Asia; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous); 67,0-66,5 (Maastrichtian, Late Cretaceous)	OM (TLM, PLM); SEM-EDS; AFM; FESEM		XRPD; FTIR; ToF-SIMS	Surmik et al.	2023
269	Biomacromolecules and/or their degradation products	Amino acids	Dinosauria	Edmontosaurus sp. (UOL GEO.1)	Hell Creek Formation, Harding County, South Dakota	USA	North America	Mesozoic	Cretaceous	67,0-66,5 (Maastrichtian, Late Cretaceous)	XPol		ATR-FTIR; MS; LC-MS/MS	Tuinstra et al.	2025
270	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Inkayacu paracasensis (MUSM 1444)	Yumaque Point, Paracas National Reserve	Peru	South America	Cenozoic	Paleogene	37,7-33,9 (Priabonian, Late Eocene)	SEM			Clarke et al.	2010
271	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Indet. (SMF ME 3850)	Messel shale, near Darmstadt,	Germany	Europe	Cenozoic	Paleogene	41,2-37,7 (Bartonian, Middle Eocene)	SEM; ESEM; EDS			Vinther et al.	2010

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
272	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Gansus yumenensis (MGSF318, MGSF317)	Xiagou Formation, Yumen, Gansu	China	Asia	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	VP-FESEM		EDS; FTIR; RPE; Py-GC/MS	Barden et al.	2011
273	Biomacromolecules and/or their degradation products	Eumelanin	Avialae; Avialae; Avialae; Avialae; Avialae; Dinosauria; Fish	Confuciusornis sanctus (MGSF315, LL12418); Gansus yumenensis (MGSF317); Indet. (BHI-6358); Indet. (HMNS 2010.185.02); Indet. (BHI-6403); Archaeopteryx lithographica (MB.Av.100); Gosiutichthys parvus (BHI-6319)	Jehol Group; Xiagou Formation; Green River Formation; Green River Formation; Green River Formation; Solnhofen Lagerstätte; Green River Formation	China; China; USA; USA; USA; Germany; USA	Asia; Asia; North America; North America; North America; Europe; North America	Mesozoic; Mesozoic; Cenozoic; Cenozoic; Cenozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Paleogene; Paleogene; Paleogene; Jurassic; Paleogene	131,4-120,0 (Hauterivian-Aptian, Early Cretaceous); 115,0-105,0 (Aptian-Albian, Early Cretaceous); 56,0-47,8 (Ypresian, Early Eocene); 56,0-47,8 (Ypresian, Early Eocene); 56,0-47,8 (Ypresian, Early Eocene); 154,8-145,0 (Kimmeridgian–Tithonian, Late Jurassic); 56,0-47,8 (Ypresian, Early Eocene)	VP-FESEM		SRS-XRF; XANES; EXAFS; FTIR	Wogelius et al.	2011
274	Biomacromolecules and/or their degradation products	Eumelanin	Fish	Argentinoidei (FUM-N-2050)	Fur Formation	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM (TLM); SEM; TEM; nano-TC		EDS; ToF-SIMS; FTIR	Lindgren et al.	2012
275	Biomacromolecules and/or their degradation products	Eumelanin	Testudines; Reptilia; Reptilia	Eosphargis breineri (FUM-N-1450); Mosasauria: Tylosaurus nepaeolicus (SMU 76532); Ichthyosauria indet. (YORYM 1993.338)	Knudeklint, Island of Fur in northern Jutland, Fur Formation; Boquillas Formation, Texas; Blue Lias Formation, Lyme Bay	Denmark; USA; England	Europe; North America; Europe	Cenozoic; Mesozoic; Mesozoic	Paleogene; Cretaceous; Jurassic	55,0 (Ypresian, Eocene); 86,0 (Coniacian, Late Cretaceous); 199,5-192,9 (Sinemurian, Early Jurassic)	SEM		EDS; ToF-SIMS	Lindgren et al.	2014

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
276	Biomacromolecules and/or their degradation products	Eumelanin	Avialae; Avialae; Avialae; Amphibia; Amphibia; Amphibia; Amphibia; Mammalia; Mammalia; Fish	ave Indet. (SMF-ME 3850); Messelornis (SMF-ME11402a); ave Indet. (FUM-N2275); Anura: Palaeobatrachus (SMF-ME11390a); Anura: Pipidae (MU 41-13); Anura: Pipidae (MU 32-2A/B); Anura: Pelobates (PW 2005- 5034-LS_GDKE); morcego Hassianycteris (SMF-ME11407b); morcego Palaeochiropteryx (SMF-ME11406a); Cyclostomata	Messel; Messel; Fur Formation; Messel; Mush Valley; Mush Valley; Enspel Formation; Messel; Messel; Francis Creek Shale, Mazon Creek	Germany; Germany; Denmark; Germany; Ethiopia; Ethiopia; Germany; Germany; Germany; USA	Europe; Europe; Europe; Europe; Africa; Africa; Europe; Europe; Europe; North America	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Paleozoic	Paleogene; Paleogene; Paleogene; Paleogene; Neogene; Neogene; Paleogene; Paleogene; Carboniferous	56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-47,8 (Ypresian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 23,0-20,4 (Aquitanian, Early Miocene); 23,0-20,4 (Aquitanian, Early Miocene); 27,8-23,0 (Chattian, Oligocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 315,2-307 (Moscovian, Carboniferous)	SEM		ToF-SIMS	Colleary et al.	2015
277	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Coliiformes (AMNH FARB 30806)	Green River Formation, Wyoming	USA	North America	Cenozoic	Paleogene	50,0 (Ypresian, Early Eocene)	OM (TLM); SEM; TEM; nano-TC		XAS; SRS-XRF	Egerton et al.	2015
278	Biomacromolecules and/or their degradation products	Eumelanin	Fish	Teleostei (FUM-N-2268)	Interval between the Stolle Klint Clay (Ølst Formation) and Fur Formation, Isle of Fur, Limfjord region	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	SEM; FESEM; TEM		EDS; ToF-SIMS	Lindgren et al.	2015a
279	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Anchiornis huxleyi (YFGP-T5199)	Tiaojishan Formation, Jianchang, Liaoning	China	Asia	Mesozoic	Jurassic	174,7-145,0 (Middle–Late Jurassic)	OM (TLM); SEM; TEM; nano-TC		EDS; ToF-SIMS	Lindgren et al.	2015b
280	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Bohaiornithidae (CUGB P1202)	Jiufotang Formation, Jianchang, Liaoning	China	Asia	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	FESEM; CT Scan		RS	Peteya et al.	2016
281	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Indet. (FUM-1980)	Fur Formation, Knudeklint locality, Island of Fur, northern Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM; SEM-EDS; FESEM; SRXTM		XAS; XANES; ToF-SIMS	Gren et al.	2017
282	Biomacromolecules and/or their degradation products	Eumelanin	Testudines	Tasbacka danica (MHM-K2)	Fur Formation, Ejerslev Mo-clay pit, Isle of Mors, Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	FESEM; TEM	IHQ	ToF-SIMS; FTIR	Lindgren et al.	2017

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
283	Biomacromolecules and/or their degradation products	Eumelanin	Reptilia	Ichthyosauria: Stenopterygius sp. (MH 432)	Posidonia Shale Formation, Kromer Slate Quarry, village of Ohmden, Holzmaden	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	SRXTM	IHQ	SRS-XRF; EDS; NanoSIMS; ToF-SIMS; Py-GC/MS	Lindgren et al.	2018
284	Biomacromolecules and/or their degradation products	Eumelanin	Amphibia; Amphibia; Amphibia	Anura: Pelophylax pueyoi (MNCN 63775, MNCN 63776, NMP 39449, SMF-ME-00978, MNCN 63798, MNCN 63848, MNCN 66503, NHM 49999); Salamandridae: Chelotriton sp.; Salamandridae: indet. (CNU-V-1264)	Libros Biota; Rubielos de Mora; Daohuguo	Spain; Spain; China	Europe; Europe; Asia	Cenozoic; Cenozoic; Mesozoic	Neogene; Neogene; Jurassic	11,6-5,3 (Tortonian-Messinian, Late Miocene); 15,9-11,3 (Middle Miocene); 174,7-161,5 (Middle Jurassic)	OM; SEM; FM	CH	AHPO	McNamara et al.	2018
285	Biomacromolecules and/or their degradation products	Eumelanin	Avialae	Indet. (MN 7754-V)	Crato Formation, Araripe Basin, Ceará	Brazil	South America	Mesozoic	Cretaceous	120,0 (Aptian, Early Cretaceous)	OM; SEM-EDS; TEM; CLSM		FTIR	Campos et al.	2019
286	Biomacromolecules and/or their degradation products	Eumelanin	Reptilia	Pterosauria: Tupandactylus imperator (CPCA 3590)	Crato Formation, Santana Group, Cariri Valley, Ceará	Brazil	South America	Mesozoic	Cretaceous	121,4-113,0 (Aptian, Early Cretaceous)	SEM		SR-μXRF; RS; HPLC; LC-MS	Pinheiro et al.	2019
287	Biomacromolecules and/or their degradation products	Eumelanin	Amphibia; Amphibia; Reptilia; Mammalia	Anura: Pelophylax pueyoi (NHML-R4999); Anura: Pelophylax pueyoi (NHML-R4982); réptil Indet. (HMLDMe9018); morcego Chiroptera (HMLDMe7069)	Libros biota; Libros biota; Messel; Messel	Spain; Spain; Germany; Germany	Europe; Europe; Europe; Europe	Cenozoic; Cenozoic; Cenozoic; Cenozoic	Neogene; Neogene; Paleogene; Paleogene	11,6-5,3 (Tortonian-Messinian, Late Miocene); 11,6-5,3 (Tortonian-Messinian, Late Miocene); 56,0-47,8 (Early Eocene); 56,0-47,8 (Early Eocene)	SEM	CH	SRS-XRF	Rossi et al.	2019
288	Biomacromolecules and/or their degradation products	Eumelanin	Dinosauria	Hadrosauridae (YPMPU 016969)	Bearpaw Shale Formation, Crawford Ranch, Wheatland County, Montana	USA	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM (PLM); SEM		EDS; RS	Fabbri et al.	2020
289	Biomacromolecules and/or their degradation products	Eumelanin	Fish; Fish; Fish; Fish; Fish	Scombridae (FUM-N-12779); Perciformes (FUM-N-12781); Percoidei (FUM-N-13476); Actinopterygii (FUM-N-16240); Perciformes (NHMD 625460)	Stolleklint Clay, Ølst Formation, Danish Basin, Limfjord region, northern Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM; FESEM		EDS; ToF-SIMS	Heingård et al.	2021

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290	Biomacromolecules and/or their degradation products	Eumelanin	Testudines	Pan-Cheloniidae (DK 807)	Fur Formation, western Limfjord region	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)	OM (PLM); FESEM; TEM		EDS; ToF-SIMS; FTIR	De La Garza et al.	2022
291	Biomacromolecules and/or their degradation products	Eumelanin	Reptilia	Ichthyosauria: Stenopterygius sp. (UMH-A-0001, UMH-A-0002)	Posidonia Shale, Holzmaden town	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)	OM; Fotografia FUV; FESEM; TEM		SRS-XRF; ToF-SIMS	De La Garza et al.	2023
292	Biomacromolecules and/or their degradation products	Eumelanin	Dinosauria; Amphibia; Amphibia; Avialae; Avialae; Avialae; Avialae; Mammalia; Mammalia; Fish	dinossauro Yi qi (STM 31-2); Anura: Pipidae (MU 41-3, MU 32-2A/B); Anura: Palaeobatrachus (SMF-ME 11390a); Ave indet. (FUM-N 2275); Ave indet. (SMF-ME 3850); Messelornis (SMF-ME 11402a); Sapeornis sp. (STM 15-18); morcego Hassianycteris (SMF-ME 11407b); morcego Palaeochiropteryx (SMF-ME 11406a); Cyclostomata indet.	Tiaojishan Formation; Mush Valley; Messel; Fur Formation; Messel; Messel; Yixian Formation; Messel; Messel; Mazon Creek, Illinois	China; Ethiopia; Germany; Denmark; Germany; Germany; China; Germany; Germany; USA	Asia; Africa; Europe; Europe; Europe; Europe; Asia; Europe; Europe; North America	Mesozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Mesozoic; Cenozoic; Cenozoic; Paleozoic	Jurassic; Paleogene; Paleogene; Paleogene; Paleogene; Paleogene; Cretaceous; Paleogene; Paleogene; Carboniferous	161,5-154,8 (Oxfordian, Late Jurassic); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 121,4-100,5 (Aptian-Albian, Early Cretaceous); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 315,2-307 (Moscovian, Carboniferous)	OM; SEM		ToF-SIMS	Roy et al.	2023
293	Biomacromolecules and/or their degradation products	Eumelanin	Dinosauria; Avialae; Amphibia	Sinornithosaurus millenii (IVPP V 12811); Confuciusornis sp. (CKGM F 6433, IVPP V 13171); Anura: Pelophylax pueyoi (CKGM F 6434, MNCN 63678, MNCN 63694, MNCN 63773)	Jehol Biota; Jehol Biota; Libros Biota	China; China; Spain	Asia; Asia; Europe	Mesozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Neogene	132,6-121,4 (Hauterivian-Barremian, Early Cretaceous); 132,6-121,4 (Hauterivian-Barremian, Early Cretaceous); 11,6-5,3 (Tortonian-Messinian, Late Miocene)	SEM		AHPO-HPLC; ToF-SIMS	Slater et al.	2023b

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
294	Biomacromolecules and/or their degradation products	Eumelanin	Avialae; Avialae; Avialae; Indet.	Enantiornithine (STM7-26); Enantiornithine (STM7-27); Ornithuromorpha (STM8-23); Indet. (TF)	Jehol Biota; Jehol Biota; Jehol Biota; Tibetan Plateau	China; China; China; China	Asia; Asia; Asia; Asia	Mesozoic; Mesozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Cretaceous; Paleogene	125,7-121,4 (Barremian, Early Cretaceous); 125,7-121,4 (Barremian, Early Cretaceous); 125,7-121,4 (Barremian, Early Cretaceous); 33,9-23,0 (Oligocene)	SEM		ToF-SIMS; ATR-FTIR; RS	Pan et al.	2024
295	Biomacromolecules and/or their degradation products	Eumelanin	Amphibia; Avialae; Fish	Anura: Pelophylax pueyoi (CKGM-m142;); Anatidae (MNCN 2.017 AV-001-a;); Mene rhombea (MCSNV 18–19/2020)	Libros Biota; Libros Biota; Bolca Biota, Pesciara site, Verona	Spain; Spain; Italy	Europe; Europe; Europe	Cenozoic; Cenozoic; Cenozoic	Neogene; Neogene; Paleogene	10,0 (Tortonian, Miocene); 10,0 (Tortonian, Miocene); 49,0 (Ypresian, Eocene)	SEM		RS	Rossi, Unitt & Mcnamara	2024
296	Biomacromolecules and/or their degradation products	Eumelanin	Fish	Dastilbe crandalli (GP/2E-9378b)	Crato Formation, Araripe Basin	Brazil	South America	Mesozoic	Cretaceous	110,0 (Albian, Early Cretaceous)	OM; CM; SEM		EDS; RS; FTIR	Prado et al.	2025
297	Biomacromolecules and/or their degradation products	Pheomelanin	Amphibia	Anura: Girino indet. (FS003a,b)	Enspel Formation	Germany	Europe	Cenozoic	Paleogene	27,3-23,0 (Chattian, Oligocene)	SEM; VP-FESEM		EDS; XAS; SRS-XRF; XANES; FTIR; Py-GC/MS	Barden et al.	2015
298	Biomacromolecules and/or their degradation products	Pheomelanin	Avialae; Avialae; Avialae; Amphibia; Amphibia; Amphibia; Amphibia; Mammalia; Mammalia; Fish	ave Indet. (SMF-ME 3850); Messelornis (SMF-ME11402a); ave Indet. (FUM-N2275); Anura: Palaeobatrachus (SMF-ME11390a); Anura: Pipidae (MU 41-13); Anura: Pipidae (MU 32-2A/B); Anura: Pelobates (PW 2005- 5034-LS_GDKE); morcego Hassianycteris (SMF-ME11407b); morcego Palaeochiropteryx (SMF-ME11406a); Cyclostomata	Messel; Messel; Fur Formation; Messel; Mush Valley; Mush Valley; Enspel Formation; Messel; Messel; Francis Creek Shale, Mazon Creek	Germany; Germany; Denmark; Germany; Ethiopia; Ethiopia; Germany; Germany; Germany; USA	Europe; Europe; Europe; Europe; Africa; Africa; Europe; Europe; Europe; North America	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Paleozoic	Paleogene; Paleogene; Paleogene; Paleogene; Neogene; Neogene; Paleogene; Paleogene; Carboniferous	56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 56,0-47,8 (Ypresian, Eocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 23,0-20,4 (Aquitanian, Early Miocene); 23,0-20,4 (Aquitanian, Early Miocene); 27,8-23,0 (Chattian, Oligocene); 56,0-41,2 (Ypresian-Lutetian, Eocene); 315,2-307 (Moscovian, Carboniferous)	SEM		ToF-SIMS	Colleary et al.	2015
299	Biomacromolecules and/or their degradation products	Pheomelanin	Avialae	Anchiornis huxleyi	Tiaojishan Formation, Jianchang, Liaoning	China	Asia	Mesozoic	Jurassic	174,7-145,0 (Middle–Late Jurassic)	SEM; FESEM; TEM		EDS; ToF-SIMS	Lindgren et al.	2015b

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
300	Biomacromolecules and/or their degradation products	Pheomelanin	Dinosauria	Psittacosaurus sp. (SMF R 4970)	Jehol Biota, Yixian Formation, Liaoning	China	Asia	Mesozoic	Cretaceous	133,0-120,0 (Valanginian-Barremian, Early Cretaceous)	Fotografia XP; OM (PLM); SEM		LSF	Vinther et al.	2016
301	Biomacromolecules and/or their degradation products	Pheomelanin	Dinosauria	Borealopelta markmitchelli (TMP 2011.033.0001)	Wabiskaw Member, Clearwater Formation, Alberta	Canada	North America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Early Cretaceous)	Fotografia XP; Fotografia FUV; TC; SEM		ToF-SIMS; Py-GC/MS	Brown et al.	2017
302	Biomacromolecules and/or their degradation products	Pheomelanin	Mammalia	Apodemus atavus (GZG.W.20027b, GZG.W.17393a)	lagerstätte de Willershausen, Northeim, Baixa Saxônia	Germany	Europe	Cenozoic	Neogene	3,0 (Piacenzian, Pliocene)	ESEM-EDS		XRD; SRS-XRF; XAS; XANES; FTIR	Manning et al.	2019
303	Biomacromolecules and/or their degradation products	Pheomelanin	Reptilia; Reptilia	Pterosauria: Anurognathidae (NJU–57003); Pterosauria: Anurognathidae (CAGS–Z070)	Yanliao Biota, Mutoudeng, Daohugou, Hebei	China	Asia	Mesozoic	Jurassic	165,3-160,0 (Callovian-Oxfordian, Middle–Late Jurassic)	SEM; FM		FTIR; LSF	Yang et al.	2019
304	Biomacromolecules and/or their degradation products	Pheomelanin	Dinosauria; Avialae; Amphibia	Sinornithosaurus millenii (IVPP V 12811); Confuciusornis sp. (CKGM F 6433, IVPP V 13171); Anura: Pelophylax pueyoi (CKGM F 6434, MNCN 63678, MNCN 63694, MNCN 63773)	Jehol Biota; Jehol Biota; Libros Biota	China; China; Spain	Asia; Asia; Europe	Mesozoic; Mesozoic; Cenozoic	Cretaceous; Cretaceous; Neogene	132,6-121,4 (Hauterivian-Barremian, Early Cretaceous); 132,6-121,4 (Hauterivian-Barremian, Early Cretaceous); 11,6-5,3 (Tortonian-Messinian, Late Miocene)	SEM		AHPO-HPLC; ToF-SIMS	Slater et al.	2023b
305	Biomacromolecules and/or their degradation products	Biliverdina	Dinosauria	Heyuannia huangi (ootaxon Macroolithus yaotunensis: NMNS CYN-2004-DINO-05/I)	Hongcheng Basin, Jiangxi	China	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)			HPLC-ESI-Q-TOF-MS	Wiemann et al.	2017
306	Biomacromolecules and/or their degradation products	Leukocyte	Reptilia	Ichthyosauria: Stenopterygius sp.	Posidonia Shale Formation, HOLCIM Cement quarry, Dotternhausen	Germany	Europe	Mesozoic	Jurassic	184,2-174,7 (Toarcian, Early Jurassic)			XRD; XRF; ToF-SIMS	Plet et al.	2017
307	Biomacromolecules and/or their degradation products	Leukocyte	Dinosauria	Maiasaura sp.	Two Medicine Formation, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	OM; SEM		EDS	Barreto et al.	2007
308	Biomacromolecules and/or their degradation products	Carbohydrate	Dinosauria	Tarbosaurus bataar	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)		CH		Pawlicki	1977a
309	Biomacromolecules and/or their degradation products	Carbohydrate	Dinosauria	Indet.	Gobi Desert	Mongolia	Asia	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	OM; SEM; TEM	CH		Pawlicki	1984a
310	Biomacromolecules and/or their degradation products	Carbohydrate	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	OM; SEM; TEM	IHQ	SR-FTIR; EDS; µ-XRF; µ-XANES	Boatman et al.	2019

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311	Biomacromolecules and/or their degradation products	Tropomyosin	Testudines	Tasbacka danica (MHM-K2)	Fur Formation, Ejerslev Mo-clay pit, Isle of Mors, Jutland	Denmark	Europe	Cenozoic	Paleogene	54,0 (Ypresian, Early Eocene)		IHQ	ToF-SIMS; FTIR	Lindgren et al.	2017
312	Biomacromolecules and/or their degradation products	Tropomyosin	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 555); Tyrannosaurus rex (MOR 1125); Tyrannosaurus rex (MOR 1126); Tyrannosaurus rex (MOR 1128); Brachylophosaurus canadensis (MOR 2598); Ceratopsídeo indet. (MOR 10857)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Valley County	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 866.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); SEM; TEM; nano-TC	CH; IHQ	ToF-SIMS	Schweitzer et al.	2025
313	Biomacromolecules and/or their degradation products	Struthiocalcin	Avialae; Avialae; Avialae	Struthio camelus (LOT 13901); Struthio camelus (LOT 14426); Struthio camelus (LOT 15575)	Laetoli; Olduvai Gorge; Wonderwerk Cave	Tanzania; Tanzania; South Africa	Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic	Neogene; Quaternary; Quaternary	3,8 (Pliocene); 1,3 (Pleistocene); 1,0-0,9 (Pleistocene)		ARA	LC-MS/MS; Q-TOFMS	Demarchi et al.	2016
314	Biomacromolecules and/or their degradation products	Struthiocalcin	Avialae	Struthio sp. (ootaxon Liushu) (IVPP V26107)	Linxia Basin, Liushu Formation, Hezheng County, Hezheng County	China	Asia	Cenozoic	Neogene	9,0-6,5 (Tortonian-Messinian, Late Miocene)	TC		LC-MS/MS	Demarchi et al.	2022
315	Biomacromolecules and/or their degradation products	Struthiocalcin	Avialae	Struthio linxiaensis (IVPP V26107)	Linxia Basin, Liushu Formation, Hezheng County, Hezheng County	China	Asia	Cenozoic	Neogene	9,0-6,5 (Tortonian-Messinian, Late Miocene)	OM (TLM, PLM); SEM-EDS; SEM-BSE	CH	RS	Wu et al.	2024b
316	Biomacromolecules and/or their degradation products	Osteocalcins	Mammalia; Mammalia; Testudines; Mammalia	Bubalus paleokerabau (RMNH 5); Bovidae (IVAU 6); Caprotragoides sehlini (IVAU 7); Theridomorpha (RMNH 8)	Trinil site, Java; chinji town; Manchones town, Saragoça Province; Olalla locality, Calamocha city, Teruel Province	Indonesia; Pakistan; Spain; Spain	Asia; Asia; Europe; Europe	Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Paleogene	1,0 (Calabrian, Early Pleistocene); 13,0 (Serravallian, Middle Miocene); 13,0 (Serravallian, Middle Miocene); 30,0 (Rupelian, Oligocene)		ELISA; RIA		Ulrich et al.	1987
317	Biomacromolecules and/or their degradation products	Osteocalcins	Testudines; Dinosauria; Dinosauria; Dinosauria	Psephophorus sp. (F30.52); dinossauro cf. Centrosaurus (F33.12, F33.46); Sauropoda (F34. CV); Lambeosaurus sp. (F38.2, F38. 51)	Maryland; Indet.; Indet.; Judith River Formation, Dinosaur Provincial Park; Alberta; Wapiti Formation, Grande Prairie, Alberta	USA; Indet.; Indet.; Canada	North America; Indet.; Indet.; North America	Cenozoic; Mesozoic; Mesozoic; Mesozoic	Neogene; Cretaceous; Jurassic; Cretaceous	15,0 (Burdigalian, Early Miocene); Late Cretaceous; Late Jurassic; 83,6-72,1 (Campanian, Late Cretaceous)		DIBA; RIA	RP-HPLC	Muyzer et al.	1992

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318	Biomacromolecules and/or their degradation products	Osteocalcins	Dinosauria	Iguanodon sp. (R6600)	Smokejacks Brickworks, Ockley, Surrey	England	Europe	Mesozoic	Cretaceous	125,7-121,4 (Barremian, Early Cretaceous)	OM	SDS-PAGE; WB; DIBA; CAE	FPLC; RP-HPLC	Embery et al.	2003
319	Biomacromolecules and/or their degradation products	Scleroprotein	Dinosauria	cf. Megalosaurus sp.	Rognacian Formation	France	Europe	Mesozoic	Cretaceous	72,1-66,0 (Maastrichtian, Late Cretaceous)	SEM		IEC	Voss-Foucart	1968
320	Biomacromolecules and/or their degradation products	Phosphoprotein	Dinosauria	Iguanodon sp. (R6600)	Smokejacks Brickworks, Ockley, Surrey	England	Europe	Mesozoic	Cretaceous	130,0-125,7 (Hauterivian, Early Cretaceous)	SEM	SDS-PAGE; WB; DIBA; CAE	FPLC; HPLC	Embery et al.	2000
321	Biomacromolecules and/or their degradation products	Dentin matrix protein 1 (DMP1)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025
322	Biomacromolecules and/or their degradation products	Albumin (ALB)	Mammalia	Hominidae: Australopithecus robustus	Omo site	Ethiopia	Africa	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)		RIA		Lowenstein	1980

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Record ID	Level of Biostructural Organization	Biomaterial Type	Taxonomy		Geographic Distribution			Geological Age			Analytical Techniques			Main Author	Year
			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
323	Biomacromolecules and/or their degradation products	Albumin (ALB)	Mammalia; Mammalia; Mammalia; Mammalia	Hominidae: indet. (VM-0, VM1960); Equídeo Equus caballus (EEG, VM1653); Equídeo Equus caballus (CV-5); Bovidae indet. (VM786, VM1587)	Venta Micena site, Orce, Granada; Venta Micena site, Orce, Granada; Cueva Victoria, Cartagena, Murcia; Venta Micena site, Orce, Granada	Spain	Europe	Cenozoic	Quaternary	1,6-1,4 (Calabrian, Early Pleistocene)		RIA; ELISA		Borja et al.	1997
324	Biomacromolecules and/or their degradation products	Albumin (ALB)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)			AAR; MS/MS; RP-HPLC	Cappellini et al.	2019
325	Biomacromolecules and/or their degradation products	Albumin (ALB)	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)		ARA	RP-HPLC; LC-MS/MS	Welker et al.	2020
326	Biomacromolecules and/or their degradation products	Albumin (ALB)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada' s High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025
327	Biomacromolecules and/or their degradation products	Ovalbumin	Dinosauria	Sauropoda (ootaxon Megaloolithidae)	Anacleto Formation, Neuquén Group, Patagônia	Argentina	South America	Mesozoic	Cretaceous	83,6-72,1 (Campanian, Late Cretaceous)	SEM; TEM; CM	ELISA	EDS	Schweitzer et al.	2005b
328	Biomacromolecules and/or their degradation products	Elastin	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	OM (TLM); FESEM	ELISA; IHQ	ATR-FTIR; ToF-SIMS; LC-MS/MS	Schweitzer et al.	2009
329	Biomacromolecules and/or their degradation products	Elastin	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 555); Tyrannosaurus rex (MOR 1125); Tyrannosaurus rex (MOR 1126); Tyrannosaurus rex (MOR 1128); Brachylophosaurus canadensis (MOR 2598); Ceratopsídeo indet. (MOR 10857)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Valley County	USA; USA; USA; USA; USA; USA	North America; North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 866.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	OM (TLM); SEM; TEM; nano-TC	CH; IHQ	ToF-SIMS	Schweitzer et al.	2025
330	Biomacromolecules and/or their degradation products	Elastin	Dinosauria	Tiranosaurus rex (MOR 555)	Hell Creek Formation, McCone County, Montana	USA	North America	Mesozoic	Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous)	OM; ESEM; TEM	IHQ	EDS	Boatman et al.	2019
331	Biomacromolecules and/or their degradation products	Laminin	Dinosauria	Brachylophosaurus canadensis (MOR 2598)	Judith River Formation, Phillips County, Montana	USA	North America	Mesozoic	Cretaceous	80 (Campanian, Late Cretaceous)	ESEM	ELISA; IHQ	EDS	Schweitzer et al.	2009

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
332	Biomacromolecules and/or their degradation products	Laminin	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 555); Tyrannosaurus rex (MOR 1125); Tyrannosaurus rex (MOR 1126); Tyrannosaurus rex (MOR 1128); Brachylophosaurus canadensis (MOR 2598); Ceratopsídeo indet. (MOR 10857)	Montana: Hell Creek Formation, McCone County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Hell Creek Formation, Garfield County; Judith River Formation, Phillips County; Judith River Formation, Valley County	USA; USA; USA; USA; USA	North America; North America; North America; North America; North America	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic	Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 866.5–67.0 (Maastrichtian, Late Cretaceous); 66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	ESEM	ELISA; IHQ	EDS	Schweitzer et al.	2025
333	Biomacromolecules and/or their degradation products	Actin	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	ESEM	ELISA; IHQ	EDS	Schweitzer et al.	2013
334	Biomacromolecules and/or their degradation products	Tubulin	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	SEM; TEM; FM	IFI; HQ	MS/MS	Schweitzer et al.	2013
335	Biomacromolecules and/or their degradation products	Histone H4	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	SEM; TEM; FM	IFI; HQ	MS/MS	Schweitzer et al.	2013
336	Biomacromolecules and/or their degradation products	PHEX	Dinosauria; Dinosauria	Tyrannosaurus rex (MOR 1125); Brachylophosaurus canadensis (MOR 2598)	Montana: Hell Creek Formation, Garfield County; Judith River Formation, Phillips County	USA; USA	North America; North America	Mesozoic; Mesozoic	Cretaceous; Cretaceous	66.5–67.0 (Maastrichtian, Late Cretaceous); 83,6-72,1 (Campanian, Late Cretaceous)	SEM; FESEM	IFI; HQ	EDS; XRD	Schweitzer et al.	2013
337	Biomacromolecules and/or their degradation products	Amelogenin (AMELX)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)	SEM; FESEM		EDS; XRD	Cappellini et al.	2019
338	Biomacromolecules and/or their degradation products	Amelogenin (AMELX)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)	SEM; FESEM		EDS; XRD	Welker et al.	2019
339	Biomacromolecules and/or their degradation products	Amelogenin (AMELX)	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)		ARA	RP-HPLC; LC-MS/MS	Welker et al.	2020

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
340	Biomacromolecules and/or their degradation products	Amelogenin (AMELX)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada' s High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025
341	Biomacromolecules and/or their degradation products	Amelogenin (AMELX)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025
342	Biomacromolecules and/or their degradation products	Ameloblastin (AMBN)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)			AAR; MS/MS; RP-HPLC	Cappellini et al.	2019
343	Biomacromolecules and/or their degradation products	Ameloblastin (AMBN)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)			MS/MS; LC-MS/MS	Welker et al.	2019
344	Biomacromolecules and/or their degradation products	Ameloblastin (AMBN)	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)		ARA	RP-HPLC; LC-MS/MS	Welker et al.	2020

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
345	Biomacromolecules and/or their degradation products	Ameloblastin (AMBN)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada' s High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025
346	Biomacromolecules and/or their degradation products	Ameloblastin (AMBN)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025
347	Biomacromolecules and/or their degradation products	Enamelin (ENAM)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)			AAR; MS/MS; RP-HPLC	Cappellini et al.	2019
348	Biomacromolecules and/or their degradation products	Enamelin (ENAM)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)			MS/MS; LC-MS/MS	Welker et al.	2019
349	Biomacromolecules and/or their degradation products	Enamelin (ENAM)	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)		ARA	RP-HPLC; LC-MS/MS	Welker et al.	2020

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
350	Biomacromolecules and/or their degradation products	Enamelin (ENAM)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada' s High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025
351	Biomacromolecules and/or their degradation products	Enamelin (ENAM)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025
352	Biomacromolecules and/or their degradation products	Amelotin (AMTN)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)			AAR; MS/MS; RP-HPLC	Cappellini et al.	2019
353	Biomacromolecules and/or their degradation products	Amelotin (AMTN)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)			MS/MS; LC-MS/MS	Welker et al.	2019
354	Biomacromolecules and/or their degradation products	Amelotin (AMTN)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada' s High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025

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Record ID	Level of Biostructural Organization	Biomaterial Type	Taxonomy		Geographic Distribution			Geological Age			Analytical Techniques			Main Author	Year
			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
355	Biomacromolecules and/or their degradation products	Amelotin (AMTN)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Buluk site; Locherengan site; Locherengan siten; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025
356	Biomacromolecules and/or their degradation products	Matrix metalloproteinase-20 (MMP20)	Mammalia	Stephanorhinus sp. (Dm.5/157-16635)	Dmanisi, Kvemo Kartli region, South Caucasus	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Quaternary, Early Pleistocene)			AAR; MS/MS; RP-HPLC	Cappellini et al.	2019
357	Biomacromolecules and/or their degradation products	Matrix metalloproteinase-20 (MMP20)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)			MS/MS; LC-MS/MS	Welker et al.	2019
358	Biomacromolecules and/or their degradation products	Matrix metalloproteinase-20 (MMP20)	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)		ARA	RP-HPLC; LC-MS/MS	Welker et al.	2020
359	Biomacromolecules and/or their degradation products	Matrix metalloproteinase-20 (MMP20)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada's High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)		ARA	HPLC; LC-MS/MS	Paterson et al.	2025

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
360	Biomacromolecules and/or their degradation products	Matrix metalloproteinase-20 (MMP20)	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)			LC-MS/MS	Green et al.	2025

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
361	Biomacromolecules and/or their degradation products	COL1A1, COL1A2, COL3A1	Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia; Mammalia	Elephantidae: Palaeoloxodon recki (fdrg10313a); Hippopotamidae: Archaeopotamus sp. (KNM-LT 26247); Hippopotamidae indet. (KNM-NP 64551); Deinotheriidae: Prodeinotherium hobleyi (KNM-WS 65217); Mammutidae: Zygolophodon sp. (KNM-WS 65653); Gomphotheriidae: Gomphotheriidae indet. (KNM-WS 101824); Rhinocerotidae indet. (KNM-LC 17680); Anthracotheriidae: Brachyodus aequatorialis (KNM-LC 30762); Rhinocerotidae: cf. Chilotheridium pattersoni (KNM-LP 30); Arsinoitheriidae: Arsinoitherium sp. (KNM-TP 102134)	Turkana Basin: Koobi Fora Formation (Área 103); Lothagam site (Nawata Formation); Napudet site; Buluk site; Buluk site; Buluk site; Locherengan site; Locherengan site; Loperot site; Topernawi site	Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya; Kenya	Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa; Africa	Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic; Cenozoic	Quaternary; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Neogene; Paleogene	1,5 (Calabrian, Early Pleistocene); 7,0 (Messinian, Late Miocene); 11-5 (Tortonian-Messinian, Late Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 16 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene); 17 (Burdigalian, Early Miocene) 18 (Burdigalian, Early Miocene); 29 (Rupelian, Oligocene)	OM (TLM); SEM		EDS	Green et al.	2025
362	Biomacromolecules and/or their degradation products	COL17α1	Mammalia	Hominidae: Homo erectus (D4163)	Dmanisi	Georgia	Eurasia	Cenozoic	Quaternary	1,7 (Calabrian, Early Pleistocene)	OM (TLM); SEM	ARA	EDS	Welker et al.	2020
363	Biomacromolecules and/or their degradation products	Alpha-2-HS-glycoprotein (AHSG)	Mammalia	Gigantopithecus blacki (CF-B-16)	Chuifeng Cave, Bubing Basin, Guangxi Zhuang Autonomous Region	China	Asia	Cenozoic	Quaternary	1,9 (Gelasian, Early Pleistocene)	OM (TLM); SEM	ARA	EDS	Welker et al.	2019
364	Biomacromolecules and/or their degradation products	Alpha-2-HS-glycoprotein (AHSG)	Mammalia	Epiaceratherium sp. (CMNFV59632)	Haughton Formation, Haughton Crater, Devon Island, Nunavut, Canada's High Arctic	Canada	North America	Cenozoic	Neogene	21,8 (Aquitanian, Early Miocene)	OM (TLM, PLM); SEM; SEM-BSE	ARA	EDS; RS	Paterson et al.	2025

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
365	Biomacromolecules and/or their degradation products	Alpha-tectorin	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
366	Biomacromolecules and/or their degradation products	Beta-tectorin	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
367	Biomacromolecules and/or their degradation products	Otogelin	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
368	Biomacromolecules and/or their degradation products	Otolin-1	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
369	Biomacromolecules and/or their degradation products	Neuroserpin	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023

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Record ID	Level of Biostructural Organization	Biomaterial Type	Taxonomy		Geographic Distribution			Geological Age			Analytical Techniques			Main Author	Year
			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
370	Biomacromolecules and/or their degradation products	Collagenase, type IV	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
371	Biomacromolecules and/or their degradation products	Protocadherin FAT4	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
372	Biomacromolecules and/or their degradation products	Thrombospondin-1	Fish	Phycis tenuis (ZPAL P.21/C-OTH-07/006, ZPAL P.21/C-OTH-07/008-027)	Korytnica Clays, Korytnica Basin, Korytnica-Plebania, Korytnica-Forest and Mt. Lysa localities, southern slopes of the Holy Cross Mountains	Poland	Europe	Cenozoic	Neogene	14,0 (Langhian, Miocene)	AFM; TEM; FESEM	ARA	EBSD; LC-MS/MS	Stolarski et al.	2023
373	Biomacromolecules and/or their degradation products	Osteonectin	Mammalia	Anancus arvernensis (GZG.W.35028)	Willershausen, Lower Saxony	Germany	Europe	Cenozoic	Neogene	3,0 (Neogene, Late Pliocene)	OM; SEM; TEM	SDS-PAGE; WB	EDS	Schmidt-Schultz, Reich & Schultz	2021
374	Biomacromolecules and/or their degradation products	Osteopontin	Mammalia	Anancus arvernensis (GZG.W.35028)	Willershausen, Lower Saxony	Germany	Europe	Cenozoic	Quaternary	3,0 (Neogene, Late Pliocene)	OM; SEM; TEM	SDS-PAGE; WB	EDS	Schmidt-Schultz, Reich & Schultz	2021
375	Biomacromolecules and/or their degradation products	Bone morphogenetic protein 2 (BMP-2)	Mammalia	Anancus arvernensis (GZG.W.35028)	Willershausen, Lower Saxony	Germany	Europe	Cenozoic	Neogene	3,0 (Neogene, Late Pliocene)	OM; SEM; TEM	SDS-PAGE; WB	EDS	Schmidt-Schultz, Reich & Schultz	2021

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
376	Biomacromolecules and/or their degradation products	N-, O-, and S-heterocyclic polymers (degradation products of proteins, lipids, and sugars)	Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Dinosauria; Avialae; Avialae; Avialae; Reptilia; Reptilia; Reptilia; Reptilia; Reptilia; Reptilia; Reptilia; Reptilia; Amphibia; Amphibia; Lepospondyli; Fish; Fish; Synapsida; Reptilia; Reptilia;	Allosaurus (YPM VP 4944); Deinonychus (YPM VP 5220); Deinonychus (AMNH 3015); Troodontidae (IGM 100/1323); Troodontidae (MAE 14-40); Troodontidae (AMNH FARB 6631); Troodontidae (IGM 100/1003); Troodontidae (PFMM-0014003517); Troodontidae (YPM VP PU 023259); Deinonychus (AMNH 3015); Dryosaurus (YPM VP 7324); Saurópode (YPM VP 1907); Saltasauridae (STIPB E360); Titanosauridae (YPM PU 21158); Heyannia (NMNS CYN-2004-DINO-05); Melanosaurus (YPM VP PU 21801); ave Telmatornis (YPM VP 902); ave Enantiornithine (IGM 100/1339); ave Psammornis (ZFMK 23a: III/c/23); Pterosauria: Rhamphorhynchoidea (YPM VP 9150); Pterosauria: Pteranodon (YPM VP 002271); Plesiossauria indet. (YPM VP 065733); Plesiossauria indet. (YPM VP 065736); Ichthyosauria: Ichthyosaurus (YPM VP 065735); Crocodylomorpha: indet. (YPM VP 065732);	Indet.; Indet.	Indet.; Indet.;	Indet.; Indet.	Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Cenozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Mesozoic; Paleozoic; Paleozoic; Cenozoic; Cenozoic; Paleozoic;	Jurassic; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Jurassic; Jurassic; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Quaternary; Jurassic; Cretaceous; Jurassic; Jurassic; Jurassic; Jurassic; Jurassic; Cretaceous; Jurassic; Permian; Permian; Indet.;	Jurassic; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Jurassic; Jurassic; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Cretaceous; Quaternary; Jurassic; Cretaceous; Jurassic; Jurassic; Jurassic; Jurassic; Jurassic; Cretaceous; Jurassic; Permian; Permian; Cenozoic; Cenozoic; Permian;			RS	Wiemann, Crawford & Briggs	2020

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		
377	Biomacromolecules and/or their degradation products	Collagen	Mammalia	Pliohippus sp.; Stenomylus sp.	Wickieup, Arizona; Wellton, Arizona	USA; USA	North America; North America	Cenozoic; Cenozoic	Neogene; Neogene	5,3-2,5 (Pliocene); 23,0-5,3 (Miocene)	TEM	CH		Armitage & Solliday	1968

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			Clade	Subclade	Locality	Country	Continent	Era	Period	Age/ Epoch (Ma)	Optical	Biological	Chemical		

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