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Research Advances

LA–ICP–MS U–Pb Geochronology of Detrital Zircon in the Guanzhong Basin, China and Its Tectonic Response

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Objective

The Guanzhong Basin in the transitional zone of the Qinling orogenic belt and the southern margin of the Ordos Basin has been extensively studied in recent years. Although some results have been obtained, some problems such as whether the materials from the North China craton and the Qinling orogenic belt are detrital sedimentary rocks of the Guanzhong Basin still remain unresolved. Detrital sedimentary rocks contain information about the source area; therefore, studying these rocks can enable the analysis of the key geological concerns about the area. In particular, the unique information provided by the zircon U-Pb ages of the detrital sedimentary rocks is required to further examine the timing and tectonic significance of detrital zircon U-Pb geochronology in the Guanzhong Basin.

Methods

The tested and analyzed zircon samples from the Guanzhong Basin were collected from the Cretaceous–Tertiary sandstones in the basin. In the late 1980s, laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) test technology was developed based on ICP-MS combined with laser sampling methods (Ding Lixue et al., 2010; Yang Hua et al., 2014; Gong Xuejing et al., 2017). The basic principle of this technology is to ablate and gasify the sample surface using a focused laser micro beam, transport sample particles to a plasma mass spectrometer for ionization using a carrier gas, filter the sample using a mass spectrometry system, and detect ions with different charge-mass ratios using a receiver.

Results

The sample mineral compositions and structures were first observed using a microscope, and the samples that exhibited no ablation, alteration, or weathering were selected for further analysis. Approximately 200particles were randomly selected, fixed with epoxy resin, and polished to the middle of the detrital crystals, thereby leaving the crystal exposed on the surface. The shape and internal structure of each sample were observed via the reflective transmission light of an optical microscope. The fine structures of the samples were further observed under cathode luminescence. These procedures were performed in the electron microscope and scanning electron microscope laboratories of the geological mineralization and indicating mines key laboratory of the Ministry of Land and Resources. After combining the images of detrital zircon obtained using transmitted light, reflected light, and cathode luminescence images, including dark cathode luminescence, an optimized selection was conducted to ensure that the flat areas had no inclusions or fractures. In general, dark areas in cathode luminescence images have high U contents; this is beneficial for obtaining accurate data and ages. However, radioactively damaged areas, such as the LA-ICP-MS test points, should not be used (Appendix 1).

The point denudation sampling method used for the detrital zircon U-Pb isotope analysis is explained as follows. A single PHA standard sample was used for every six unknown measuring points. Each measured point was analyzed for 60 s, which included 10s for the background signal collection, 40s for laser ablation and sampling, and 10s to flush the sample pool and line.

Sandstones belonging to the detrital sedimentary rocks were analyzed herein. Most detrital sedimentary rocks are gray to dark gray; have medium- to fine-sized grains; and contain quartz, plagioclase, orthoclase, white mica, black mica, and cuttings, which are primarily observed to be metamorphic and sedimentary rocks. Opaque minerals, such as apatite and zircon, are the main accessory minerals of sandstones.

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In this study, three measurement points on each zircon sample obtained from the Guanzhong Basin were analyzed to date and assess the structural significance of the detrital zircons. For these points, the $^{207}Pb/^{206}Pb$ single-point test error (l-sigma error percentage) ranged from 0.79% to 7.3%, with an average error of 0.84%. In the zircon samples of the detrital rocks, the long axis grain diameters ranged from 40 to 100 μm and were translucent. The oscillatory stripe of the cathode luminescence image clearly depicts the genesis of the magma.

Conclusions

LA-ICP-MS was used to analyze 180 (including 115 concordant points) zircon grain samples. Fig.1 depicts the age distribution of all the concordant points on the $^{206}Pb/^{238}U$–$^{207}Pb/^{235}U$ concordant diagram. A single-point accuracy >5% was observed. According to the age error of $^{206}Pb/^{238}U$–$^{207}Pb/^{206}Pb$ (whichever was less), an age histogram and a probability density distribution of these sample points were obtained.

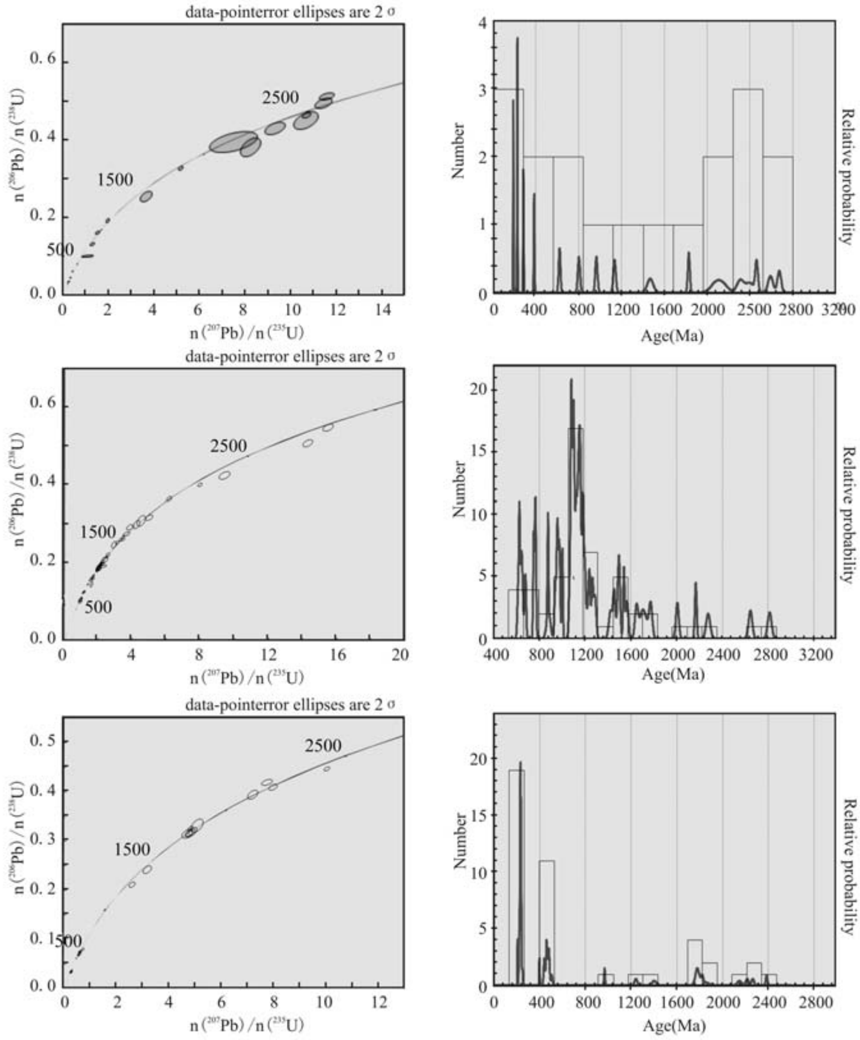

Fig. 1. Concordia plots and a histogram of the detrital zircon U-Pb dating of selected samples in the Guanzhong Basin.

The results show that the age spectra of the zircons can be divided into four groups: 174–259, 281–503, 617–1197, and 1218–2868 Ma. Based on the age of the zircon features combined with the results of a previous study, the sandstones most likely originated primarily from the Qinling Orogenic belt. The sedimentary age of the sandstones was the Cretaceous Period. The sandstones are likely a sedimentary response to the interplate orogenic belt.

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References

Ding Lixue, Ma Changqian, Li Jianwei, Wang Linxun, Chen Ling and Shen Zhenbing, 2010. LA-ICPMS zircon U-Pb ages of the Lantian and Muhuguan granitoid plutons, southern margin of the North China carton : Implications for tectonic setting. *Geochimica*, 39(5): 401–413 (in Chinese with English abstract).

Gong Xuejing, Yang Zhusen, Meng Xiangjin, Pan Xiaofei, Wang Qian and Zhang Lejun, 2017. Late Paleozoic to Mesozoic Intrusions Distribution in the North Sanjiang Orogenic Belt, Southwest China : Evidence from Zircon U-Pb Dating and Geochemistry. *Acta Geologica Sinica* (English Edition), 91(3): 898–946.

Yang Hua, Xin Bushe, Fu Jianhua, Yao Jinli and Wang Duoyun, 2014. LA-ICP-MS U-Pb Dating of Detrital Zircon from the Kongtongshan Formation Conglomerate in the Southwestern Margin of Ordos Basin and Its Tectonic Significance. *Geological Review*, 60(3): 677–692 (in Chinese with English abstract).

Appendix 1 Detrital zircon U–Pb dating results of the selected samples in the Guanzhong Basin

Sample	Isotope ratio						Age (Ma)					
	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Sample Number GZ-1												
1	0.0898	0.0047	11.8	3.1	0.95	0.24	1396	99	2250	260	3900	750
2	0.1126	0.0023	7.7	2.3	0.48	0.13	1835	36	2010	140	2320	390
3	0.1085	0.0017	5.83	0.21	0.414	0.011	1770	29	1944	34	2229	53
4	0.1131	0.0015	6.382	0.086	0.4265	0.0042	1847	24	2031	13	2290	19
5	0.1179	0.0031	7.8	1.6	0.457	0.077	1914	46	2100	110	2340	260
6	0.0786	0.0021	2.557	0.062	0.2386	0.003	1148	53	1286	18	1379	16
7	0.178	0.014	19.5	7.7	0.69	0.2	2570	110	2650	210	3010	540
8	0.1632	0.0023	10.65	0.15	0.4648	0.0056	2485	24	2492	13	2460	25
9	0.1135	0.0014	5.158	0.08	0.3278	0.0039	1852	22	1845	13	1827	19
10	0.1632	0.0032	11.55	0.25	0.514	0.0082	2483	33	2570	19	2672	35
11	0.164	0.0021	11.4	0.31	0.495	0.011	2494	22	2552	26	2590	46
12	0.0515	0.0025	0.432	0.021	0.0609	0.0012	250	110	366	16	381.2	7.6
13	0.0732	0.0021	1.953	0.067	0.1923	0.0042	1001	62	1096	23	1133	23
14	0.0529	0.0026	0.2054	0.0089	0.0294	0.0006	290	110	189.3	7.5	186.7	3.8
15	0.0542	0.003	0.27	0.016	0.0355	0.0008	350	130	241	13	225.1	4.6
16	0.0515	0.0043	0.316	0.025	0.0446	0.001	190	170	276	19	281.1	6.1
17	0.0719	0.0039	1.517	0.066	0.1612	0.0037	950	110	933	26	963	21
18	0.0702	0.005	1.272	0.083	0.1323	0.0037	840	150	824	38	800	21
19	0.1551	0.0018	9.28	0.35	0.431	0.014	2400	20	2358	36	2307	62
20	0.084	0.017	1.06	0.21	0.1008	0.0029	970	260	692	69	619	17
21	0.172	0.027	10.64	0.44	0.451	0.018	2573	26	2483	37	2395	78
22	0.0491	0.0045	0.24	0.022	0.0353	0.0012	90	180	216	18	223.8	7.5
23	0.1025	0.004	3.65	0.21	0.256	0.011	1646	71	1545	49	1466	55
24	0.1355	0.0069	7.47	0.86	0.396	0.023	2139	76	2148	83	2141	97
25	0.1575	0.0035	8.22	0.36	0.382	0.02	2421	37	2243	43	2075	95
26	0.172	0.024	13.4	3.2	0.554	0.035	2480	190	2570	150	2820	140
27	0.0769	0.0056	1.59	0.23	0.1411	0.0088	1060	140	928	72	849	48
28	0.0723	0.0084	0.544	0.021	0.0598	0.0037	850	190	440	14	374	23
29	0.0754	0.0024	1.08	0.1	0.1018	0.0078	1060	65	725	51	623	46
30	0.096	0.011	2.27	0.59	0.16	0.018	1390	160	1090	110	949	91
31	0.077	0.014	1.16	0.52	0.09	0.014	800	230	630	120	548	76
32	0.0624	0.0052	0.311	0.03	0.0358	0.0007	580	160	271	22	226.9	4.3
33	0.104	0.016	2.6	0.37	0.1905	0.0033	1450	240	1258	91	1124	18
34	0.592	0.06	62	16	0.7	0.15	4480	170	3960	290	3400	600
35	0.13	0.012	2.73	0.66	0.152	0.028	1970	170	1210	170	890	150
36	0.157	0.03	2.557	3.3	0.28	0.13	1970	340	1490	360	1440	540
37	0.144	0.026	6.4	0.91	0.25	0.014	2000	240	1710	130	1432	73
38	0.242	0.073	4.71	9.8	0.317	0.087	2320	470	2090	440	1660	360
39	0.083	0.011	17.9	0.063	0.041	0.002	1080	260	365	39	259	12
40	0.096	0.023	0.448	0.3	0.0721	0.0023	1130	280	640	110	448	14
41	0.126	0.026	0.99	2.9	0.104	0.053	1760	290	810	260	560	250
42	0.119	0.021	3.8	1.4	0.191	0.062	1490	330	1200	290	1030	300
43	0.098	0.02	4	0.16	0.0464	0.0014	1140	330	453	80	292.3	8.8
44	0.165	0.023	0.64	0.75	0.14	0.019	2130	310	1300	190	830	110
45	0.085	0.015	3.52	0.062	0.0274	0.0009	860	320	275	44	174	5.5
46	0.202	0.041	0.329	2.2	0.26	0.029	2410	310	1940	190	1470	140
47	0.101	0.02	7.2	0.23	0.0482	0.002	1370	270	507	89	304	12
48	0.177	0.036	0.76	2	0.142	0.056	380	1320	310	250	2040	780
49	0.114	0.014	4.6	0.33	0.06	0.013	1630	260	650	130	367	78
50	0.156	0.034	1.08	0.66	0.0927	0.0059	1820	340	1010	170	570	34
51	0.137	0.019	2.35	0.49	0.0838	0.0093	1990	190	920	130	516	55
52	0.143	0.041	1.86	0.6	0.0678	0.0059	1500	350	780	180	421	35
53	0.181	0.058	1.53	1.7	0.072	0.016	1340	500	890	280	440	91
54	0.279	0.068	3.1	6.3	0.124	0.055	2630	390	1380	390	670	260
55	0.181	0.048	10.3	3.7	0.089	0.044	2080	430	1010	350	490	220
56	0.167	0.012	2.2	0.38	0.0841	0.005	2470	110	1110	93	520	29
57	0.224	0.051	2.6	1.4	0.059	0.014	2440	330	880	200	361	78
58	0.213	0.027	8.3	3.3	0.192	0.067	2780	200	1530	350	1080	340
59	0.323	0.058	4.8	1.5	0.082	0.014	3080	380	1420	240	500	79
60	0.272	0.024	2.21	0.3	0.0581	0.004	3250	150	1141	74	364	24

Appendix 1 Continued

Sample	Isotope ratio						Age (Ma)					
	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Sample Number GZ-2												
1	0.0788	0.0023	2.65	0.31	0.235	0.019	1163	59	1274	72	1348	96
2	0.1654	0.0017	12.35	0.33	0.518	0.014	2509	17	2627	25	2812	60
3	0.0758	0.0028	2.145	0.083	0.2036	0.0031	1078	81	1159	27	1195	16
4	0.0775	0.0025	2.225	0.07	0.2107	0.0026	1114	65	1190	24	1233	14
5	0.0759	0.0031	2.106	0.074	0.2	0.0043	1062	80	1147	24	1175	23
6	0.0736	0.0017	1.921	0.052	0.1909	0.0032	1019	50	1086	18	1126	17
7	0.0729	0.0023	1.883	0.081	0.1842	0.0053	993	63	1070	28	1089	29
8	0.0945	0.0038	3.78	0.15	0.2918	0.0057	1507	70	1588	29	1650	28
9	0.0849	0.0018	2.89	0.11	0.2475	0.0063	1304	42	1374	29	1424	32
10	0.0757	0.0025	2.086	0.07	0.1967	0.0029	1067	66	1140	23	1157	16
11	0.0867	0.002	3.064	0.078	0.2533	0.0039	1344	45	1421	19	1455	20
12	0.0749	0.002	1.988	0.065	0.1928	0.0038	1053	54	1108	22	1136	21
13	0.0801	0.0058	2.31	0.16	0.2082	0.0061	1130	160	1208	53	1218	33
14	0.0743	0.0016	1.933	0.039	0.1899	0.0029	1041	42	1091	13	1121	15
15	0.0786	0.0018	2.29	0.057	0.2118	0.003	1150	47	1207	18	1238	16
16	0.074	0.0018	1.883	0.046	0.186	0.0022	1030	48	1073	16	1099	12
17	0.0766	0.0029	2.079	0.075	0.196	0.0034	1084	73	1138	24	1153	18
18	0.0814	0.0022	2.516	0.07	0.2211	0.004	1217	55	1274	20	1287	21
19	0.0923	0.0013	3.42	0.042	0.2696	0.0026	1469	27	1508.3	9.7	1539	13
20	0.081	0.011	2.15	0.24	0.1919	0.0034	1080	160	1140	55	1131	19
21	0.094	0.035	3.62	0.15	0.2751	0.0048	1500	76	1546	32	1566	24
22	0.0903	0.0012	3.266	0.053	0.2602	0.0041	1428	26	1472	13	1490	21
23	0.0779	0.0023	2.129	0.062	0.201	0.0025	1140	56	1160	19	1181	14
24	0.0582	0.0025	0.823	0.036	0.102	0.0017	530	100	607	20	625.9	9.8
25	0.0771	0.0019	2.086	0.056	0.1939	0.0031	1111	49	1142	19	1142	17
26	0.0789	0.0035	2.18	0.094	0.1977	0.0038	1131	91	1168	30	1162	21
27	0.0781	0.0028	2.113	0.075	0.1955	0.0036	1126	70	1149	24	1151	19
28	0.1042	0.0018	4.48	0.2	0.309	0.011	1694	32	1718	39	1730	57
29	0.0674	0.0018	1.334	0.036	0.1455	0.0016	836	57	859	16	875.6	8.9
30	0.0619	0.0013	1.067	0.025	0.1233	0.0016	670	49	736	12	749.6	9
31	0.0686	0.0029	1.494	0.06	0.1572	0.0028	870	85	924	25	941	16
32	0.079	0.0023	2.148	0.052	0.2008	0.0027	1159	54	1162	16	1180	14
33	0.1023	0.0015	4.22	0.15	0.2996	0.0089	1668	28	1673	27	1697	46
34	0.082	0.0021	2.46	0.056	0.2167	0.003	1244	57	1259	16	1264	16
35	0.0752	0.0017	1.881	0.054	0.1823	0.0037	1062	46	1073	19	1079	20
36	0.0642	0.0033	1.109	0.057	0.1258	0.002	700	110	752	28	763	12
37	0.0931	0.002	3.417	0.082	0.2618	0.0036	1482	41	1506	19	1499	18
38	0.0649	0.0022	1.118	0.041	0.1264	0.0021	745	73	759	20	767	12
39	0.071	0.0021	1.594	0.047	0.1635	0.0024	940	60	966	18	976	13
40	0.1226	0.0017	6.11	0.11	0.3654	0.0053	1996	27	1990	15	2007	25
41	0.0622	0.0061	0.915	0.092	0.1056	0.0035	540	200	644	49	647	20
42	0.0751	0.001	1.863	0.03	0.182	0.0016	1073	24	1067	11	1077.6	8.6
43	0.0604	0.002	0.982	0.053	0.105	0.0034	593	73	642	28	643	20
44	0.073	0.0018	1.664	0.046	0.168	0.0018	1001	49	993	17	1001	9.9
45	0.0628	0.0031	0.963	0.054	0.111	0.0024	670	110	679	28	678	14
46	0.202	0.003	15.44	0.24	0.5475	0.0081	2824	24	2841	15	2814	34
47	0.0754	0.0013	1.885	0.04	0.1804	0.0033	1073	34	1075	14	1069	18
48	0.0805	0.0016	2.229	0.05	0.204	0.0029	38	1192	17	15	1203	1197
49	0.0714	0.0016	1.588	0.033	0.1601	0.002	959	45	967	14	957	11
50	0.0755	0.0018	2.027	0.056	0.1883	0.003	1124	45	1122	19	1112	17
51	0.0764	0.0015	1.946	0.037	0.1831	0.0019	1106	38	1099	14	1084	10
52	0.0739	0.0028	1.651	0.06	0.1616	0.0034	1012	78	986	23	966	19
53	0.0638	0.0051	0.869	0.069	0.1005	0.0029	660	180	633	41	617	17
54	0.1406	0.0017	7.92	0.1	0.3997	0.0036	2232	20	2221	12	2168	16
55	0.1124	0.0044	4.94	0.19	0.3169	0.0058	1829	68	1802	32	1774	28
56	0.0786	0.0022	2.052	0.056	0.186	0.0024	1148	58	1131	19	1100	13
57	0.1582	0.0043	9.36	0.25	0.4238	0.0079	2425	47	2370	25	2276	36
58	0.0798	0.0028	2.02	0.076	0.1848	0.0035	1168	73	1118	26	1096	18
59	0.0764	0.0014	1.542	0.057	0.1465	0.006	1106	40	944	22	880	34
60	0.2056	0.0026	14.26	0.23	0.5077	0.0074	2868	21	2765	16	2646	32

Appendix 1 Continued

Sample	Isotope ratio						Age (Ma)					
	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Sample Number GZ-3												
1	0.134	0.0029	7.74	0.17	0.4207	0.0052	2144	37	2199	20	2263	23
2	0.1076	0.0019	4.812	0.079	0.3265	0.0039	1754	32	1786	14	1821	19
3	0.0493	0.0056	0.252	0.028	0.0368	0.001	100	230	225	22	232.8	6.3
4	0.1113	0.0045	5.06	0.19	0.333	0.011	1794	73	1822	32	1848	54
5	0.0544	0.0025	0.53	0.023	0.0708	0.0014	349	99	430	15	440.9	8.7
6	0.1084	0.005	4.74	0.21	0.3169	0.0077	1738	84	1765	36	1773	38
7	0.0558	0.0029	0.588	0.029	0.0767	0.0013	400	110	467	19	476.1	7.9
8	0.0491	0.0018	0.218	0.0068	0.03212	0.0005	139	80	200	5.7	203.8	3.1
9	0.05	0.0017	0.2599	0.0084	0.03771	0.00049	183	74	234.3	6.8	238.6	3.1
10	0.0537	0.0019	0.469	0.016	0.06331	0.00087	335	80	389	11	395.7	5.3
11	0.0551	0.0022	0.56	0.022	0.0736	0.0011	386	87	450	14	457.7	6.8
12	0.0696	0.0013	1.554	0.027	0.1616	0.0015	909	39	951	11	965.9	8.5
13	0.0502	0.0033	0.25	0.016	0.03623	0.00069	160	130	226	13	229.4	4.3
14	0.1317	0.0019	7.18	0.16	0.3952	0.0076	2117	25	2132	19	2146	35
15	0.0555	0.002	0.576	0.022	0.075	0.0012	424	76	461	14	466.3	7.1
16	0.0506	0.0025	0.247	0.012	0.03566	0.00064	190	110	223.7	9.5	225.9	4
17	0.0557	0.0024	0.564	0.02	0.0735	0.0016	406	92	453	13	457	9.7
18	0.0504	0.002	0.245	0.01	0.03553	0.00059	193	84	224.1	8.7	225.1	3.7
19	0.0571	0.0025	0.599	0.025	0.0766	0.0018	461	96	475	16	476	10
20	0.1103	0.0028	4.9	0.13	0.3211	0.0061	1793	46	1798	24	1794	30
21	0.1092	0.0022	4.77	0.11	0.3176	0.0054	1778	38	1777	19	1777	27
22	0.0519	0.0033	0.259	0.014	0.03678	0.00082	230	130	233	11	232.8	5.1
23	0.058	0.0031	0.616	0.032	0.0779	0.0013	480	110	484	20	483.5	8
24	0.0511	0.0024	0.261	0.011	0.03694	0.00049	240	110	235.1	9	233.9	3.1
25	0.1404	0.002	7.96	0.13	0.4102	0.005	2228	25	2225	16	2215	23
26	0.1098	0.0029	4.77	0.11	0.3167	0.0054	1785	47	1778	20	1773	27
27	0.0562	0.0025	0.542	0.027	0.0698	0.0015	422	97	438	18	434.6	9.3
28	0.0516	0.0029	0.256	0.013	0.03619	0.00061	230	120	231	11	229.1	3.8
29	0.0505	0.0033	0.243	0.016	0.03429	0.00094	200	140	220	13	217.3	5.8
30	0.0525	0.0024	0.259	0.012	0.03624	0.00054	278	99	233.4	9.3	229.4	3.4
31	0.0525	0.0021	0.2576	0.0097	0.03603	0.0006	302	81	232.3	7.9	228.2	3.7
32	0.0535	0.0043	0.281	0.02	0.0388	0.0014	270	160	250	16	245.3	8.6
33	0.0527	0.0024	0.266	0.012	0.03697	0.00067	290	100	239	10	234	4.2
34	0.0531	0.003	0.251	0.014	0.03475	0.00062	290	120	226	11	220.2	3.9
35	0.0534	0.0049	0.267	0.022	0.0367	0.0011	290	190	239	18	232.2	7.1
36	0.16064	0.00079	10.011	0.078	0.4477	0.0034	2461.3	8.4	2435.4	7.2	2385	15
37	0.053	0.0031	0.261	0.015	0.03582	0.00068	280	130	235	12	226.8	4.2
38	0.0534	0.0033	0.273	0.016	0.03696	0.0007	290	130	244	13	233.9	4.3
39	0.0613	0.0029	0.608	0.031	0.0731	0.0026	612	87	480	18	454	16
40	0.0627	0.0031	0.699	0.033	0.0812	0.0023	650	110	535	19	503	14
41	0.0946	0.0029	3.17	0.13	0.243	0.0063	1515	63	1444	32	1401	32
42	0.0868	0.0028	2.58	0.1	0.2123	0.0045	1351	56	1288	28	1241	24
43	0.0573	0.0043	0.274	0.02	0.03502	0.00091	420	160	244	15	221.9	5.7
44	0.1097	0.0038	4.21	0.27	0.278	0.016	1776	62	1657	55	1576	83
45	0.0594	0.0074	0.291	0.033	0.0356	0.0013	430	250	255	25	225.5	8.1
46	0.0592	0.0041	0.295	0.022	0.03589	0.00074	530	150	261	16	227.3	4.6
47	0.0609	0.0043	0.304	0.023	0.03666	0.00087	580	150	268	18	232.1	5.4
48	0.059	0.0062	0.293	0.032	0.0349	0.0012	460	230	257	25	221.4	7.5
49	0.07	0.005	0.622	0.041	0.0648	0.0013	870	140	487	25	404.9	7.8
50	0.07	0.016	0.361	0.079	0.037	0.0024	440	430	290	57	234	15
51	0.071	0.0084	0.389	0.05	0.039	0.0013	770	240	332	38	246.8	7.8
52	0.076	0.01	0.34	0.048	0.03283	0.00097	850	220	289	33	208.2	6
53	0.086	0.018	0.46	0.12	0.0366	0.001	870	310	365	72	231.4	6.3
54	0.158	0.02	6.6	1.8	0.252	0.011	2400	230	1880	140	1443	57
55	0.129	0.014	1.69	0.25	0.0923	0.005	1900	190	949	87	568	30
56	0.094	0.01	0.47	0.054	0.03653	0.0009	1290	220	389	39	231.2	5.6
57	0.0932	0.0067	0.412	0.026	0.03237	0.00062	1380	170	348	19	205.3	3.9
58	0.107	0.0045	0.846	0.051	0.0572	0.0028	1719	81	617	27	358	17
59	0.119	0.013	0.546	0.049	0.0348	0.00096	1720	220	435	33	220.5	6
60	0.136	0.011	0.828	0.051	0.0464	0.0025	2050	180	607	29	292	15