Supplementary materials for:

Morphological selectivity of the Permian-Triassic ammonoid mass extinction

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Figure DR1. Ammonoid morphospaces and distances between centroids. *Otoceras concavum* and *Hypophiceras triviale* were grouped into Griesbachian. (A) Morphospaces of the Changhsingian and Griesbachian ammonoids. (B) The distribution of distances between the null hypothesis simulation 1 (random extinction

with 42 survivors) and Changhsingian centroid. The blue arrow is empirical distance between the centroids of the Changhsingian and Griesbachian species. (C) Morphospaces of the Changhsingian ammonoids, survivors and newcomers. (D) The distribution of distances between the null hypothesis simulation 2 (random extinction with 14 survivors) and Changhsingian centroid. The blue arrows are empirical distance between the centroids of the Changhsingian species and survivors. The white symbols are the centroid of each groups. The red lines indicate 95% quantile.

Figure DR2. Disparity of all Changhsingian species, survivors, newcomers and all Griesbachian species. *Otoceras concavum* and *Hypophiceras triviale* were grouped into Griesbachian. (A) Sum of variance. (B) Sum of range. Vertical bars indicate 95% confidence interval.

Table DR1. Data matrix of 22 characters for 127 studied ammonoids species.

	Species	Stage	Character code																						No.	Reference
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
1	<i>Abichites abichi</i> Shevrev, 1965	Changhsingian	1	1	3	2	0	1	0	0	0	0	1	1	0	2	2	1	0	1	0	0	0	0	MB.C.25389	Korn et al., 2016
2	<i>Abichites alibashiensis</i> Korn et al., 2016	Changhsingian	0	1	3	2	2	0	0	0	0	0	1	0	0	2	1	1	0	1	0	1	0	0	MB.C.25399, holotype	Korn et al., 2016
3	<i>Abichites ariaeii</i> Korn et al., 2016	Changhsingian	1	1	3	1	0	0	0	0	0	0	1	1	0	1	2	1	1	1	0	0	0	0	MB.C.25410, holotype	Korn et al., 2016
4	<i>Abichites paucinodus</i> Korn et al., 2016	Changhsingian	1	1	3	2	0	2	0	0	0	0	1	1	0	2	2	1	0	1	0	0	0	0	MB.C.25439, holotype	Korn et al., 2016
5	<i>Abichites shahriari</i> Korn et al., 2016	Changhsingian	1	1	3	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	MB.C.25445, holotype	Korn et al., 2016
6	<i>Abichites stoyanowi</i> Shevrev, 1965	Changhsingian	1	1	3	1	1	0	0	0	0	0	1	1	0	2	1	1	0	1	0	0	0	0	MB.C.25420	Korn et al., 2016
7	<i>Abichites subtrapezoidalis</i> Korn et al., 2016	Changhsingian	1	1	3	2	1	1	0	0	0	0	1	0	0	1	2	0	1	1	0	0	0	0	MB.C.25371, holotype	Korn et al., 2016
8	<i>Abichites terminalis</i> Korn et al., 2016	Changhsingian	1	1	3	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	MB.C.25447, holotype	Korn et al., 2016
9	<i>Alibashites ferdowsii</i> Korn et al., 2016	Changhsingian	1	2	3	2	2	0	0	0	0	0	1	1	0	2	2	1	1	1	0	1	0	0	MB.C.25327, holotype	Korn et al., 2016
10	<i>Alibashites mojsisovicsi</i> (Stoyanow, 1910)	Changhsingian	1	1	3	1	2	0	0	0	0	0	1	1	0	2	2	1	1	1	0	0	0	0	MB.C.25308	Korn et al., 2016
11	<i>Alibashites stepanovi</i> Korn et al., 2016	Changhsingian	1	0	3	1	2	1	0	0	0	0	1	1	0	2	2	0	1	1	0	0	0	0	MB.C.25345, holotype	Korn et al., 2016
12	<i>Alibashites uncinatus</i> Korn et al., 2016	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	1	0	2	1	1	1	1	1	0	0	0	MB.C.25335, holotype	Korn et al., 2016
13	<i>Arasella minuta</i> (Zakharov, 1983)	Changhsingian	1	0	3	2	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	MB.C.25462	Korn et al., 2016
14	<i>Araxocellites cristatus</i> Korn et al., 2019	Changhsingian	1	1	3	2	0	2	0	0	0	0	1	1	0	2	2	0	1	1	0	0	0	0	MB.C.22706, holotype	Korn et al., 2019
15	<i>Araxocellites laterocostatus</i> Korn et al., 2019	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	MB.C.29164, holotype	Korn et al., 2019
16	<i>Araxocellites sanestapanus</i> Korn et al., 2019	Changhsingian	1	0	3	2	2	0	0	0	0	0	1	1	0	1	1	1	0	1	1	0	0	0	MB.C.29156, holotype	Korn et al., 2019
17	<i>Changhsingoceras sichuanense</i>	Changhsingian	3	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	34356	Zhao et al., 1978
18	<i>Chaotianoceras minutum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	0	1	0	0	0	1	1	1	1	1	0	1	1	0	0	14955, holotype	Zhao et al., 1978
19	<i>Chaotianoceras modestum</i> Zhao, Liang et Zheng, 1979	Changhsingian	1	0	3	1	2	0	0	1	0	0	0	1	1	2	1	1	1	0	1	0	0	0	14950, holotype	Zhao et al., 1978
20	<i>Dushanoceras rotalarium</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	2	3	1	2	0	0	0	0	0	1	1	1	2	1	1	1	0	1	1	0	0	15000, holotype	Zhao et al., 1978
21	<i>Dzhulfites hebes</i> Korn et al., 2016	Changhsingian	1	1	3	2	2	0	0	0	0	1	0	0	0	1	0	2	0	0	1	1	0	0	MB.C.25181, holotype	Korn et al., 2016
22	<i>Dzhulfites zalensis</i> Korn et al., 2016	Changhsingian	1	1	2	2	2	0	0	0	0	0	1	0	0	2	0	0	0	0	1	1	0	0	MB.C.25176, holotype	Korn et al., 2016
23	<i>Iranites transcaucasicus</i> (Shevrev, 1965)	Changhsingian	1	0	3	2	2	0	0	0	1	0	0	0	0	3	1	1	1	1	0	0	0	0	MB.C.29149.1	Korn et al., 2019
24	<i>Julfotirolites kozuri</i> Korn et al., 2016	Changhsingian	1	1	3	1	2	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0	0	0	MB.C.25305, holotype	Korn et al., 2016
25	<i>Liuchengoceras minutum</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	2	2	0	0	1	0	0	0	0	1	0	0	0	1	0	1	1	0	0	14832, holotype	Zhao et al., 1978
26	<i>Meitianoceras paulum</i> Yang et Yang, 1992	Changhsingian	1	1	3	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	87015, holotype	Yang et Yang, 1992
27	<i>Meitianoceras sphaelobatum</i> Yang et Yang, 1992	Changhsingian	2	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	87007, holotype	Yang et Yang, 1992
28	<i>Mingyuexiaceras radiatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	14834, holotype	Zhao et al., 1978
29	<i>Neoaganides costatus</i> Yang et Yang, 1992	Changhsingian	4	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	87017, holotype	Yang et Yang, 1992
30	<i>Neoaganides laevigatus</i> Yang et Yang, 1992	Changhsingian	4	3	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	87024, holotype	Yang et Yang, 1992

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31	<i>Neoaganides ultimus</i> Korn et al., 2016	Changhsingian	3	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	MB.C.25169, holotype	Korn et al., 2016	
32	<i>Pachydiscoceras changhsingense</i> Chao et Liang	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	1	1	1	0	1	1	0	1	1	0	0	14986, holotype	Zhao et al., 1978	
33	<i>Pachydiscoceras flexoplicatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	1	0	0	0	1	1	2	1	1	1	0	1	1	0	0	14943, holotype	Zhao et al., 1978	
34	<i>Pachydiscoceras obesum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	0	0	14988, holotype	Zhao et al., 1978	
35	<i>Paratirolites birunii</i> Korn et al., 2016	Changhsingian	1	1	3	1	2	0	0	1	0	0	0	1	0	1	1	2	1	0	1	1	0	0	MB.C.25200, holotype	Korn et al., 2016	
36	<i>Paratirolites coronatus</i> Korn et al., 2016	Changhsingian	1	3	3	2	2	0	0	0	0	1	0	1	0	2	1	2	1	0	1	1	0	0	MB.C.25195, holotype	Korn et al., 2016	
37	<i>Paratirolites kittli</i> Stoyanow, 1910	Changhsingian	1	2	3	1	2	0	0	0	0	1	0	0	0	2	2	2	1	0	1	1	0	0	MB.C.25210	Korn et al., 2016	
38	<i>Paratirolites multiconus</i> Korn et al., 2016	Changhsingian	1	1	3	1	2	0	0	1	0	0	0	0	0	2	0	2	1	0	1	0	0	0	MB.C.25298, holotype	Korn et al., 2016	
39	<i>Paratirolites quadratus</i> Korn et al., 2016	Changhsingian	1	2	3	2	2	0	0	0	0	0	1	1	0	2	2	1	0	1	1	1	0	0	MB.C.25296, holotype	Korn et al., 2016	
40	<i>Paratirolites serus</i> Korn et al., 2016	Changhsingian	1	2	3	2	2	0	0	0	0	1	0	0	0	2	1	2	0	0	1	1	0	0	MB.C.25300, holotype	Korn et al., 2016	
41	<i>Paratirolites trapezoidalis</i> Shevrev, 1965	Changhsingian	1	2	3	1	2	0	0	0	0	0	1	1	0	2	1	2	1	0	1	1	0	0	MB.C.25185	Korn et al., 2016	
42	<i>Paratirolites vediensis</i> Shevrev, 1965	Changhsingian	1	2	3	1	2	0	0	0	0	1	0	0	0	2	1	2	0	0	1	1	0	0	MB.C.25264	Korn et al., 2016	
43	<i>Pentagonoceras attenuatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	1	0	0	1	0	0	0	0	1	1	1	2	0	0	1	1	0	0	14941, holotype	Zhao et al., 1978	
44	<i>Pentagonoceras chaotianense</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	1	0	0	0	1	1	1	1	2	1	1	0	0	0	0	14981, holotype	Zhao et al., 1978	
45	<i>Pentagonoceras costatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	1	0	0	0	0	1	1	0	2	1	0	1	1	0	0	14940, holotype	Zhao et al., 1978	
46	<i>Pentagonoceras guizhouense</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	1	0	0	0	0	1	2	1	2	0	0	1	1	0	0	14939, holotype	Zhao et al., 1978	
47	<i>Pentagonoceras spinosum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	2	3	2	2	0	0	1	0	0	0	0	1	1	1	2	0	0	1	1	0	0	14946, holotype	Zhao et al., 1978	
48	<i>Pentagonoceras? guangyuanense</i> Zhao, Liang et Zheng, 1978	Changhsingian	0	1	3	2	2	0	0	1	0	0	0	0	1	1	1	2	0	0	1	1	0	0	14942, holotype	Zhao et al., 1978	
49	<i>Pernodoceras robustum</i> Chao et Liang	Changhsingian	1	2	3	2	2	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	0	0	14989, holotype	Zhao et al., 1978	
50	<i>Pleuronodoceras multinodosum</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	1	2	0	0	1	0	0	0	1	1	1	0	1	0	1	0	0	0	0	14974, holotype	Zhao et al., 1978	
51	<i>Pleuronodoceras carinatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	2	1	1	0	0	1	0	0	0	1	1	1	1	1	0	1	0	0	0	0	14976, holotype	Zhao et al., 1978	
52	<i>Pleuronodoceras dayenense</i> Yang et Yang, 1992	Changhsingian	1	1	3	2	2	0	0	1	0	0	0	0	1	1	1	1	0	1	1	0	0	0	87045, holotype	Yang et Yang, 1992	
53	<i>Pleuronodoceras densiplicatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	1	1	0	0	1	0	0	0	0	1	1	1	1	0	1	0	0	0	0	14978	Zhao et al., 1978	
54	<i>Pleuronodoceras multinodosum</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	1	2	0	0	1	0	0	0	0	1	1	1	1	0	1	0	0	0	0	14974, holotype	Zhao et al., 1978	
55	<i>Pleuronodoceras radiatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	2	1	2	0	0	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	14977, holotype	Zhao et al., 1978	
56	<i>Pseudogastriceras guangxiense</i> Zhao, Liang et Zheng, 1978	Changhsingian	3	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	14812, holotype	Zhao et al., 1978
57	<i>Pseudogastriceras guizhouense</i> Zhao, Liang et Zheng, 1978	Changhsingian	3	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	14811, holotype	Zhao et al., 1978
58	<i>Pseudogastriceras szechuanense</i> Chao et Liang	Changhsingian	3	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	14814	Zhao et al., 1978
59	<i>Pseudostephanites costatus</i> Chao et Liang	Changhsingian	1	2	3	2	0	2	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	0	14841, holotype	Zhao et al., 1978	
60	<i>Pseudostephanites nodosus</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	2	3	2	0	2	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	0	14840	Zhao et al., 1978	
61	<i>Pseudotirolites acuticostatus</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	2	0	0	0	1	0	0	1	1	2	1	1	1	0	1	1	0	0	14935, holotype	Zhao et al., 1978	
62	<i>Pseudotirolites dislobatus</i> Zheng, 1981	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	0	0	34437, holotype	Zheng, 1981	
63	<i>Pseudotirolites orientalis</i> Chao et Liang	Changhsingian	1	1	2	2	2	0	0	1	0	0	0	1	1	1	1	2	1	0	1	1	0	0	14921, holotype	Zhao et al., 1978	

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64	<i>Pseudotriolites qinglongensis</i> Zheng, 1981	Changhsingian	1	2	3	2	2	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	0	34435, holotype	Zheng, 1981		
65	<i>Qinglongites compressus</i> Zheng, 1981	Changhsingian	4	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	34403, holotype	Zheng, 1981		
66	<i>Qinglongites costatus</i> Zheng, 1981	Changhsingian	4	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	34401, holotype	Zheng, 1981	
67	<i>Qinglongites curvatus</i> Zheng, 1981	Changhsingian	4	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	34399, holotype	Zheng, 1981	
68	<i>Qinglongites obesus</i> Zheng, 1981	Changhsingian	4	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	34405, holotype	Zheng, 1981	
69	<i>Rongjiangoceras lenticulare</i> Zhao, Liang et Zheng, 1978	Changhsingian	2	1	2	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	14829, holotype	Zhao et al., 1978	
70	<i>Rotodiscoceras hubeiense</i> Yang et Yang, 1992	Changhsingian	0	1	3	1	1	0	0	0	0	0	1	1	0	1	0	1	0	1	1	0	0	0	87046, holotype	Yang et Yang, 1992	
71	<i>Rotodiscoceras kwangsiense</i> (Chao et Liang)	Changhsingian	1	1	3	2	2	0	0	0	0	0	1	1	1	2	1	1	1	1	0	1	0	0	14971, holotype	Zhao et al., 1978	
72	<i>Rotodiscoceras langdaiense</i> Zheng, 1981	Changhsingian	2	1	2	2	2	0	0	1	0	0	0	1	1	2	0	1	1	0	1	1	0	0	34453, holotype	Zheng, 1981	
73	<i>Rotodiscoceras latilobatum</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	2	2	1	0	0	1	0	0	0	1	1	2	0	1	0	1	0	0	0	0	14967, holotype	Zhao et al., 1978	
74	<i>Sabaliceras wangrenense</i> Yang et Yang, 1992	Changhsingian	2	3	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	87040, holotype	Yang et Yang, 1992	
75	<i>Shevyrevites nodosus</i> (Shevrev, 1965)	Changhsingian	1	1	3	2	1	0	0	0	0	0	1	1	0	1	1	1	0	1	0	0	0	0	MB.C.29155	Korn et al., 2019	
76	<i>Shevyrevites shevyrevi</i> Teichert & Kummel, 1973	Changhsingian	1	0	4	2	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	MB.C.29153	Korn et al., 2019	
77	<i>Sinoceltites sichuanensis</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	1	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	14867, holotype	Zhao et al., 1978	
78	<i>Stacheoceras chaotianense</i> Zhao, Liang et Zheng, 1978	Changhsingian	3	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	14826, holotype	Zhao et al., 1978	
79	<i>Stoyanowites aspinosus</i> Korn et al., 2016	Changhsingian	0	0	3	1	0	0	0	0	0	0	0	1	0	2	1	1	1	1	0	0	0	0	MB.C.25458, holotype	Korn et al., 2016	
80	<i>Stoyanowites dieneri</i> (Stoyanow, 1910)	Changhsingian	1	0	4	1	1	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	0	MB.C.25451	Korn et al., 2016	
81	<i>Tapashanites chaotianensis</i> Zhao, Liang et Zheng, 1978	Changhsingian	1	1	3	2	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	14860, holotype	Zhao et al., 1978	
82	<i>Tapashanites floriformis</i> Chao et Liang, 1965	Changhsingian	1	1	2	2	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	14851, holotype	Zhao et al., 1978	
83	<i>Wangrenoceras rotalarium</i> Yang et Yang, 1992	Changhsingian	1	1	2	2	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	0	87048, holotype	Yang et Yang, 1992	
84	<i>Xenodiscus dorashamensis</i> Shevrev, 1965	Changhsingian	1	1	3	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	MB.C.29142.1	Korn et al., 2019	
85	<i>Phisonites triangulus</i> Shevrev, 1965	Changhsingian	1	1	3	0	0	0	0	0	0	1	0	0	0	0	2	0	0	2	0	1	0	0	MB.C.22703	Korn et al., 2019	
86	<i>Otoceras concavum</i> Tozer, 1967	Changhsingian/Griesbachian	2	2	1	0	0	0	0	1	0	0	0	0	1	2	2	0	0	2	0	1	0	0	YIG 921/164	Dagys and Ermakova, 1990	
87	<i>Hypophiceras triviale</i> (Spath, 1930)	Changhsingian/Griesbachian	1	0	3	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	pl. 6, fig. 2	Spath, 1935	
88	<i>Episageceras dalainamae</i> (Diener, 1897)	Griesbachian (Survivor)	3	1	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	1	0	0	pl. 1, fig. 6	Diener, 1897
89	<i>Otoceras woodwardi</i> Griesbach, 1880	Griesbachian (Survivor)	3	2	0	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	2	0	1	0	0	GSI 5928	Kummel, 1972
90	<i>Otoceras boreale</i> Spath, 1935	Griesbachian (Survivor)	3	2	1	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	2	0	1	0	0	GSC 28236	Tozer, 1994
91	<i>Otoceras gracile</i> Tozer, 1994	Griesbachian (Survivor)	3	1	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	1	0	1	0	0	GSC 28235	Tozer, 1994
92	<i>Hypophiceras gracile</i> (Spath, 1930)	Griesbachian (Survivor)	1	0	3	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	0	0	0	pl. 18, fig. 5	Spath, 1935
93	<i>Hypophiceras minimum</i> (Spath, 1935)	Griesbachian (Survivor)	1	1	3	1	0	0	0	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	0	pl. 8, fig. 3	Spath, 1935
94	<i>Hypophiceras minor</i> (Spath, 1930)	Griesbachian (Survivor)	1	1	3	1	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	0	0	0	0	pl. 1, fig. 4	Spath, 1935
95	<i>Metophiceras subdemissum</i> Spath, 1935	Griesbachian (Survivor)	1	0	4	1	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	0	0	0	0	pl. 2, fig. 1, holotype	Spath, 1930
96	<i>Metophiceras noe-nygaardi</i> Spath, 1935	Griesbachian (Survivor)	1	0	3	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0	0	0	0	pl. 8, fig. 4, holotype	Spath, 1935

Continued

97	<i>"Metophipiceras praecursor"</i> Spath, 1935	Griesbachian (Survivor)	1	0	3	1	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	pl. 1, fig. 7, holotype	Spath, 1935
98	<i>Tompophiceras extremum</i> (Spath, 1935)	Griesbachian (Survivor)	1	0	3	2	1	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	GSC 28040	Tozer, 1994
99	<i>Tompophiceras nielsenii</i> (Spath, 1935)	Griesbachian (Survivor)	0	0	4	2	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	pl. 5, fig. 2	Tozer, 1994
100	<i>Ophiceras greenlandicum</i> Spath, 1930	Griesbachian (Newcomer)	1	1	3	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	pl. 2, fig. 12, holotype	Spath, 1930
101	<i>Ophiceras subgibbosum</i> Spath, 1935	Griesbachian (Newcomer)	1	1	3	0	0	1	0	0	0	1	0	0	0	1	2	0	0	1	0	0	pl. 5, fig. 3, holotype	Spath, 1935
102	<i>Ophiceras commune</i> Spath, 1930	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	pl. 3, fig. 3, holotype	Spath, 1930
103	<i>Ophiceras tibeticum</i> Griesbach, 1880	Griesbachian (Newcomer)	1	1	3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	GSI 5969	Kummel, 1972
104	<i>Ophiceras medium</i> Griesbach, 1880	Griesbachian (Newcomer)	1	0	3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	GSI 5972	Kummel, 1972
105	<i>Ophiceras dubium</i> " Spath, 1935	Griesbachian (Newcomer)	2	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	1	0	pl. 14, fig. 5, holotype	Spath, 1935
106	<i>Aldanoceras tenue</i> Dagys et Ermakov, 1996	Griesbachian (Newcomer)	1	0	3	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	0	YIG 921/64	Dagys and Ermakova, 1990
107	<i>Anotoceras nala</i> Diener, 1897	Griesbachian (Newcomer)	0	3	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	1	GSI 5959	Kummel, 1972
108	<i>Discophiceras subkyotikum</i> (Spath, 1930)	Griesbachian (Newcomer)	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	pl. 6, fig. 7	Spath, 1930
109	<i>Vishnuites pralambha</i> Diener, 1897	Griesbachian (Newcomer)	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	GSI, 5950, holotype	Kummel, 1972
110	<i>Vishnuites kummeli</i> Tozer, 1994	Griesbachian (Newcomer)	2	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	GSC 33142, holotype	Tozer, 1994
111	<i>Vishnuites striatus</i> Spath, 1935	Griesbachian (Newcomer)	3	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	pl. 1, fig. 5, holotype	Spath, 1935
112	<i>Vishnuites oxynotus</i> Spath, 1935	Griesbachian (Newcomer)	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	pl. 3, fig. 5	Spath, 1935
113	<i>Wordieoceras wordiei</i> (Spath, 1930)	Griesbachian (Newcomer)	1	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	GSC 28060	Tozer, 1994
114	<i>Wordieoceras decipiens</i> (Spath, 1930)	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	pl. 3, figs. 2a, 2b, holotype	Spath, 1930
115	<i>Wordieoceras tompoense</i> Dagys and Ermakova, 1996	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	YIG 921/96, holotype	Dagys and Ermakova, 1990
116	<i>Jieshaniceras guizhouense</i> (Zakharov and Mu in Mu et al., 2007)	Griesbachian (Newcomer)	1	0	2	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	PIMUZ 26780	Brühwiler et al., 2008
117	<i>Mullericeras gujiaoense</i> Dai et al., 2019	Griesbachian (Newcomer)	3	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	YFMCUG 00018, holotype	Dai et al., 2019
118	<i>Pseudovishnuites guidingensis</i> (Zakharov and Mu in Mu et al., 2007)	Griesbachian (Newcomer)	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	NIGP139992, holotype	Mu et al., 2007
119	Gyronitidae gen. indet. sp. indet.	Griesbachian (Newcomer)	2	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	YFMCUG 00005	Dai et al., 2019
120	<i>Hubeitoceras yanjaensis</i> (Xu, 1988)	Griesbachian (Newcomer)	3	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	0	PIMUZ 26757	Brühwiler et al., 2008
121	<i>Bukkenites nitidus</i> Tozer, 1994	Griesbachian (Newcomer)	3	2	1	0	0	0	0	0	0	1	0	0	0	1	2	0	1	1	0	1	GSC 18896, holotype	Tozer, 1994
122	<i>Bukkenites strigatus</i> Tozer, 1994	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	1	GSC 28079	Tozer, 1994
123	<i>Bukkenites macilentus</i> Tozer, 1994	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	1	GSC 28080, holotype	Tozer, 1994
124	<i>Bukkenites incisus</i> Tozer, 1994	Griesbachian (Newcomer)	3	2	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	1	0	1	GSC 28082	Tozer, 1994
125	<i>Bukkenites nanus</i> Tozer, 1994	Griesbachian (Newcomer)	2	1	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	1	GSC 28075, holotype	Tozer, 1994
126	<i>Pseudoprotychites hiemalis</i> (Diener, 1895)	Griesbachian (Newcomer)	3	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	NSM PM23240	Shigeta et al., 2009
127	<i>Pachyprotychites otoceratoides</i> (Diener, 1895)	Griesbachian (Newcomer)	2	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	1	NSM PM23242	Shigeta et al., 2009

Table DR2. List of 22 shell characters for studied ammonoids.

No.	Definition	
1	H/D: <0.3 (0); 0.3~0.4 (1); 0.4~0.5 (2); 0.5~0.6 (3); >0.6 (4)	Geometry
2	W/D: <0.25 (0); 0.25~0.4 (1); 0.4~0.55 (2); 0.55~0.7 (3); >0.7 (4)	
3	U/D: <0.12 (0); 0.15~0.3 (1); 0.3~0.45 (2); 0.45~0.6 (3); >0.6 (4)	
4	Rib: absent (0); weak (1); strong (2)	Rib
5	Node on ventral-lateral shoulder: absent (0); weak (1); strong (2)	Node
6	Node on umbilical shoulder: absent (0); weak (1); strong (2)	
7	Sharp Venter: absent (0); present (1)	Venter
8	Angular venter: absent (0); present (1)	
9	Narrow rounded venter: absent (0); present (1)	
10	Rounded venter: absent (0); present (1)	
11	Tabulate venter: absent (0); present (1)	
12	Change in ventral shape through ontogeny: no (0); yes (1)	
13	Ventral keel: absent (0); present (1)	
14	Ventro-lateral (VL) shoulder shape: absent (0); rounded (1); angular (2)	Flank
15	Flank shape: convex (0); flattened (1); concave (2)	
16	Flank slope from umbilical shoulder to VL shoulder: convergent (0); parallel (1); divergent (2).	
17	Change in flank shape or slope through ontogeny: no (0); yes (1)	Umbilicus
18	Umbilical shoulder shape: absent (0); rounded (1); acute (2)	
19	Orientation of umbilical wall: vertical (0); slope (1)	
20	Depth of umbilicus: shallow (0); deep (1)	Constrictions
21	Constrictions: absent (0); present (1)	
22	Strigation: absent (0); present (1)	Strigation

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