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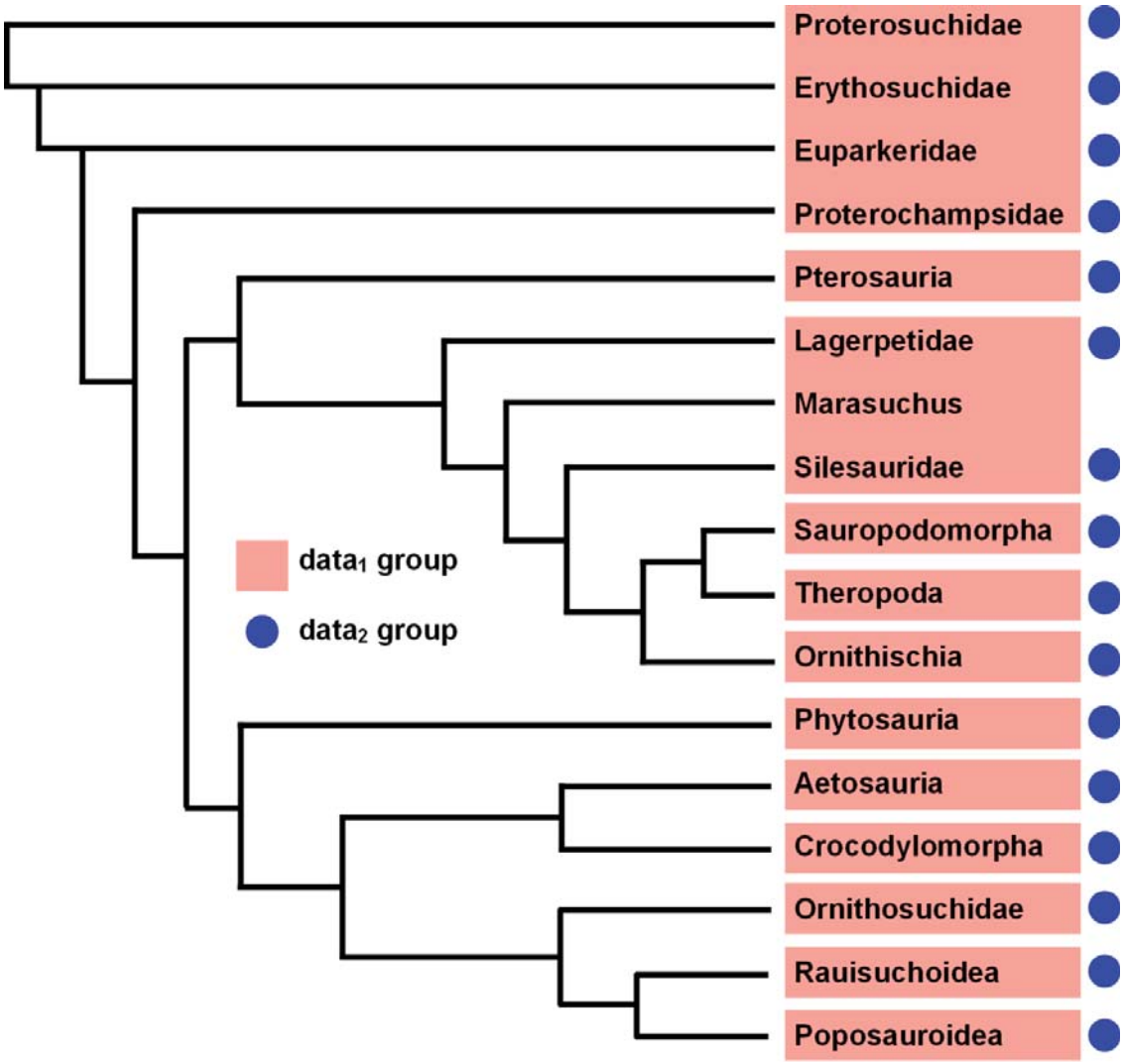

Supplementary Figure 1| Archosaurian phylogeny [S1] showing assignment of taxonomic groups in $data_1$ and $data_2$.

Supplementary Table 1| Summary table of Spearman's rank pairwise correlation coefficients (r_s) between the rate of geographic range size change and diversification rate. Convex hull measurements from raw palaeogeographic occurrences and mean great circle distance (GCD) measurements standardised to samples of 5 and 10 occurrences (1,000 reps). *significant at $p < 0.05$, **significant at $p < 0.01$, ***significant at $p < 0.001$.

	convex hull	mean GCD $n = 5$	mean GCD $n = 10$
all time bins	0.67***	0.34**	0.44***
Early Triassic	0.71	-	-
Mid Triassic	0.86***	0.69*	0.95***
Anisian	0.61	-	-
Ladinian	0.94***	-	-
Late Triassic	0.64***	0.24	0.26
Carnian	0.41	-	-
Norian	0.43*	0.37	0.12
Rhaetian	**0.40**	**-0.22**	**-0.21**
Early Jurassic	0.54**	0.31	0.55
Hettangian	0.68	-	-
Sinemurian	0.18	-	-
Pliensbachian	0.57	-	-
Toarcian	-	-	-
Mid Jurassic	-	-	-
Late Jurassic	0.61***	0.48*	0.47*
Oxfordian	0.71*	-	-
Kimmeridgian	0.33	-	-
Tithonian	0.51	0.62	0.62

Supplementary Table 2| Summary table of pairwise Spearman rank correlation coefficients (r_s) between sampling proxies and the rate of geographic range size change. *significant at $p < 0.05$, **significant at $p < 0.01$, ***significant at $p < 0.001$.

	Convex hull	Mean GCD $n = 5$	Mean GCD $n = 10$
Non-marine area	-0.04	0.08	0.12
Sea level	0.30**	-0.17	-0.33*
Formations	0.45***	0.34**	0.38**
Abundance	0.36***	0.07	-0.02
Total range	0.33***	0.23*	0.31*

Supplementary Table 3| Summary table of pairwise Spearman rank correlation coefficients (r_s) between sampling proxies and diversification rate. *significant at $p < 0.05$, **significant at $p < 0.01$, ***significant at $p < 0.001$.

	Diversification rate
Non-marine area	-0.001
Sea level	0.26**
Formations	0.35***
Abundance	0.32***
Total range	0.30***

Supplementary Table 4| Multiple regression model of diversification rate with respect to geographic range change as measured using convex hulls and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-1.45324	-0.49620	0.01652	0.40325	1.58541

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	-1.806e-02	6.512e-02	-0.277	0.782
range change (convex hulls)	**9.404e-02**	**1.033e-02**	**9.107**	**3.8e-15*** **
non-marine area	3.188e-03	1.339e-02	0.238	0.812
sea level	1.239e-03	2.923e-03	0.424	0.673
formations	-3.503e-03	3.839e-03	-0.912	0.364
abundance	4.053e-05	3.348e-05	1.211	0.229
total range	1.024e-09	8.000e-10	1.280	0.203

Residual std. Error: 0.6423 on 112 degrees of freedom
Multiple R-squared: 0.5571, Adjusted R-squared : 0.5334
F-statistic: 23.48 on 6 and 112 DF, *p*-value: <2.2e-16

Supplementary Table 5| Minimum adequate multiple regression model selected using AIC of diversification rate with respect to geographic range change as measured using convex hulls and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-0.38574	-0.06228	0.00098	0.04759	0.38714

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	0.001271	0.009763	0.13	0.897
range change (convex hulls)	**0.115194**	**0.007489**	**15.38**	**<2e-16*** **

Residual std. Error: 0.1136 on 134 degrees of freedom
Multiple R-squared: 0.6384, Adjusted R-squared : 0.6357
F-statistic: 236.6 on 1 and 134 DF, *p*-value: <2.2e-16

Supplementary Table 6| Multiple regression model of diversification rate with respect to geographic range change as measured using mean GCD of 5 samples and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-0.133950	-0.41441	-0.04567	0.41208	0.139831

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	-6.052e-02	7.819e-02	-0.774	0.442
range change (meanGCD *n*=5)	1.038e-01	7.226e-02	1.436	0.156
non-marine area	1.539e-02	1.710e-02	0.900	0.371
sea level	3.698e-03	3.501e-03	1.057	0.295
formations	4.179e-03	5.028e-03	0.831	0.409
abundance	2.664e-05	3.891e-05	0.685	0.496
total range	1.696e-09	1.021e-09	1.660	0.102

Residual std. Error: 0.6101on 66 degrees of freedom
Multiple R-squared: 0.2849, Adjusted R-squared : 0.2199
F-statistic: 4.383 on 6 and 66 DF, *p*-value: 0.0008745

Supplementary Table 7| Minimum adequate multiple regression model selected using AIC of diversification rate with respect to geographic range change as measured using mean GCD of 5 samples and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-1.34528	-0.40067	-0.01556	0.35769	1.35469

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	-8.540e-02	7.338e-02	-1.164	0.2485
range change (meanGCD *n*=5)	**1.321e-01**	**6.568e-02**	**2.011**	**0.0482***
sea level	**7.146e-03**	**2.314e-03**	**3.088**	**0.0029****
total range	**2.191e-09**	**8.888e-10**	**2.465**	**0.0162***

Residual std. Error: 0.6072 on 69 degrees of freedom
Multiple R-squared: 0.2594, Adjusted R-squared : 0.2272
F-statistic: 8.058 on 3 and 69 DF, *p*-value: 0.000112

Supplementary Table 8| Multiple regression model of diversification rate with respect to geographic range change as measured using mean GCD of 10 samples and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-1.5331	-0.3178	0.0019	0.3790	1.1698

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	-5.283e-02	7.645e-02	-0.691	0.49293
range change (meanGCD *n*=10)	**1.672e-01**	**8.397e-02**	**1.992**	**0.05225.**
non-marine area	1.113e-02	1.736e-02	0.641	0.52443
sea level	4.959e-03	3.389e-03	1.463	0.15008
formations	-9.546-05	5.065e-03	-0.019	0.98504
abundance	1.816e-05	4.212e-05	0.431	0.66841
total range	**2.987e-09**	**1.016e-09**	**2.941**	**0.00507****

Residual std. Error: 0.5222 on 47 degrees of freedom
Multiple R-squared: 0.394, Adjusted R-squared : 0.3167
F-statistic: 5.094 on 6 and 47 DF, *p*-value: 0.0004242

Supplementary Table 9| Minimum adequate multiple regression model selected using AIC of diversification rate with respect to geographic range change as measured using mean GCD of 10 samples and sampling proxies.

Residuals:

Min	1 Q	Median	3 Q	Max
-1.53222	-0.32494	-0.01966	0.32678	1.18370

Coefficients:

	Estimate	Std. Error	t value	*p*
(Intercept)	-6.091e-02	7.291e-02	-0.835	0.407444
range change (meanGCD *n*=10)	**1.748e-01**	**6.850e-02**	**2.552**	**0.013802***
sea level	**5.638e-03**	**2.429e-03**	**2.321**	**0.024431***
total range	**2.980e-09**	**8.520e-10**	**3.498**	**0.000993*****

Residual std. Error: 0.5095 on 50 degrees of freedom
Multiple R-squared: 0.3863, Adjusted R-squared : 0.3495
F-statistic: 10.49 on 3 and 50 DF, *p*-value: 1.832e-05

Supplementary Table 10| Summary table of pairwise Spearman Rank correlation coefficients (r_s) between extinction/origination rates (using method of Foote 2000) and the rate of geographic range size change. *significant at $p < 0.05$, **significant at $p < 0.01$, ***significant at $p < 0.001$.

	Origination rate	Extinction rate
Convex hull	-0.05	-0.22
MeanGCD *n*=5	-0.17	-0.08
MeanGCD *n*=10	-0.18	-0.06

Supplementary Note 1

Data download
Paleobiology Database search criteria:

Basic options
Taxonomic level = *genus*
Taxon or taxa to include = *Tetrapoda*
Oldest interval = *Induan*
Youngest interval = *Tithonian*
Included collections
Environments = *terrestrial* (and thus all lithologies and relevant environmental zones)
Continents or paleocontinents = *Modern*
Collection fields
Geographic fields = *country*; *latitude/longitude*(in decimal)
Time fields = *period*; *epoch*; *stage*
Stratigraphy fields = *formation*
Lithology fields = *environment*
Occurrence fields
Basic fields = *class name*; *order name*; *family name*; *abundance*

Classification of taxa

Aetosauria
Consists of family Stagonolepididae.

Archosauriformes ($data_1$ only)
Paraphyletic assemblage of basal Archosauriforme taxa that fall outside of the main groups of the Archosauria[1]; Doswelliidae, Erythrosuchidae, Proterosuchidae, Euparkeriidae, Proterochampsidae, Rhadinosuchidae, *Crosbysaurus*, *Protecovasaurus*, *Tecovasaurus*, *Vancleavea*, *Yongesuchus*, *Zanclodon*, *Graoullyodon*, *Lucianosaurus*, *Smok*. As it may be problematic to include paraphyletic groups in the analysis, a parallel set of tests ($data_2$) were also carried out with the basal Archosauriformes split into family-level groups:
Doswelliidae;
Erythrosuchidae;
Proterosuchidae;
Euparkeriidae;
Proterochampsidae;
Any basal Archosauriforme taxa that could not be assigned at the family level were omitted from the analysis.

Basal Cynodontia ($data_1$ only)
Paraphyletic assemblage of basal Cynodont taxa that fall outside of Cynognathia or Probainognathia[2]; Galesauridae, Thrinaxodontidae, *Platycraniellus*, *Candelariodon*, *Trucidocynodon*. None of the basal Cynodont families contain sufficient genera to be used as individual higher taxonomic groups in the $data_2$ analysis.

Crocodylomorpha
Atoposauridae, Goniopholididae, Hsisosuchidae, Protosuchidae, Saltoposuchidae, Shartegosuchidae, Sphenosuchidae, Stegomosuchidae, Teleosauridae, in addition to Erpetosuchidae and Gracilisuchus, that form a monophyletic group with the Crocodylomorpha in Brusatte *et al.*[1].

Cynognathia
Cynognathidae, Diademondontidae, Traversodontidae, Trirachodontidae.

Dicynodontia
Kannemeyeriidae, Kingoriidae, Lystrosauridae, Oudenodontidae, Shansiodontidae, Stahleckeriidae.

Dinosauromorpha ($data_1$ only)
Paraphyletic assemblage of basal Dinosauromorpha taxa that fall outside of the main groups of the Dinosauria[1]; Lagerpetidae, Silesauridae, *Marasuchus*, *Nyasasarus*, *Saltopus*, *Spondylosoma*. A parallel set of tests ($data_2$) were also carried out with the Dinosauromorphs split into family-level groups;

Lagerpetidae;
Silesauridae;

with taxa that could not be assigned at the family level omitted from the analysis.

Lissamphibia
Fossils of subclass Lissamphibia are rare in the Triassic-Jurassic fossil record and are therefore classified at a higher taxonomic rank to obtain a suitable sample size. Lissamphibians of orders Salientia, Caudata and Gymnphiona are all present in the data set.

Ornithischia
Ankylosauridae, Camptosauridae, Chaoyangsauridae, Dryosauridae, Fabrosauridae, Heterodontosauridae, Huayangosauridae, Hypsilophodontidae, Iguanodontidae, Lesothosauridae, Pachycephalosauridae, Pisanosauridae, Polacanthidae, Stegosauridae.

Ornithosuchia
Ornithosuchidae, in addition to *Revueltosaurus*, which form a monophyletic group in Brusatte *et al.*[1].

Phytosauria
Consisting of family Phytosauridae.

Poposauroidea
Monophyletic group of Ctenosauriscidae, Poposauridae, Shuvosauridae[1,3].

Probainognathia
Allodontidae, Amphidontidae, Amphilestidae, Brasilodontidae, Chiniquodontidae, Docodontidae, Dromatheriidae, Dryolestidae, Eleutherodontidae, Gobiconodontidae, Hahnotheriidae, Haramiyidae, Henosferidae, Kermackodontidae, Klemeliidae, Kuehneotheriidae, Lumkuiidae, Madysauridae, Megazostrodontidae, Morganucodontidae, Paulchoffatiidae, Paurodontidae, Peramuridae, Probainognathidae, Shuotheriidae, Simpsonodontidae, Sinoconodontidae, Tegotheriidae, Therioherpetidae, Theroteinidae, Tinodontidae, Triconodontidae, Trithelodontidae, Tritylodontidae, Woutersiidae.

Procolophonomorpha
Owenettidae, Procolophonidae, Sclerosauridae, *Sphodrosaurus*, *Xenodiphyodon*.

Protorosauria
Consisting of monophyletic assemblage of Protorosauridae, Drepanosauridae, Podopterygidae, Tanystropheidae[4].

Pterosauria

Anurognathidae, Dimorphonodontidae, Eudimorphodontidae, Germanodactylidae, Rhamphorhynchidae, Wukongopteridae, in addition to Scleromochlidae, which form a monophyletic group in Brusatte *et al.*[1].

Rauisuchoidea
Although some analysts regard what is referred to here as Rauisuchoidea as a paraphyletic assemblage[3], Brusatte *et al.*[1] identify the Rauisuchoidea as monophyletic and sister to the Poposauroidea.

Rhynchocephalia
Gephrysauridae, Sphenodontidae.

Rhynchosauria
Hyperodapedodontiae, Rhynchosauridae, *Mesosuchus* and *Howesia*.

Sauropodomorpha
Anchisauridae, Blikanasauridae, Brachiosauridae, Camarasauridae, Cetiosauridae, Dicraeosauridae, Diplodocidae, Euskelesauridae, Guaibasauridae, Haplocanthosauridae, Mamenchisauridae, Massospondylidae, Melanorosauridae, Plateosauridae, Riojasauridae, Thecodontosauridae, Titanosauridae, Vulcanodontidae, Yunnanosauridae.

Squamata
Bavariasauridae, Dorsetisauridae, Paramacellodidae.

Temnospondyli
Benthosuchidae, Brachyopidae, Capitosauridae, Heylerosauridae, Lapillopsidae, Lydekkerinidae, Mastondonosauridae, Metoposauridae, Paracyclotosauridae, Plagiosauridae, Rhytidosteidae, Sclerothoracidae, Stenotosauridae, Thoosuchidae, Trematosauridae.

Testudinata
Adocidae, Bashuchelyidae, Eurysternidae, Indochelyidae, Kayentachelyidae, Plesiochelyidae, Pleurosternidae, Proganochelidae, Sichuanchelyidae, Toxochelyidae, Xinjiangchelyidae.

Therocephalia
Bauriidae, Ericiolacertidae, Ictidosuchidae, Moschorhinidae, Regisauridae, Scaloposauridae.

Theropoda
Monophyletic (including avian taxa). Abelisauridae, Allosauridae, Ceratosauridae, Coelophysidae, Coeluridae, Compsognathidae, Dilophosauridae, Dromaeosauridae, Herrerasauridae, Megalosauridae, Metriacanthosauridae, Piatnitzkysauridae, Proceratosauridae, Protoavidae, Scansoriopterygidae, Therizinosauridae, Troodontidae.

Trilophosauria
Consisting of family Trilophosauridae.

Supplementary References

1 Brusatte, S. L., Benton, M. J., Desojo, J. B. & Langer, M. C. The higher-level phylogeny of Archosauria (Tetrapoda: Diapsida). *Journal of Systematic Palaeontology* **8**, 3-47, doi:10.1080/14772010903537732 (2010).

2 Ruta, M., Botha-Brink, J., Mitchell, S. A. & Benton, M. J. The radiation of cynodonts and the ground plan of mammalian morphological diversity. *Proceedings of the Royal Society B: Biological Sciences* **280**, doi:10.1098/rspb.2013.1865 (2013).

3 Nesbitt, S. J. The early evolution of Archosaurs: relationships and the origin of major clades. *Bulletin of the American Museum of Natural History*, 1-288 (2011).

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