

Supplementary Materials for

Middle-Late Triassic insect radiation revealed by diverse fossils and isotopic ages from China

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Supplementary Materials and Methods

Fig. S1. Photographs showing outcrops bearing Tongchuan and Karamay entomofaunas.

Table S1. Insect list of the Tongchuan entomofauna.

Table S2. U-Pb analytical results for samples from the Tongchuan outcrop.

References (67–80)

Supplementary Materials and Methods

Stratigraphic information

The Tongchuan Formation conformably underlies the Upper Triassic Yanchang Formation and overlies the Lower-Middle Triassic Ermaying Formation in the Tongchuan outcrop. The fossil-bearing layer of the Tongchuan Formation is a series of greyish green sandstones, interbedded with shale and mudstone (fig. S1a), yielding bivalves, spinicaudatans, ostracods, insects, tadpole shrimps, fishes, reptiles, chrysophyte cysts, sporopollen, and plants (67–69). Approximately 30 insect families in 11 orders, including Blattodea, Coleoptera, Diptera, Grylloblattida, Glosselytrodea, Hemiptera, Mecoptera, Miomoptera, Odonatoptera, Orthoptera, and Trichoptera, are herein recorded (table S1). The lower part of the Tongchuan Formation is considered to be Anisian-Ladinian in age, and the upper part is considered to be Carnian (this paper). It should be noted that there are some earlier studies of the insects from the same section (e.g., 70, 71); nearly all the earlier attributions, however, were questionable and the studied specimens are not accessible. Thus, we did not consider these earlier data but based on our collections.

The upper part of the Karamay Formation conformably underlies the Upper Triassic Baijiantan Formation and unconformably overlies the Paleozoic granite in the Huayuangou outcrop. The fossil-bearing layer of the Karamay Formation is composed of yellow mudstone (fig. S1b), yielding kazacharthrans, insects, sporopollen and plants (72). Approximately 10 insect families in six orders, including Blattaria, Coleoptera, Hemiptera, Mecoptera, Odonata, and Trichoptera, have been found. Based on diverse biostratigraphical work on both the surface and subsurface in the northwestern Junggar Basin, the age of the Karamay Formation is considered to be late

Middle to Late Triassic for the lower part, and Late Triassic for the upper part (72). The upper part is probably Carnian in age based on the megaspore fossils (72, 73).

Previous geochronology of the Tongchuan Formation

The Triassic in the Ordos Basin contains abundant tuff or tuffaceous sandstone, especially in the Middle Triassic Tongchuan Formation (74). In previous geochronological studies, some radioisotopic results were obtained from both surface and subsurface specimens (30, 75–77). Liu *et al.* (77) obtained a weighted mean age of 243.1 ± 3.9 Ma for the lower part of the Tongchuan Formation and ages of 234.6 ± 6.5 Ma to 238.6 ± 2.6 Ma for the upper part based on SHRIMP U-Pb dating of tuffs. However, the ages with a mean value of 234.6 ± 6.5 Ma are scattered and not concordant; consequently, they do not reliably represent the real depositional ages of the strata. The ages with a weighted mean of 238.6 ± 2.6 Ma are slightly concordant but also scattered. Zhang *et al.* (30) obtained an age range between 234.3 ± 2.8 Ma and 236.1 ± 2.7 Ma for the Chang-7 Member (upper part of the Tongchuan Formation; 79) using ICP-MS U-Pb dating on tuff samples, reflecting a Carnian age. Wang *et al.* (76) obtained a range of 241.3–239.7 Ma for the lower part of the Chang-7 Member based on using SHRIMP U-Pb analyses of two tuff samples. According to the data, these ages are concordant but scattered, and two concordant age ranges, 246–227 Ma and 246–229 Ma, were obtained for these samples. However, Wang *et al.* (76) subjectively selected the older age range of 241–239 Ma as the depositional age based on the assumption that the specimens were mixed with younger zircons. This explanation is obviously unreliable, and the absolute age of the tuff should be within the youngest range of 229–227 Ma, indicating a Late Triassic age (Carnian). Therefore, the previous dating actually indicates a Carnian age for the base of the upper part of the Tongchuan Formation.

Biostratigraphic age of the Tongchuan Formation

Recent paleontological work indicated a Middle–Late Triassic age for the Tongchuan Formation (69, 77). Deng *et al.* (77) identified the obvious differences in the sporopollen assemblages between the two parts of the Tongchuan Formation: the assemblage from the lower part resembles that from the Lower Triassic Zifang Formation, reflecting a Middle Triassic age, while the upper part bears abundant Late Triassic elements, which is consistent with other sporopollen results based on samples from different areas in the Ordos Basin (78–80). An early Late Triassic age for the upper part was also supported by the presence of the reptile *Yonghesuchus sangbiensis* (80). The Tongchuan entomofauna was recently considered to be Ladinian in age (69). In conclusion, paleontological evidence indicates a Middle Triassic age for the lower part of the Tongchuan Formation, and a Late Triassic age for the upper part.

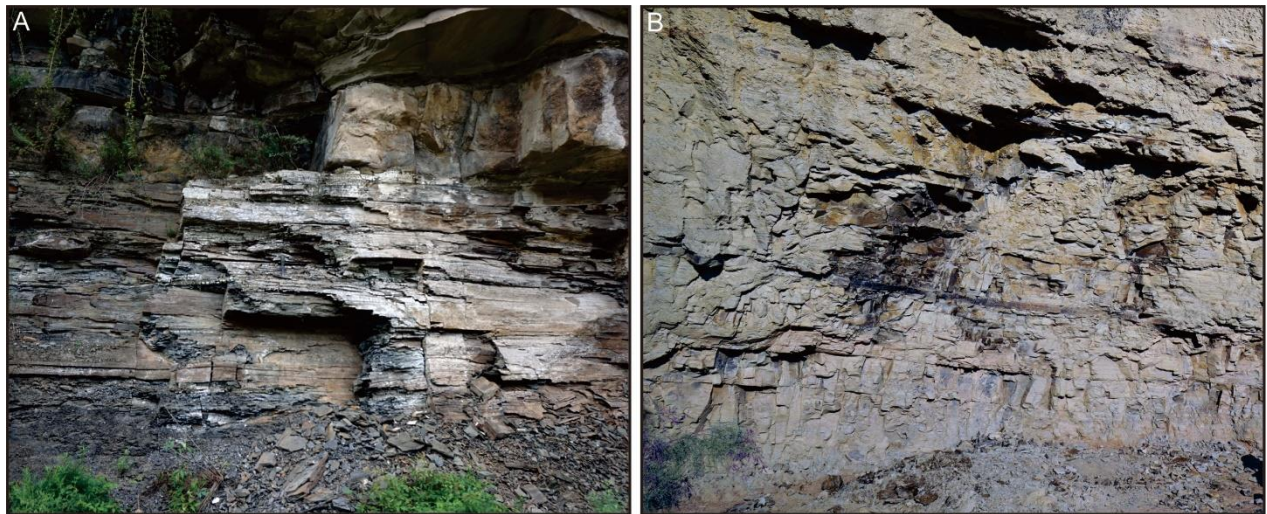


Fig. S1. Photographs showing outcrops bearing Tongchuan and Karamay entomofaunas.

Photo Credit: Daran Zheng, The University of Hong Kong

Table S1. Insect list of the Tongchuan entomofauna.

Order	Family
Odonatoptera	Zygophlebiidae
Blattodea	Mylacridae
Grylloblattida	Chaulioditidae
Orthoptera	Locustavidae
Hemiptera	Dracaphididae, Suriyokocixiidae, Curvicubitidae, Scytinopteridae, Ipsviciidae, Dunstaniidae, Hylicellidae, Progonocimicidae (Cicadocorinae)
Glosselytrodea	Jurinidae
Miomoptera	Permosialidae
Mecoptera	Mesopsychidae, Pseudopolycentropodidae, Parachoristidae, Thaumatomeropidae, Permochoristidae
Diptera	Vladipteridae
Trichoptera	Families uncertain (earliest caddisfly case)
Coleoptera	Cupedidae, Ademosynidae, Schizophoridae, Tricoleidae, Adephaga (families uncertain), Staphylinidae, other Polyphaga (families uncertain)

Table S2. U-Pb analytical results for samples from the Tongchuan outcrop.

Samples	Isotopic ratios						U-Pb Ages(Ma)						
	Th/U	$^{207}\text{Pb}/^{206}\text{Pb}$	$\pm 1\sigma$	$^{207}\text{Pb}/^{235}\text{U}$	$\pm 1\sigma$	$^{206}\text{Pb}/^{238}\text{U}$	$\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$	$\pm 1\sigma$	$^{207}\text{Pb}/^{235}\text{U}$	$\pm 1\sigma$	$^{206}\text{Pb}/^{238}\text{U}$	$\pm 1\sigma$
TC-01, gray-green tuffaceous sandstone													
91500	0.35052	0.07491	0.0002	1.85649	0.0089	0.17969	0.0007	1066	6	1066	3	1065	4
91500	0.34648	0.07509	0.0002	1.8583	0.0086	0.17949	0.0008	1072	6	1066	3	1064	4
91500	0.34383	0.07464	0.0002	1.83581	0.0097	0.17834	0.0008	1059	6	1058	3	1058	4
GJ	0.03289	0.05976	0.0001	0.81597	0.0048	0.099	0.0005	594	10	606	3	609	3
GJ	0.03309	0.05999	0.0002	0.81245	0.0041	0.09821	0.0005	611	6	604	2	604	3
NIST	0.98777	0.90425	0.0017	33.683	0.136	0.2701	0.0010			3601	4	1541	5
TC-01-1	0.83034	0.05246	0.0012	0.36302	0.0081	0.05018	0.0003	306	54	314	6	316	2
TC-01-2	0.70787	0.05118	0.0004	0.26423	0.0023	0.03745	0.0002	249	10	238	2	237	1
TC-01-3	1.02226	0.05328	0.0002	0.29243	0.0017	0.03983	0.0003	341	6	260	1	237	2
TC-01-4	0.62527	0.05234	0.0003	0.28215	0.002	0.0391	0.0002	300	7	252	2	247	1
TC-01-5	1.59265	0.05321	0.0003	0.29095	0.0018	0.03965	0.0002	338	7	259	1	251	1
TC-01-6	1.06092	0.10783	0.0014	4.42742	0.0514	0.29779	0.0015	1763	24	1717	10	1680	8
TC-01-7	0.59142	0.05163	0.0002	0.28702	0.0017	0.04031	0.0002	269	6	256	1	255	1
TC-01-8	0.7197	0.05144	0.0002	0.26535	0.0021	0.0374	0.0003	261	8	239	2	237	2

TC-01-9	0.96614	0.05444	0.0003	0.43422	0.0031	0.05783	0.0002	389	10	366	2	362	1
TC-01-10	0.73722	0.10916	0.0024	4.50988	0.0857	0.29964	0.0035	1785	41	1733	16	1690	17
TC-01-11	0.54098	0.0515	0.0012	0.27278	0.006	0.03841	0.0003	263	54	245	5	243	2
TC-01-12	1.31117	0.05239	0.0004	0.27767	0.0029	0.03844	0.0003	302	12	249	2	243	2
TC-01-13	1.39648	0.05861	0.0026	0.36145	0.0159	0.04472	0.0003	553	99	313	12	282	2
TC-01-14	0.30825	0.11469	0.0003	5.04023	0.0296	0.31863	0.0018	1875	5	1826	5	1783	9
TC-01-15	2.20103	0.06086	0.0004	0.33484	0.0024	0.03992	0.0002	634	8	293	2	252	1
91500	0.34222	0.07477	0.0003	1.84361	0.0102	0.17882	0.0008	1062	9	1061	4	1061	4
91500	0.35175	0.07499	0.0003	1.85679	0.0102	0.17952	0.0008	1133	7	1066	4	1064	4
GJ	0.02734	0.06005	0.0002	0.82076	0.0046	0.0991	0.0005	606	7	608	3	609	3
GJ	0.03293	0.06001	0.0002	0.81685	0.0039	0.09871	0.0004	606	6	606	2	607	2
TC-01-16	0.41546	0.14456	0.0025	3.0967	0.0458	0.15537	0.0013	2283	30	1432	11	931	7
TC-01-17	0.84557	0.05488	0.0003	0.2895	0.0023	0.03823	0.0002	407	10	258	2	242	1
TC-01-18	0.30206	0.16402	0.0005	9.8276	0.0556	0.43443	0.0023	2498	4	2419	5	2326	10
TC-01-19	0.94539	0.1646	0.0003	10.6517	0.0757	0.46918	0.0031	2503	5	2493	7	2480	14
TC-01-20	1.38182	0.10505	0.0016	4.13034	0.0587	0.28515	0.0014	1715	28	1660	12	1617	7
TC-01-21	0.56959	0.15187	0.0004	9.10984	0.0627	0.4348	0.0024	2367	5	2349	6	2327	11
TC-01-22	0.70594	0.18173	0.0005	5.49274	0.0251	0.21919	0.0012	2669	4	1899	4	1278	7

TC-01-23	0.54344	0.05532	0.0007	0.32088	0.0036	0.04209	0.0003	425	14	283	3	266	2
TC-01-24	0.68196	0.05208	0.0012	0.30309	0.0065	0.04221	0.0003	289	52	269	5	266	2
TC-01-25	0.66805	0.05315	0.0002	0.33843	0.0025	0.04619	0.0004	335	8	296	2	291	2
TC-01-26	0.64366	0.10194	0.0002	4.15029	0.0252	0.29508	0.0015	1660	5	1664	5	1667	7
TC-01-27	1.17478	0.05175	0.0005	0.27076	0.0026	0.03795	0.0002	274	11	243	2	240	1
TC-01-28	0.56847	0.05833	0.0004	0.37331	0.0026	0.04651	0.0004	542	7	322	2	293	2
TC-01-29	1.12458	0.05248	0.0005	0.29063	0.0033	0.04018	0.0003	306	13	259	3	254	2
TC-01-30	0.52436	0.10856	0.0004	5.02669	0.0355	0.33593	0.0025	1775	6	1824	6	1867	12
91500	0.34207	0.07478	0.0003	1.84947	0.0098	0.17935	0.0007	1063	9	1063	4	1063	4
91500	0.35191	0.07498	0.0003	1.85093	0.0104	0.17899	0.0008	1133	7	1064	4	1061	4
GJ	0.02818	0.06029	0.0002	0.81668	0.0039	0.09821	0.0003	613	7	606	2	604	2
GJ	0.0326	0.06034	0.0002	0.82136	0.0037	0.0987	0.0003	617	12	609	2	607	2
TC-01-31	0.8368	0.09849	0.0024	3.66022	0.0813	0.26955	0.0027	1596	47	1563	18	1538	14
TC-01-32	0.76627	0.05369	0.0003	0.34104	0.0033	0.04607	0.0004	358	10	298	3	290	2
TC-01-33	0.64298	0.05265	0.0003	0.32498	0.0027	0.04478	0.0003	314	8	286	2	282	2
TC-01-34	0.88099	0.10724	0.0004	4.62699	0.0415	0.31284	0.0026	1753	7	1754	7	1755	13
TC-01-35	0.74437	0.05218	0.0003	0.27567	0.0019	0.03831	0.0002	293	7	247	2	242	1
TC-01-36	0.74064	0.05377	0.0004	0.37679	0.0032	0.05082	0.0002	361	11	325	2	320	1

TC-01-37	0.35524	0.05633	0.001	0.31123	0.0051	0.04007	0.0002	465	38	275	4	253	1
TC-01-38	0.6481	0.14834	0.0016	6.44191	0.06	0.31496	0.0018	2327	19	2038	8	1765	9
TC-01-39	1.08716	0.05423	0.0008	0.34439	0.0034	0.04607	0.0006	381	13	300	3	290	3
TC-01-40	1.09438	0.05506	0.0005	0.311	0.0033	0.04096	0.0002	414	14	275	3	259	1
TC-01-41	0.99788	0.0555	0.0006	0.35831	0.0062	0.04678	0.0006	432	18	311	5	295	4
TC-01-42	0.56934	0.16778	0.0017	10.0292	0.0855	0.43354	0.0023	2536	17	2437	8	2322	10
TC-01-43	0.69691	0.05259	0.0002	0.32585	0.0024	0.04504	0.0004	311	9	286	2	284	2
TC-01-44	1.0225	0.05295	0.0004	0.29585	0.0023	0.04058	0.0003	327	8	263	2	256	2
TC-01-45	1.16842	0.05328	0.0003	0.34583	0.003	0.04721	0.0005	341	11	302	2	297	3
91500	0.33821	0.07485	0.0003	1.848	0.01	0.17904	0.0008	1065	7	1063	4	1062	5
91500	0.35609	0.07491	0.0003	1.8524	0.0105	0.1793	0.0008	1066	8	1064	4	1063	4
GJ	0.02981	0.06025	0.0002	0.81803	0.0035	0.09844	0.0003	613	7	607	2	605	2
GJ	0.03356	0.06015	0.0002	0.81357	0.0037	0.09807	0.0003	609	3	604	2	603	2
TC-01-46	1.2764	0.05094	0.0003	0.2628	0.0025	0.0374	0.0003	238	10	237	2	237	2
TC-01-47	1.29404	0.05189	0.0006	0.27263	0.0038	0.0381	0.0003	281	17	245	3	241	2
TC-01-48	0.53991	0.05401	0.0003	0.34325	0.0031	0.04609	0.0004	371	9	300	2	290	2
TC-01-49	0.7663	0.05683	0.0012	0.50682	0.0103	0.06468	0.0004	485	47	416	7	404	2
TC-01-50	0.8147	0.05307	0.0004	0.3328	0.0027	0.04548	0.0002	332	11	292	2	287	1

TC-01-51	1.03372	0.05134	0.0007	0.26448	0.0037	0.03739	0.0002	256	22	238	3	237	1
TC-01-52	1.50794	0.05274	0.0006	0.28009	0.0034	0.03853	0.0003	318	15	251	3	244	2
TC-01-53	1.15522	0.05147	0.0006	0.2656	0.003	0.03745	0.0003	262	14	239	2	237	2
TC-01-54	0.75423	0.05379	0.0003	0.33515	0.0023	0.04523	0.0004	362	8	293	2	285	2
TC-01-55	0.32003	0.05163	0.0003	0.28115	0.0022	0.03949	0.0002	269	9	252	2	250	1
TC-01-56	0.50285	0.16627	0.001	10.2352	0.0461	0.44645	0.0017	2520	10	2456	4	2379	7
TC-01-57	0.91898	0.11174	0.0015	4.66482	0.057	0.30278	0.0017	1828	25	1761	10	1705	8
TC-01-58	0.54876	0.05166	0.0003	0.31182	0.0031	0.04376	0.0003	270	10	276	2	276	2
TC-01-59	0.89102	0.07768	0.0005	0.42262	0.0038	0.03943	0.0002	1139	11	358	3	249	1
TC-01-60	0.55478	0.12096	0.0003	6.05067	0.041	0.36279	0.0025	1970	6	1983	6	1995	12
91500	0.34986	0.07467	0.0003	1.84725	0.0112	0.17939	0.0009	1061	6	1062	4	1064	5
91500	0.34403	0.07509	0.0002	1.85315	0.01	0.17895	0.0008	1072	6	1065	4	1061	4
GJ	0.02774	0.0601	0.0003	0.82044	0.006	0.09897	0.0004	606	13	608	3	608	2
GJ	0.02989	0.05988	0.0002	0.81595	0.0039	0.09881	0.0004	598	6	606	2	607	2
TC-01-61	0.84156	0.05303	0.0003	0.3444	0.0026	0.04709	0.0003	330	8	300	2	297	2
TC-01-62	1.18043	0.05147	0.0005	0.2664	0.0028	0.03753	0.0002	262	13	240	2	237	1
TC-01-63	0.60822	0.14112	0.0018	6.64541	0.0767	0.34152	0.0020	2241	23	2065	10	1894	10
TC-01-64	0.82624	0.05416	0.001	0.37459	0.0084	0.05011	0.0004	378	36	323	6	315	2

TC-01-65	0.4188	0.05185	0.0002	0.31191	0.0021	0.04362	0.0002	279	7	276	2	275	1
TC-01-66	0.1788	0.21316	0.058	10.1811	2.2553	0.3464	0.0548	2930	518	2451	205	1917	262
TC-01-67	0.73563	0.05482	0.0003	0.3777	0.0025	0.04997	0.0003	405	7	325	2	314	2
TC-01-68	1.52145	0.05537	0.0005	0.34652	0.0043	0.04534	0.0002	427	18	302	3	286	2
TC-01-69	0.92672	0.0528	0.0004	0.27663	0.0026	0.03799	0.0002	320	14	248	2	240	1
TC-01-70	0.61334	0.05942	0.0003	0.31341	0.0022	0.03828	0.0003	583	8	277	2	242	2
TC-01-71	0.71309	0.05253	0.0004	0.32614	0.0035	0.04505	0.0004	308	11	287	3	284	3
TC-01-72	0.40291	0.05245	0.001	0.32414	0.0052	0.04482	0.0004	305	42	285	4	283	2
TC-01-73	0.91965	0.05163	0.0008	0.30408	0.0056	0.0427	0.0004	269	25	270	4	270	2
TC-01-74	0.92075	0.12208	0.0003	5.85881	0.0303	0.34795	0.0016	1987	4	1955	4	1925	7
TC-01-75	0.7902	0.05163	0.0003	0.27463	0.0016	0.03859	0.0002	269	6	246	1	244	1
91500	0.34031	0.07498	0.0003	1.85426	0.0104	0.17934	0.0008	1133	7	1065	4	1063	4
91500	0.35379	0.07478	0.0002	1.84614	0.0109	0.179	0.0009	1063	38	1062	4	1062	5
GJ	0.02854	0.05997	0.0002	0.81533	0.004	0.09858	0.0004	611	7	605	2	606	2
GJ	0.03206	0.06018	0.0002	0.81743	0.0039	0.0985	0.0004	609	6	607	2	606	2
TC-01-76	0.4771	0.05749	0.0002	0.60185	0.0044	0.07594	0.0006	511	7	478	3	472	3
TC-01-77	1.3001	0.0527	0.0003	0.27284	0.0022	0.03755	0.0002	316	8	245	2	238	1
TC-01-78	0.496	0.05784	0.0003	0.63259	0.004	0.07931	0.0004	524	7	498	2	492	2

TC-01-79	0.82201	0.14711	0.0011	7.37743	0.0463	0.3637	0.0012	2313	13	2158	6	2000	6
TC-01-80	0.6918	0.0612	0.0002	0.78667	0.0042	0.09324	0.0006	646	6	589	2	575	3
TC-01-81	0.49367	0.05315	0.0007	0.30595	0.0036	0.04175	0.0002	335	30	271	3	264	1
TC-01-82	0.49116	0.05152	0.001	0.26586	0.0047	0.03743	0.0004	264	47	239	4	237	2
TC-01-83	0.99655	0.05781	0.0007	0.37334	0.005	0.04682	0.0003	522	18	322	4	295	2
TC-01-84	0.96782	0.15942	0.0003	10.0487	0.0529	0.45702	0.0024	2450	4	2439	5	2426	11
TC-01-85	0.91756	0.05177	0.001	0.30744	0.0064	0.04306	0.0003	275	35	272	5	272	2
TC-01-86	1.0209	0.05166	0.0002	0.27168	0.0017	0.03814	0.0002	270	7	244	1	241	1
TC-01-87	1.04168	0.05237	0.0002	0.2838	0.0024	0.03931	0.0003	301	9	254	2	249	2
TC-01-88	1.82917	0.05668	0.0007	0.30361	0.006	0.03859	0.0004	479	28	269	5	244	2
TC-01-89	0.81173	0.05392	0.0009	0.37964	0.0061	0.05107	0.0003	368	25	327	4	321	2
TC-01-90	1.17825	0.05221	0.0006	0.28188	0.0031	0.03915	0.0002	295	18	252	2	248	1
91500	0.35067	0.07505	0.0002	1.85392	0.0096	0.17911	0.0009	1070	6	1065	3	1062	5
91500	0.34325	0.07471	0.0002	1.84648	0.0087	0.17923	0.0007	1061	40	1062	3	1063	4
GJ	0.02855	0.06008	0.0002	0.82182	0.0037	0.09917	0.0004	606	1	609	2	610	2
GJ	0.03099	0.06005	0.0002	0.82101	0.0035	0.09913	0.0004	606	6	609	2	609	2
TC-01-91	0.53147	0.05067	0.0011	0.26888	0.0055	0.03848	0.0003	226	52	242	4	243	2
TC-01-92	1.0251	0.05177	0.0004	0.26873	0.0024	0.03765	0.0003	275	9	242	2	238	2

TC-01-93	1.0477	0.05325	0.0005	0.34191	0.0033	0.04657	0.0002	340	13	299	2	293	1
TC-01-94	0.98577	0.05146	0.0004	0.26531	0.0021	0.03739	0.0002	262	10	239	2	237	1
TC-01-95	1.86602	0.05217	0.0007	0.27074	0.0034	0.03763	0.0002	293	20	243	3	238	1
TC-01-96	1.25619	0.05104	0.0019	0.28558	0.0106	0.04058	0.0004	243	90	255	8	256	2
TC-01-97	0.91214	0.05139	0.0016	0.27436	0.0081	0.03872	0.0003	258	72	246	6	245	2
TC-01-98	1.23296	0.07209	0.0098	0.30058	0.0407	0.03024	0.0004	989	293	267	32	192	3
TC-01-99	0.82277	0.14338	0.0019	2.64022	0.032	0.13355	0.0007	2268	23	1312	9	808	4
TC-01-100	0.91407	0.06089	0.0017	0.31928	0.0089	0.03803	0.0002	636	62	281	7	241	1
91500	0.331	0.07497	0.0003	1.8518	0.0098	0.17909	0.0007	1133	7	1064	3	1062	4
91500	0.35897	0.07467	0.0002	1.84633	0.0101	0.17929	0.0009	1061	6	1062	4	1063	5
91500	0.35204	0.07499	0.0002	1.85246	0.0085	0.17914	0.0007	1133	6	1064	3	1062	4
GJ	0.02937	0.06008	0.0002	0.83287	0.0055	0.10052	0.0006	606	8	615	3	617	3
GJ	0.02786	0.06012	0.0003	0.83536	0.0082	0.10075	0.0009	609	13	617	5	619	5
NIST	0.98824	0.90256	0.0069	33.575	0.4388	0.26974	0.0031			3598	13	1539	16

TC-02, gray-green tuffaceous sandstone

91500	0.33294	0.07507	0.0002	1.85121	0.0093	0.1788	0.0007	1072	6	1064	3	1060	4
91500	0.35568	0.0747	0.0002	1.84415	0.0091	0.17902	0.0008	1061	5	1061	3	1062	4
91500	0.35305	0.07487	0.0002	1.85524	0.0088	0.17968	0.0007	1065	4	1065	3	1065	4

GJ	0.02957	0.06002	0.0001	0.83231	0.0034	0.10056	0.0004	606	6	615	2	618	2
GJ	0.02806	0.06009	0.0001	0.83326	0.0035	0.10055	0.0004	606	1	615	2	618	2
NIST	0.99312	0.90173	0.0015	33.5306	0.1209	0.26965	0.0009			3596	4	1539	5
TC-02-1	0.80336	0.05129	0.0002	0.26579	0.0018	0.03757	0.0002	254	7	239	1	238	1
TC-02-2	1.05289	0.15386	0.0004	4.95855	0.0206	0.23369	0.0008	2389	3	1812	4	1354	4
TC-02-3	0.49028	0.05159	0.0002	0.2679	0.0016	0.03766	0.0002	267	6	241	1	238	1
TC-02-4	0.55871	0.105	0.0017	4.40766	0.059	0.30445	0.0027	1714	30	1714	11	1713	13
TC-02-5	0.96037	0.05321	0.0004	0.28011	0.0023	0.03817	0.0002	338	12	251	2	242	1
TC-02-6	0.6749	0.10739	0.0015	4.34054	0.0521	0.29315	0.0021	1756	26	1701	10	1657	10
TC-02-7	0.82493	0.05245	0.0003	0.33253	0.0022	0.04599	0.0003	305	7	291	2	290	2
TC-02-8	0.80397	0.05211	0.0002	0.26974	0.0017	0.03753	0.0002	290	6	242	1	238	1
TC-02-9	1.12169	0.05203	0.0003	0.26867	0.002	0.03745	0.0002	287	9	242	2	237	1
TC-02-10	1.24707	0.05228	0.0007	0.27208	0.0043	0.03774	0.0003	298	23	244	3	239	2
TC-02-11	0.52561	0.05222	0.0008	0.29644	0.0043	0.04117	0.0003	295	37	264	3	260	2
TC-02-12	0.83069	0.05492	0.0008	0.2846	0.0045	0.03755	0.0002	409	27	254	4	238	1
TC-02-13	0.43635	0.11427	0.0002	5.09848	0.038	0.32359	0.0025	1868	6	1836	6	1807	12
TC-02-14	0.67332	0.10712	0.0002	4.56389	0.0268	0.30897	0.0017	1751	5	1743	5	1736	8
TC-02-15	1.3291	0.05458	0.0002	0.2825	0.0014	0.03756	0.0002	395	5	253	1	238	1

91500	0.34449	0.0748	0.0002	1.85563	0.0094	0.17987	0.0007	1065	38	1065	3	1066	4
91500	0.34938	0.07496	0.0002	1.84477	0.0093	0.17847	0.0007	1133	6	1062	3	1059	4
GJ	0.02735	0.05998	0.0001	0.82627	0.0046	0.0999	0.0005	611	6	612	3	614	3
GJ	0.03309	0.06018	0.0001	0.82855	0.0034	0.09985	0.0003	609	6	613	2	614	2
TC-02-16	0.35891	0.17942	0.0004	12.3479	0.0599	0.49907	0.0023	2648	4	2631	5	2610	10
TC-02-17	0.46543	0.09245	0.0008	0.89785	0.0093	0.07045	0.0006	1477	9	651	5	439	4
TC-02-18	0.88913	0.05236	0.0005	0.33783	0.0032	0.04682	0.0003	301	11	296	2	295	2
TC-02-19	0.97485	0.05348	0.0005	0.283	0.0026	0.03843	0.0002	349	11	253	2	243	1
TC-02-20	0.36359	0.0515	0.0007	0.26587	0.0031	0.03744	0.0002	263	31	239	2	237	1
TC-02-21	0.61372	0.16412	0.0003	10.269	0.0507	0.45369	0.0020	2499	4	2459	5	2412	9
TC-02-22	1.00738	0.1044	0.0002	4.37998	0.0222	0.30428	0.0015	1704	4	1709	4	1712	7
TC-02-23	0.94662	0.10802	0.0002	4.83946	0.0261	0.32496	0.0018	1766	5	1792	5	1814	9
TC-02-24	0.74002	0.05131	0.0002	0.26536	0.0017	0.03751	0.0002	255	7	239	1	237	1
TC-02-25	0.68653	0.05204	0.0002	0.30058	0.0014	0.0419	0.0002	287	5	267	1	265	1
TC-02-26	1.35716	0.05268	0.0005	0.29459	0.0046	0.04056	0.0006	315	16	262	4	256	3
TC-02-27	0.58499	0.10416	0.0003	4.34018	0.0262	0.30217	0.0017	1700	5	1701	5	1702	8
TC-02-28	1.08872	0.11152	0.0003	4.97428	0.0319	0.32339	0.0019	1824	5	1815	5	1806	9
TC-02-29	0.3929	0.05138	0.0002	0.28573	0.0018	0.04033	0.0002	258	7	255	1	255	1

TC-02-30	0.92644	0.05208	0.0003	0.3457	0.0038	0.04813	0.0005	289	11	301	3	303	3
91500	0.33419	0.07493	0.0003	1.85286	0.0096	0.17931	0.0007	1066	6	1064	3	1063	4
91500	0.36066	0.07483	0.0002	1.84754	0.0096	0.17903	0.0008	1065	6	1063	3	1062	4
GJ	0.02807	0.05958	0.0002	0.81808	0.0042	0.09957	0.0005	587	6	607	2	612	3
GJ	0.03302	0.05981	0.0001	0.80993	0.0037	0.0982	0.0004	598	10	602	2	604	2
TC-02-31	0.79694	0.05272	0.0017	0.27613	0.0084	0.03799	0.0003	317	73	248	7	240	2
TC-02-32	0.92837	0.10698	0.0004	4.63188	0.0372	0.3141	0.0025	1749	7	1755	7	1761	12
TC-02-33	0.26738	0.13787	0.0005	7.82873	0.1186	0.41107	0.0050	2201	12	2212	14	2220	23
TC-02-34	0.7949	0.0521	0.0003	0.27772	0.0019	0.03867	0.0002	290	7	249	1	245	1
TC-02-35	1.05464	0.05323	0.0003	0.32798	0.0025	0.0447	0.0003	339	8	288	2	282	2
TC-02-36	1.30552	0.1079	0.003	4.35963	0.1151	0.29303	0.0027	1764	52	1705	22	1657	13
TC-02-37	0.71311	0.11226	0.0003	4.92844	0.0383	0.31834	0.0023	1836	6	1807	7	1782	11
TC-02-38	0.6802	0.05215	0.0003	0.27639	0.0036	0.03843	0.0004	292	13	248	3	243	3
TC-02-39	0.81876	0.11578	0.0017	5.23399	0.068	0.32786	0.0021	1892	27	1858	11	1828	10
TC-02-40	0.56047	0.10503	0.0016	4.37066	0.0576	0.30181	0.0024	1715	29	1707	11	1700	12
TC-02-41	1.71003	0.0514	0.0005	0.26564	0.0034	0.03745	0.0003	259	18	239	3	237	2
TC-02-42	0.79398	0.05196	0.0004	0.27384	0.0029	0.03823	0.0004	284	11	246	2	242	2
TC-02-43	0.71519	0.05248	0.0006	0.28011	0.0035	0.03873	0.0003	306	15	251	3	245	2

TC-02-44	0.67297	0.10652	0.0005	4.80949	0.0531	0.32744	0.0033	1741	9	1787	9	1826	16
TC-02-45	0.45879	0.05276	0.0003	0.33483	0.0036	0.04605	0.0005	318	11	293	3	290	3
91500	0.33338	0.07472	0.0005	1.85022	0.0181	0.17959	0.0012	1061	10	1064	6	1065	6
91500	0.36161	0.07504	0.0005	1.85018	0.0174	0.17875	0.0011	1069	13	1063	6	1060	6
GJ	0.03339	0.06027	0.0002	0.80663	0.0052	0.09706	0.0005	613	7	601	3	597	3
GJ	0.02772	0.06016	0.0002	0.80156	0.0051	0.09662	0.0005	609	3	598	3	595	3
TC-02-46	0.40169	0.164	0.0006	9.45364	0.0721	0.418	0.0027	2497	6	2383	7	2251	12
TC-02-47	1.32372	0.05288	0.0008	0.34506	0.0048	0.04736	0.0004	324	18	301	4	298	2
TC-02-48	0.89328	0.05199	0.0006	0.26955	0.0036	0.0376	0.0003	285	18	242	3	238	2
TC-02-49	0.88653	0.05163	0.0005	0.28877	0.0026	0.04058	0.0003	269	10	258	2	256	2
TC-02-50	1.12826	0.05146	0.0003	0.26545	0.0026	0.03743	0.0004	262	10	239	2	237	2
TC-02-51	0.47059	0.05273	0.0003	0.34104	0.0033	0.04692	0.0004	317	10	298	3	296	2
TC-02-52	0.92545	0.05231	0.0008	0.27422	0.0043	0.03803	0.0003	299	23	246	3	241	2
TC-02-53	0.76819	0.16914	0.0004	11.5001	0.1115	0.49302	0.0046	2549	7	2565	9	2584	20
TC-02-54	1.29976	0.06126	0.0003	0.3109	0.0019	0.03681	0.0002	648	6	275	1	233	1
TC-02-55	0.78767	0.05228	0.0004	0.33067	0.0031	0.04588	0.0002	298	12	290	2	289	2
TC-02-56	0.6798	0.16954	0.0003	12.1758	0.1286	0.52079	0.0054	2553	8	2618	10	2703	23
TC-02-57	0.55797	0.12174	0.0003	6.10376	0.0533	0.36358	0.0031	1982	7	1991	8	1999	15

TC-02-58	1.12127	0.05197	0.0003	0.2891	0.0023	0.04039	0.0004	284	9	258	2	255	2
TC-02-59	1.64925	0.05139	0.0004	0.28722	0.0022	0.04054	0.0002	258	9	256	2	256	1
TC-02-60	0.65005	0.05127	0.0002	0.26507	0.0025	0.03749	0.0003	253	10	239	2	237	2
91500	0.34768	0.07469	0.0002	1.84913	0.0111	0.17952	0.0009	1061	6	1063	4	1064	5
91500	0.34617	0.07507	0.0003	1.85127	0.0105	0.17882	0.0007	1072	9	1064	4	1061	4
GJ	0.02779	0.05978	0.0001	0.81672	0.0047	0.09905	0.0005	594	10	606	3	609	3
GJ	0.03162	0.05982	0.0002	0.81702	0.0036	0.09905	0.0004	598	10	606	2	609	2
TC-02-61	0.88782	0.05385	0.0006	0.30161	0.0033	0.04063	0.0002	365	15	268	3	257	1
TC-02-62	1.50852	0.05099	0.0006	0.26822	0.0035	0.03814	0.0003	241	18	241	3	241	2
TC-02-63	1.54795	0.05526	0.0003	0.31919	0.0021	0.04189	0.0001	423	9	281	2	265	1
TC-02-64	0.69326	0.0528	0.0005	0.34632	0.0037	0.04762	0.0004	320	11	302	3	300	2
TC-02-65	1.1563	0.05152	0.0007	0.27704	0.0034	0.03913	0.0004	264	13	248	3	247	2
TC-02-66	1.27575	0.05244	0.0009	0.27481	0.0056	0.03796	0.0003	305	32	247	4	240	2
TC-02-67	0.78159	0.05106	0.0005	0.28758	0.0032	0.04085	0.0003	244	15	257	3	258	2
TC-02-68	0.83408	0.1066	0.0005	4.44393	0.0406	0.30225	0.0024	1742	7	1721	8	1702	12
TC-02-69	0.53115	0.05572	0.0013	0.29008	0.0062	0.03776	0.0004	441	54	259	5	239	2
TC-02-70	0.70862	0.05614	0.0013	0.29653	0.0068	0.03831	0.0002	458	53	264	5	242	1
TC-02-71	0.25881	0.0508	0.0006	0.26516	0.003	0.03786	0.0002	232	29	239	2	240	1

TC-02-72	0.26181	0.06164	0.0008	0.68972	0.0077	0.08116	0.0004	662	27	533	5	503	2
TC-02-73	0.63098	0.11485	0.0003	5.07736	0.0391	0.32052	0.0022	1878	6	1832	7	1792	11
TC-02-74	1.2708	0.05186	0.0005	0.27003	0.0026	0.03779	0.0003	279	11	243	2	239	2
TC-02-75	0.96508	0.05269	0.0005	0.35458	0.0029	0.04882	0.0003	316	10	308	2	307	2
91500	0.3497	0.07492	0.0002	1.85438	0.0112	0.17948	0.0009	1066	6	1065	4	1064	5
91500	0.34419	0.07484	0.0002	1.84602	0.0103	0.17886	0.0009	1065	7	1062	4	1061	5
GJ	0.02668	0.05985	0.0001	0.81779	0.0051	0.09908	0.0006	598	8	607	3	609	3
GJ	0.03172	0.05978	0.0002	0.81375	0.0038	0.09871	0.0004	594	10	605	2	607	2
TC-02-76	0.85757	0.1067	0.0002	4.50589	0.0332	0.3061	0.0021	1744	6	1732	6	1722	10
TC-02-77	0.85728	0.05226	0.0004	0.29096	0.0021	0.04038	0.0002	297	9	259	2	255	1
TC-02-78	1.08274	0.05261	0.0022	0.32237	0.0133	0.04444	0.0005	312	99	284	10	280	3
TC-02-79	0.37881	0.11272	0.0002	5.12804	0.0313	0.32989	0.0020	1844	5	1841	5	1838	10
TC-02-80	1.28971	0.05208	0.0005	0.27392	0.003	0.03814	0.0002	289	17	246	2	241	1
TC-02-81	0.74402	0.05198	0.0005	0.29016	0.0029	0.04048	0.0002	284	16	259	2	256	1
TC-02-82	1.94217	0.10543	0.0003	4.12783	0.0167	0.2839	0.0009	1722	3	1660	3	1611	4
TC-02-83	1.11699	0.05161	0.0005	0.26768	0.0033	0.0376	0.0003	268	14	241	3	238	2
TC-02-84	1.21065	0.05236	0.0017	0.30369	0.0094	0.04207	0.0003	301	75	269	7	266	2
TC-02-85	1.23895	0.04605	0.0086	0.24279	0.0448	0.03824	0.0007		318	221	37	242	4

TC-02-86	1.4984	0.17025	0.0005	10.7125	0.057	0.45627	0.0021	2560	4	2499	5	2423	9
TC-02-87	1.09581	0.05238	0.0003	0.27361	0.0025	0.0379	0.0003	302	9	246	2	240	2
TC-02-88	0.81266	0.05242	0.0004	0.32477	0.0036	0.04493	0.0004	304	12	286	3	283	2
TC-02-89	0.9711	0.05713	0.0004	0.36659	0.0033	0.04656	0.0003	497	9	317	2	293	2
TC-02-90	0.43692	0.05258	0.0004	0.32271	0.0038	0.04454	0.0004	311	12	284	3	281	3
91500	0.35047	0.0746	0.0003	1.84649	0.0113	0.17946	0.0009	1057	7	1062	4	1064	5
91500	0.34344	0.07516	0.0003	1.85391	0.0098	0.17888	0.0007	1072	7	1065	3	1061	4
GJ	0.02727	0.06033	0.0002	0.82555	0.0046	0.09922	0.0005	617	6	611	3	610	3
GJ	0.03307	0.06004	0.0002	0.81347	0.0038	0.09826	0.0004	606	6	604	2	604	2
TC-02-91	1.03771	0.06297	0.0027	0.53648	0.0227	0.06179	0.0003	707	93	436	15	387	2
TC-02-92	1.03248	0.05803	0.0026	0.30241	0.0128	0.0378	0.0005	531	99	268	10	239	3
TC-02-93	1.00115	0.05253	0.0004	0.33902	0.003	0.04681	0.0003	308	11	296	2	295	2
TC-02-94	1.47785	0.10942	0.0007	4.54461	0.0701	0.30069	0.0034	1790	14	1739	13	1695	17
TC-02-95	0.53531	0.1691	0.0004	10.8285	0.0602	0.46427	0.0022	2549	4	2509	5	2458	10
TC-02-96	1.06526	0.07926	0.0009	0.28015	0.0036	0.02564	0.0002	1179	13	251	3	163	1
TC-02-97	1.11783	0.05178	0.0006	0.2676	0.004	0.03745	0.0003	276	22	241	3	237	2
TC-02-98	0.77641	0.05174	0.0003	0.26775	0.002	0.03753	0.0003	274	8	241	2	238	2
TC-02-99	0.45808	0.11525	0.0003	5.55394	0.048	0.34942	0.0030	1884	7	1909	7	1932	14

TC-02-100	1.07014	0.05162	0.0018	0.26773	0.009	0.03762	0.0003	269	81	241	7	238	2
91500	0.33431	0.07523	0.0003	1.86179	0.0103	0.17945	0.0009	1076	-26	1068	4	1064	5
91500	0.35677	0.07469	0.0003	1.84117	0.0098	0.17875	0.0008	1061	40	1060	4	1060	4
91500	0.35047	0.07472	0.0003	1.84764	0.0102	0.17932	0.0008	1061	8	1063	4	1063	4
GJ	0.02746	0.06014	0.0003	0.82106	0.0064	0.09897	0.0007	609	11	609	4	608	4
GJ	0.03256	0.06003	0.0005	0.81061	0.0086	0.09791	0.0009	606	17	603	5	602	5
NIST	0.78823	0.89823	0.0225	0.14755	20.068	0.00119	0.1572			140		8	
