JAEA500m 深坑道周辺域での水準測量結果（2004-2012 年）

Precise Leveling around 500m-depth shafts of JAEA in 2004-2020

木股文昭[*1]・村瀬雅之[**2]・森　済[**]・宮島力雄[*]・田中俊行[*]

Abstract

The Japan Atomic Energy Agency has excavated 500m-deep shafts in Mizunami, central Japan, since 2002, and in 2020 the shafts was reclaimed. The Tono Research Institute of Earthquake Science observes groundwater levels, crustal activities, and gravity around the shafts to research the crustal activity and groundwater flow following the shaft excavation. Drainage of groundwater at the shafts is generated, and changes in groundwater flow in the surrounding area are predicted. Precise leveling is required to detect the change in groundwater flow from the vertical movement on the surface of the earth. We consider the results of the leveling conducted and its accuracy in the thesis.

1.設置した水準網と水準測量

1)水準網

国土地理院の 4 水準点も利用する。水準点は 2004 年に設置し、その後も拡張し、設置年代で色別する(図 1)。坑道と地下水位観測井の位置も図に加えた。2012 年までの測量から坑道近傍で年間 2mm ほどの沈降を観測した(kimata et al.2015)。沈降は水準点での局所的な変動の可能性もあり、沈降を空間分布として捉えて確証するために、2012 年に水準網を坑道の周辺 3×4 km へ拡張した。

堆積層が網の大半に分布するが、仮不動点とする BM0 と網北部の水準点は花崗岩上に設置した。

2) 精密水準測量

堆積層が数 100m を超える平野では、地下水の汲み上げに伴い年間 cm を超える上下変動が生じている。本域では JAEA による航空磁気探査などから、堆積層は厚さ 200m 程と推定されていて、上下変動が

*1　東濃地震科学研究所 ,Tono Research Institute of Earthquake Science, 〒509-6132, kimata@mail.tries.jp

*2 日本大学文理学部, Nihon University, College of Humanities and Sciences, 〒156-8550, murase@chs.nihon-u.ac.jp

それほど大きくないと考え、mm 以上の高精度な水準測量が必要と考えた。往復誤差で 2.5√S mm、環併合誤差で 2.0√S mm(S:距離，km)に収める水準測量を実施した。

2. 測量の結果と得た上下変動

2004 年から 2020 年までの測量結果を表 1a と 1b に示す。期間を通して BM0 の標高を不動として、各水準点の標高と BM0 からの距離を記す。BM0 の標高は 2004 年に最も近い国土地理院水準点 BM691 と 692 から測量で求めた。期間中に亡失し改埋した水準点は表に改埋後を斜体で表す。測量結果は測量中の気温で補正する。なお、水準網の閉合誤差を網調整せずに記した。なお、BM116 における閉合誤差を年ごとに図２に示す。

2004 年を基準にそれ以降の各水準点における上下変動を、BM0 から北東方向の BM116 に至る 3 本の路線に沿って図 3 に示す。図から、この期間に一番大きな変動が観測されたのは一番南東側の土岐路線で沈降が最大 14mm で 2km に渡り検出される。そして、その沈降が年とともに大きくなり、僅かに拡がっている。一方、一番北西側の月吉路線では沈降が最も小さく、その範囲も狭く南西側に限られる。中間に位置する半原路線は坑道脇を通過し、坑道近傍の水準点で最大 10mm の沈降が検出される。しかし、土岐路線ほど顕著な沈降の進行と拡張は指摘できない。

2. まとめ

坑道近傍で 2012 年までに観測された年間 1-2mm の沈降を確証するために、水準網を周辺に拡張し 2020 年まで測量を繰り返した結果、3 本の路線で坑道に近い水準点を中心に最大年間 2-3mm の沈降が観測された。測量結果と坑道での排水や近傍での地下水位低下などと対応させて、早急に検討を試みる。

参考文献

Kimata F., Y. Asai, R. Honda, T. Tanaka, H., Ishii, R. Miyajima, Ground Subsidence Following Groundwater Drawdown by Excavating of 500 m Deep Investigation Shafts in Granite Body in Mizunami, Central Japan in 2004ー2012, Engineering, **7-7**, DOI 10.4236/eng.2015.77038, July 2015.

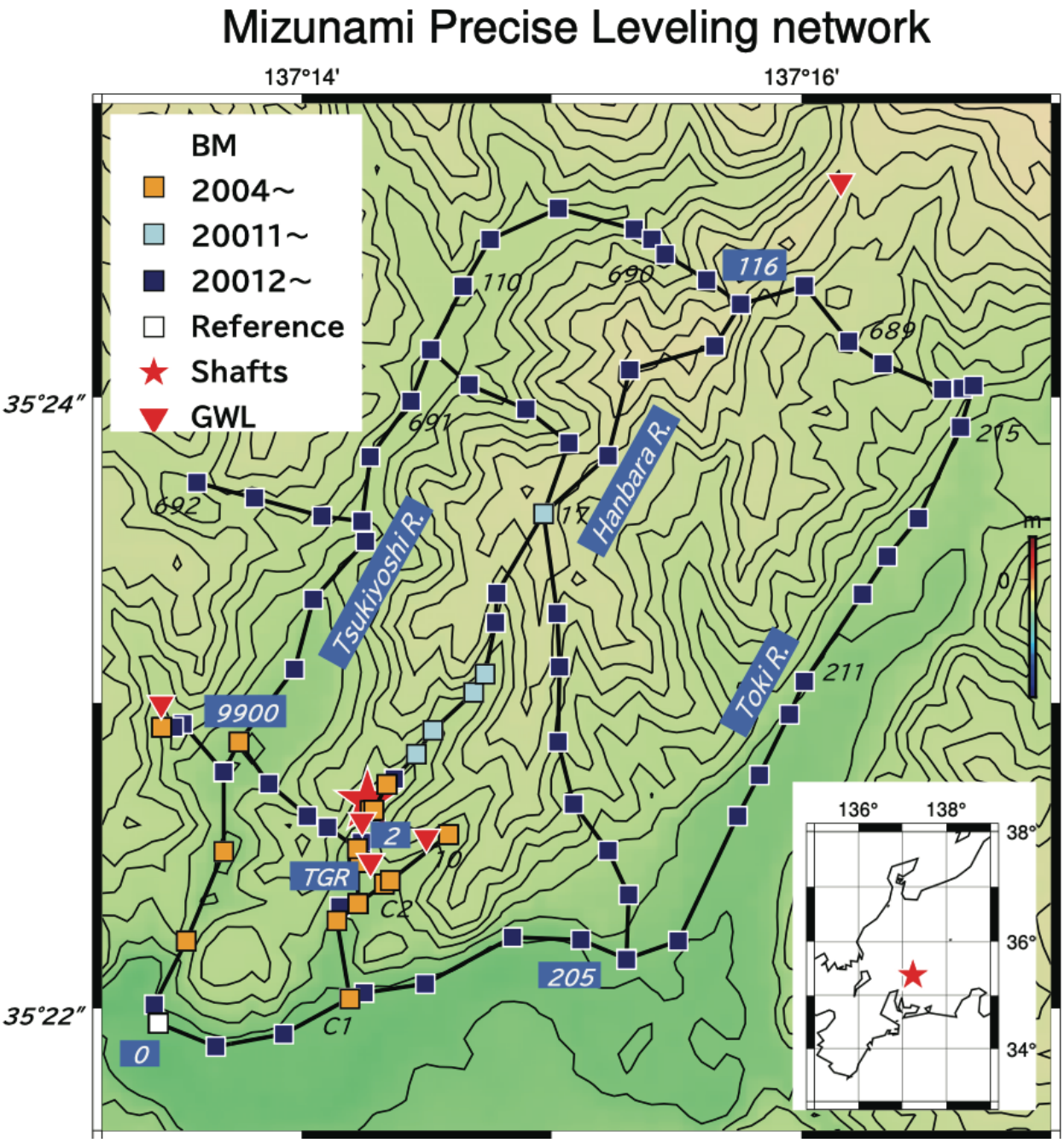

Figure 1, Location map of shafts, benchmarks, and groundwater level observation wells. The color of benchmarks represents the year of installation.

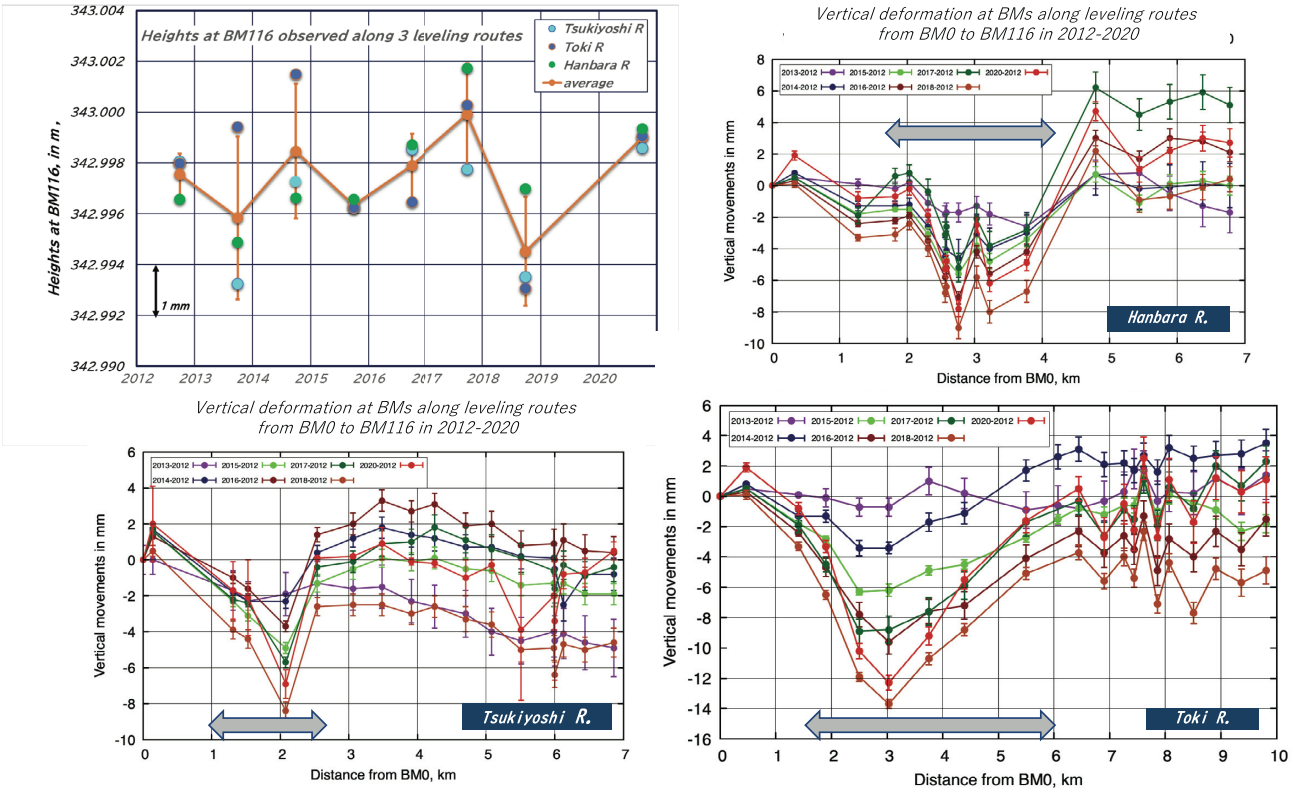

Figure 2. （upper left）Elevations of BM116 through three leveling route, Tsukiyoshi R, Hanbara R and Toki R from BM0, in 2012-2020.

Figure 3. (lower left and right) Vertical deformation profiles at benchmarks along three routs of Tsukiyoshi, Hanbara and Toki from BM 0 to BM 116 in 2012-2020.lower left; Tsukiyoshi R. upper right; Hanbara R. lower right; Toki R.

Table 1. Heights and leveling errors observed leveling in periods of 2004-2012 (1a) and 2012-2020
Table 1a

Table 1a

		Feb-04	Mar-05	Mar-06	Mar-07	Jan-08	Jan-09	Feb-10	Mar-11	Aug-11	Feb-12	Sep-12
BM	dis km	height, m	height, m	height, m	height, m	height, m	height, m	height, m	height, m	height, m	height, m	height, m
0	0.00	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441	153.3441
交1	1.48	155.0343	155.0341	155.0326	155.0293	155.0264	155.0260	155.0261	155.0254	155.0260	155.0271	155.0242
仮4	2.48	187.5385	187.5391	187.5386	187.5331	187.5316	187.5308	187.5293	187.5284	187.5290	187.5307	187.5277
2	2.57	189.0453	189.0444	189.0409	189.0351	189.0331	189.0314	189.0292	189.0280	189.0282	189.0300	189.0270
2	2.57	189.0453	189.0444	189.0409	189.0351	189.0331	189.0314	189.0292	189.0280	189.0282	189.0300	189.0270
仮1	3.05	207.2477	207.2463	207.2457	207.2428	207.2417	207.2398	207.2369	207.2353	207.2345	207.2365	207.2335
No.3観測室	4.29	214.0696	214.0672	214.0681	214.0666	214.0664	214.0660	214.0655	214.0644	214.0634	214.0645	214.0634
4	2.60	189.5059	189.5058	189.5021	189.4963	189.4948	189.4932	189.4908	189.4896	189.4902	189.4914	
9900	3.56	181.9168	181.9154	182.0130	182.0098	182.0079	182.0071	182.0058	182.0044	182.0035	182.0050	182.0039
3	4.27		213.9760	213.9765	213.9749	213.9739	213.9731	213.9724	213.9709	213.9700	213.9706	213.9695
5	2.89			199.7392	199.7337	199.7317	199.7298	199.7271	199.7254	199.7249	199.7267	199.7239
6	2.86			198.3068	198.3009	198.2988	198.2970	198.2944	198.2929	198.2930	198.2941	198.2919
7	2.50				187.9312	187.9299	187.9283	187.9261	187.9252	187.9250	187.9268	
691	6.43	237.7489		237.7497		237.7446	237.7438	237.7417				
692	8.60	262.9848		262.9885		262.9834	262.9826	262.9824				
8	2.44				190.4568	190.4548	190.4521	190.4501	190.4479	190.4482	190.4497	190.4460
9	2.48				192.0046	192.0033	192.0009	191.9993	191.9975	191.9975	191.9995	191.9957
10	2.91				213.2659	213.2668	213.2637	213.2607	213.2574	213.2569	213.2590	
交2	2.22				177.5962	177.5955	177.5946	177.5937	177.5928	177.5932	177.5949	177.5917
10-1	2.95									214.2063	214.2078	214.2018
11	3.21								219.9236	219.9231	219.9248	219.9226
12	3.40								229.9508	229.9501	229.9518	229.9492
13	3.73								250.8126	250.8114	250.8130	250.8107
14	3.95								266.9737	266.9720	266.9755	266.9733
15	4.24								289.8230	289.8209	289.8211	289.8185
16	4.45								303.6302	303.6291	303.6303	303.6286
17	4.96								345.1562	345.1568	345.1589	345.1579
17-1	5.02									344.5895	344.5877	344.5877

Table 1b

BM	distance	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm
Tsukitoshi line, 6.86 km																	
0	0.00	153.3441	0.0	153.3441	0.8	153.3441	0.0	*153.34410*	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0
101	0.14	154.9758	0.1	154.9758	0.8	154.9775	0.1	*154.97742*	0.0	154.9771	0.1	154.9774	0.2	154.9763	0.3	154.9778	0.3
102	0.45	165.8917	0.2	165.8913	0.9	165.8922	0.0	*165.89195*	0.3	165.8925	0.1	165.8921	0.2	165.8910	0.3		0.3
103	1.09	175.5875	0.2	175.5857	1.1	175.5863	0.2	*175.58626*	0.3	175.5873	0.2	175.5866	0.2		0.3		0.4
104	1.31	180.4846	0.2	180.4829	1.1	180.4828	0.2	*180.48234*	0.3	180.4836	0.3	180.4824	0.2	180.4807	0.5	180.4829	0.5
9900N	1.53					182.0114	0.2	*182.01058*	0.3	182.0121	0.3	182.0113	0.2	182.0094	0.5	182.0118	0.5
9900	1.53	182.0033	0.2	182.0010	1.1	182.0010	0.2	*182.00020*	0.3	182.0017	0.3	182.0009	0.2	181.9989	0.5	182.0012	0.6
105	2.08	186.3371	0.5	186.3352	1.2	186.3348	0.4	*186.33220*	0.3	186.3334	0.3	186.3314	0.3	186.3287	0.5	186.3302	0.6
106	2.54	195.6783	0.5	195.6770	1.2	195.6787	0.4	*195.67703*	0.5	195.6797	0.4	195.6779	0.5	195.6757	0.5	195.6784	0.6
107	3.06	213.4847	0.5	213.4831	1.2	213.4859	0.5	*213.48418*	0.6	213.4867	0.6	213.4846	0.6	213.4822	0.6	213.4849	0.6
70	3.20			219.6178	1.2	219.6211	0.6	*219.61959*	0.5	219.6223	0.6	219.6204	0.6	219.6177	0.6	219.6208	0.6
108	3.48	229.5216	0.6	229.5201	1.2	229.5234	0.6	*229.52172*	0.5	229.5249	0.6	229.5225	0.7	229.5191	0.6	229.5225	0.7
109	3.91	233.6108	0.6	233.6085	1.2	233.6122	0.7	*233.61070*	0.5	233.6135	0.6	233.6118	0.7	233.6078	0.6	233.6107	0.7
691	4.25	237.7399	0.6	237.7373	1.2	237.7411	0.7	*237.74003*	0.6	237.7430	0.6	237.7417	0.7	237.7373	0.6	237.7397	0.7
69	4.39									240.1930	0.7	240.1919	0.7	240.1875	0.7	240.1893	0.7
110	4.70	245.9860	0.6	245.9830	1.3	245.9867	0.7	*245.98549*	0.6	245.9879	0.7	245.9871	0.7	245.9827	0.7	245.9850	0.7
111	5.08	254.1336	0.7	254.1296	1.3	254.1343	0.7	*254.13304*	0.6	254.1356	0.7	254.1342	0.8	254.1300	0.7	254.1333	0.7
112	5.51	256.7927	0.9	256.7882	1.3	256.7929	0.7	*256.79129*	0.6	256.7935	0.8	256.7928	0.8	256.7877	0.7	256.7888	0.8
113	5.99	264.0716	1.0	264.0676	1.4	264.0717	0.7	*264.07034*	0.6	264.0725	0.8	264.0710	0.8	264.0667	0.7	264.0696	0.8
114					1.4	268.2503		*268.24895*	0.6								
114b	6.00	273.5879	1.1	273.5834	1.4	273.5874	0.7	*273.58591*	0.6	273.5879	0.9	273.5863	0.8	273.5815	0.7	273.5845	0.8
690	6.13	278.9716	1.1	278.9675	1.4	278.9691	0.9	*278.97030*	0.6	278.9727	0.9	278.9713	0.8	278.9669	0.7	278.9708	0.8
115	6.44	307.4236	1.1	307.4190	1.5	307.4228	0.9	*307.42165*	0.6	307.4241	0.9	307.4227	0.8	307.4186	0.7	307.4229	0.8
116	6.86	342.9981	1.1	342.9932	1.6	342.9973	0.9	*342.99622*	0.6	342.9985	0.9	342.9977	0.8	342.9935	0.8	342.9986	0.8

	distance	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm
Toki line, 9.86km		2012	error	2013	error	2014	error	2015	error	2016	error	2017	error	2018	error	2020	error
0	0.00	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0
201	0.47	148.9430	0.0	148.9435	0.3	148.9438	0.1	148.9435	0.0	148.9433	0.0	148.9435	0.1	148.9431	0.3	148.9449	0.3
202	0.95	152.0238	0.0	152.0243	0.5	152.0155	0.3	152.0139	0.1	152.0128	0.2	152.0127	0.5	152.0110	0.3	152.0124	0.4
C1	1.41	155.0242	0.2	155.0243	0.0	155.0229	0.3	155.0224	0.1	155.0218	0.2	155.0223	0.5	155.0209	0.3	155.0234	0.4
C!N						155.3383		155.3373	0.1	155.3365		155.3392	0.5	155.3352	0.3	155.3370	0.4
203	1.90	157.4964	0.3	157.4963	0.6	157.4951	0.4	157.4936	0.2	157.4917	0.6	157.4919	0.5	157.4899	0.3	157.4931	0.4
204	2.50	160.8436	0.3	160.8429	0.6	160.8402	0.5	160.8373	0.2	160.8358	0.8	160.8347	0.8	160.8317	0.3	160.8334	0.5
205	3.03	159.3776	0.3	159.3769	0.6	159.3742	0.4	159.3714	0.4	159.3680	0.8	159.3688	0.9	159.3639	0.3	159.3653	0.5
205a	3.10			159.6230	0.7	159.6203	0.6	159.6174	0.3	159.6159	0.8	159.6148	0.9	162.7060	0.4	162.7065	0.5
206	3.41	163.2568	0.5	163.2569	0.7	163.2540	0.6	163.2508	0.3	163.2476	0.8						
207	3.75	165.9014	0.6	165.9024	0.9	165.8997	0.6	165.8965	0.3	165.8938	0.8	165.8938	0.9	165.8907	0.4	165.8922	0.6
208	4.39	168.1421	0.6	168.1423	1.0	168.1410	0.7	168.1376	0.3	168.1349	0.9	168.1362	0.9	168.1333	0.4	168.1366	0.6
209	4.78	171.6871	0.6	171.1472	1.0	171.1482	0.7	171.1449	0.3	171.1431	0.9	171.1450	0.9	171.1413	0.4	171.1455	0.7
210	5.09	179.5632	0.6	179.5621	1.1												
210N	5.49					173.7434	0.7	173.7397	0.3	173.7380	0.9	173.7401	0.9	173.7366	0.4	173.7406	0.8
211		185.1040	0.7	185.1031	1.2	185.1057	0.7	185.1013	0.3	185.0999	0.9	185.1023	0.9	185.0989	0.4	185.1024	0.8
212	5.80			180.9026	1.1	180.9045	0.7	180.9007	0.3	180.8993	0.9	180.9010	0.9	180.8980	0.4	180.9016	0.8
地籍三角	6.07	189.7319	0.8	189.7313	1.3	189.7345	0.8	189.7304	0.3	186.9749	1.0	186.9767	0.9	186.9733	0.5	186.9769	0.8
213	6.44	194.9141	0.8	194.9133	1.3	194.9172	0.8	194.9133	0.5	194.9118	1.0	194.9138	0.9	194.9104	0.5	194.9146	0.8
214	6.90	196.4579	0.9	196.4576	1.3	196.4600	0.8	196.4567	0.5	196.4542	1.0	196.4553	0.9	196.4523	0.5	196.4552	1.3
215	7.26	202.1498	0.9	202.1501	1.3	202.1520	0.8	202.1492	0.5	202.1472	1.0	202.1489	0.9	202.1458	0.6	202.1493	1.3
215a				205.4617	1.3	205.4637	0.8	205.4607	0.5	205.4577	1.0		0.9				
216	7.44	210.9660	0.9	210.9678	1.3	210.9677	0.8	210.9654	0.5	210.9625	1.0	210.9645	0.9	210.9606	0.6	210.9638	1.4
216a	7.48			212.3792	1.3	212.3806	0.8	212.3782	0.5	212.3757	1.0	212.3782	0.9	212.3747	0.6	212.3785	1.4
217	7.61	213.1076	0.9	213.1093	1.3	213.1103	0.8	213.1088	0.5	213.1063	1.0	213.1087	0.9	213.1053	0.6	213.1101	1.4
218	7.86	228.6769	0.9	228.6766	1.3	228.6785	0.8	228.6755	0.6	228.6720	1.0	228.6750	1.0	228.6698	0.6	228.6742	1.4

	distance	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm
		2012	error	2013	error	2014	error	2015	error	2016	error	2017	error	2018	error	2020	error
219	8.07	249.4069	0.9	249.4072	1.3	249.4101	0.8	249.4070	0.6	249.4041	1.0	249.4075	1.0	249.4025	0.6	249.4080	1.4
689	8.51	278.7361	0.9	278.7363	1.4	278.7386	0.8	278.7357	0.6	278.7321	1.0	278.7353	1.0	278.7284	0.7	278.7344	1.4
220	8.91	300.2898	1.1	300.2910	1.4	300.2925	0.9	300.2889	0.6	300.2875	1.0	300.2918	1.0	300.2850	0.7	300.2910	1.4
221	9.37	313.2201	1.1	313.2204	1.5	313.2229	0.9	313.2178	0.6	313.2166	1.1	313.2208	1.0	313.2144	0.9	313.2204	1.4
116	9.81	342.9980	1.1	342.9994	1.6	343.0015	0.9	342.9962	0.6	342.9965	1.1	343.0003	1.0	342.9931	0.9	342.9991	1.5
Hanbara line, 6.78 km																	
0	0.00	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0	153.3441	0.0
201	0.33	148.9430	0.0	148.9435	0.3	148.9438	0.1	148.9435	0.0	148.9433	0.0	148.9435	0.1	148.9431	0.2	148.9449	0.3
202	0.81	152.0238	0.0	152.0243	0.3	152.0155	0.3	152.0139	0.0	152.0128	0.2	152.0127	0.1	152.0109	0.2	152.0124	0.3
C1	1.27	155.0242	0.2	155.0243	0.3	155.0229	0.3	155.0224	0.1	155.0218	0.2	155.0223	0.5	155.0209	0.2	155.0234	0.4
C!N	1.27							155.3373	0.1	155.3365	0.2	155.3392	0.5	155.3352		155.3370	0.4
C1-2	1.82	172.2612	0.2	172.2610	0.4	172.2599	0.3	172.2597	0.1	172.2590	0.2	172.2618	0.5	172.2581	0.4	172.2605	0.4
C1-3	1.92	178.1564	0.3	- - - -		178.1544	0.3	178.1538	0.1	178.1531	0.2	178.1554	0.5	178.1517	0.4	178.1537	0.4
C2	2.03	177.5915	0.4	177.5917	0.4	177.5903	0.4	177.5900	0.1	177.5896	0.2	177.5923	0.5	177.5891	0.4	177.5913	0.4
T41	2.24	186.9209	0.5	186.9200	0.4	188.6229	0.4	188.6225	0.4	- - - -		- - - -		**188.6214**	0.4	**188.6237**	0.4
2	2.31	189.0266	0.5	189.0255	0.5	189.0240	0.4	189.0235	0.4	189.0231	0.3	189.0262	0.8	189.0226	0.5	189.0247	0.4
市点	2.43			189.1714	0.5	190.6686	0.4	190.6677	0.5	190.6673	0.4	190.6702	0.8	190.6667	0.5	- - - -	
6	2.56	198.2914	0.5	198.2896	0.5	198.2869	1.2	198.2862	0.5	198.2856	0.4	198.2883	0.8	198.2846	0.6	198.2861	0.4
5	2.58	199.7234	0.5	199.7217	0.6	199.7193	1.2	199.7187	0.5	199.7182	0.4	199.7208	0.8	199.7170	0.6	199.7186	0.4
T1	2.76	206.8019	0.5	206.8002	0.6	206.7973	1.2	206.7963	0.5	206.7948	0.4	206.7967	0.9	206.7929	0.7	206.7941	0.5
11	3.03	219.9217	0.6	219.9204	0.6	219.9186	1.3	219.9179	0.5	219.9175	0.4	219.9196	0.9	219.9159	0.7	219.9192	0.5
12	3.22	229.9482	0.6	229.9464	0.7	229.9442	1.3	229.9434	0.5	229.9426	0.4	229.9444	0.9	229.9402	0.7	229.9420	0.5
13	3.55	250.8095	0.8	250.8075	0.7	250.8057	1.3	- - - -	0.5	250.8041	0.4	250.8054	0.9	250.8013	0.7	250.8030	0.5
14	3.77	266.9718	0.8	266.9692	0.7	266.9688	1.3	266.9684	0.5	266.9676	0.5	266.9690	1.0	266.9651	0.7	266.9669	0.5
15	4.06	289.8165	0.8	289.8124	0.8	289.8103	1.3	289.8091	0.5	289.8070	0.5	289.8071	1.0	289.8014	0.7	289.8001	0.5
16	4.27	303.6264	0.8	303.6229	0.8	303.6218	1.3	303.6213	0.5	303.6192	0.5	303.6205	1.0	303.6177	0.7	303.6179	0.5

	distance	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm
Toki line, 9.86km		2012	error	2013	error	2014	error	2015	error	2016	error	2017	error	2018	error	2020	error
17	4.79	345.1551	0.8	345.1558	0.9	345.1558	1.3	345.1558	0.5	345.1581	0.5	345.1613	1.0	345.1573	0.7	345.1598	0.6
17-1	5.10							333.1831	0.6	333.1854	0.5	333.1877	1.0	333.1838	0.7	333.1848	0.7
18	5.44	346.0360	1.2	346.0368	0.9	346.0358	1.3	346.0349	0.5	346.0377	0.5	346.0405	1.0	346.0351	0.8	346.0370	0.8
19	5.89	383.8489	1.2	383.8484	1.1	383.8488	1.4	383.8490	0.6	383.8519	0.6	383.8542	1.1	383.8482	0.8	383.8511	0.8
20	6.38	369.6529	1.3	369.6516	1.3	369.6530	1.4	369.6532	0.6	369.6557	0.6	369.6588	1.1	369.6528	0.8	369.6559	0.8
116	6.78	342.9966	1.4	342.9949	1.3	342.9966	1.4	342.9966	0.6	342.9987	0.6	343.0017	1.1	342.9970	0.8	342.9993	0.8
East-West (Toki-Hiyoshi) line, 4.68 km																	
206	0.00	- - - -		- - - -		- - - -		- - - -		159.6159	0.0	159.6148	0.0	***159.6100***	0.0	***159.3653***	0.0
206new	0.10	163.2568	0.0	163.2569	0.0	163.2540	0.0	163.2508	0.0	163.2476	0.1	162.7118	0.0	*162.7070*	0.0	*162.7065*	0.1
61	0.52	185.5252	0.4	185.5246	0.2	185.5219	0.3	185.5192	0.0	185.5165	0.1	185.5175	0.0	185.5128	0.2	185.5133	0.2
63	0.52	202.2621	0.6	202.2617	0.5	202.2591	0.3	202.2566	0.0	- - - -		***201.2002***	0.1	***201.1969***	0.2	***201.1978***	0.2
64	0.89	229.4203	0.6	229.4188	0.5	229.4178	0.4	229.4149	0.1	229.4137	0.3	229.4169	0.2	229.4126	0.4	229.4144	0.2
65	1.31	264.1250	0.8	264.1218	0.8	264.0879	0.4	264.0841	0.4	264.0829	0.4	264.0861	0.2	264.0810	0.5	264.0815	0.3
66	1.80	293.2823	0.8	293.2784	0.8	293.2794	0.4	293.2750	0.4	293.2746	0.4	293.2778	0.6	293.2723	0.5	293.2733	0.3
17	2.31	321.5174	0.8	321.5120	0.9	321.5158	0.5	321.5109	0.5	321.5121	0.5	321.5160	0.6	321.5103	0.5	321.5123	0.3
67	2.72	345.1625	0.8	345.1559	1.0	345.1625	0.5	345.1576	0.5	345.1593	0.6	345.1648	0.7	345.1578	0.5	345.1603	0.6
67-1	3.21	321.7995	0.9	321.7924	1.1	321.7982	0.6	321.7935	0.5	321.7949	0.6	321.7992	0.7	321.7937	0.5	321.7950	0.6
67-2	3.42							299.8277	0.5	299.8288	0.6	299.8326	0.7	299.8273	0.5	299.8282	0.6
67-3	3.54							287.2998	0.5	287.3002	0.7	287.3041	0.7	287.2990	0.5	287.2994	0.6
68	3.72	273.3025	0.9	273.2972	1.1	273.2994	0.6	273.2965	0.5	273.2967	0.6	273.3001	0.7	273.2930	0.5	273.2914	0.6
69	4.14	244.8340	0.9	244.8299	1.2	244.8301	0.6	244.8272	0.6	244.8281	0.6	244.8321	0.8	244.8262	0.5	244.8263	0.6
691-1	4.54									240.1922	0.7	240.1962	0.8	240.1907	0.5	240.1912	0.6
691	4.68	237.7470	1.1	237.7418	1,2	237.7434	0.9	237.7406	0.6	237.7422	0.7	237.7462	0.9	237.7407	0.6	237.7412	0.6

	distance	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm	height, m	mm
		2012	error	2013	error	2014	error	2015	error	2016	error	2017	error	2018	error	2020	error
Tsukiyoshi branch line, 1.09 km																	
2	0.00	189.0266	0.0	189.0255	0.0	189.0235		189.0255	0.0	189.0231	0.0	189.0262	0.0	189.0226	0.0	189.0247	0.0
2-1	0.33	201.4191	0.2	201.4183	0.1	201.4163		201.4183	0.2	201.4164	0.1	201.4195	0.1	201.4159	0.1	201.4177	0.0
2-2	0.44	201.8389	0.5	201.8377	0.3	201.8367		201.8377	0.2	201.8372	0.2	201.8400	0.2	201.8364	0.2	201.8383	0.1
2-3	0.78	184.6191	0.6	184.6185	0.4	184.6166	0.1	184.6185	0.2	184.6165	0.2	184.6192	0.2	184.6157	0.2	184.6158	0.1
9900new	1.09					182.0005	0.2	- - - -		182.0118	0.3	182.0145	0.3	182.0109	0.3	182.0115	0.3
9900	1.09	182.0035	0.7	182.0015	0.9	182.0004	0.2	182.0015	0.2	182.0014	0.2	182.0093	0.3	182.0057	0.5	- - - -	
Syomasama branch line. 0.56 km																	
104	0.00	180.4846	0.0	180.4829	0.0	180.4828	0.0	180.4823	0.0	180.4836	0.0	180.4824	0.0	180.4807	0.0	180.4829	0.0
31	0.44	211.0889	0.1	211.0898	0.3	211.0894	0.2	211.0898	0.1	211.0910	0.0	211.0900	0.5	211.0887	0.1	211.0910	0.1
32	0.49	211.6235	0.2	211.6235	0.3	211.6229	0.2	211.6241	0.1	211.6257	0.1	211.6239	0.5	211.6228	0.1	211.6250	0.1
T3	0.56	213.9686	0.2	213.9683	0.3	213.9670	0.3	213.9683	0.1	213.9694	0.1	213.9683	1.0	213.9660	0.1	213.9683	0.1
Gym branch line, 0.71 km																	
C2	0.00	177.5915	0.0	177.5917	*0.00*	177.5903	0.0	177.5900	0.0	177.5896	0.0	177.5923	0.0	177.5891	0.0	177.5913	0.0
8	0.22	190.4458	0.0	190.4460	*0.00*	190.4418	0.1	190.4413	0.1	190.4401	0.0	190.4422	0.0	190.4383	0.1	190.4392	0.4
9	0.25	191.9954	0.0	191.9957	*0.09*	191.9923	0.1	191.9917	0.1	191.9908	0.0	191.9932	0.1	191.9895	0.1	191.9911	0.4
10-1	0.71	214.2013	0.2	214.2022	0.1	214.1974	0.1	214.1970	0.2	214.1943	0.2	214.1965	0.1	214.1906	0.2	214.1903	0.5
Garaishi branch line. 1.32 km																	
107	0.00	213.4847	0.0	213.4831	0.0	213.4859	0.0	213.4842	0.0	213.4867		213.4846	0.0	213.4822	0.0	213.4849	0.0
70	0.14	- - - -	0.1	219.6178	0.0	219.6211	0.0	219.6196	0.0	219.6223	0.0	219.6204	0.0	219.6177	0.0	219.6208	0.0
71	0.47	247.7063	0.6	247.7038	0.3	247.7066	0.0	247.7057	0.3	247.7087	0.2	247.7067	0.3	247.7033	0.2	- - - -	
72	0.93	265.8908	0.7	265.8889	0.5	265.8906	0.1	265.8903	0.3	265.8928	0.2	265.8907	0.4	265.8875	0.2	- - - -	
692	1.32	262.9819	0.8	262.9804	0.6	262.9816	0.2	262.9813	0.4	262.9839	0.4	262.9816	0.4	262.9786	0.3	- - - -	