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Restorement of early 19th century's Geomagnetic declinations in Japan, from Tadataka Inoh's survey azimuth ledger

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Abstract: The Santou-Houi-Ki is a national treasure of Japan recorded by Japanese cartographic surveyor Tadataka Inoh in 1800 to 1816, consist of 67 volumes survey ledger to produce the first survey map of Japan, called "Coastal Area Map of great Japan," or Inoh map (1:36000, 1:216000, 1:432000).

In the Santou-Houi-Ki estimate 200,000 magnetic compass survey azimuth data by accuracy of 0°05′unit were written, with the name or short description of magnetic compass survey reference point and target points. Inoh's team carried out the survey did not apply the correction of magnetic declination. Because before his survey, Inoh tried to observe magnetic declination in Edo (Tokyo) was nearly zero. Inoh conducted the survey on the assumption that the influence of magnetic declination to survey map of Japan is at least. The surveyed region extends from North eastern coast of Hokkaido Island to Yakushima Island in western Japan. We start analysis, check the outline of reference point and target points from the name or the description of reference point and target points, the survey azimuth recorded in Santou-Houi-Ki, and Inoh's survey diary, Inoh's maps, modern survey map, today's survey map or local source books. We execute interdisciplinary and simultaneous analysis of geomagnetic declination, real azimuth, precise position of the survey execution point and target points (latitude and longitude less than 0.1 second). And add the historical importance of each precise position of survey reference point. Calculate backward the precise position of survey reference point, where the value of magnetic declination, subtracting the magnetic survey azimuth from the true azimuth to any target points is similar or approximate. We cannot read the precise content of national treasure Santou-Houi-Ki without this interdisciplinary simultaneous analysis. We tried to analysis at 227 points in Japanese archipelago, the distribution of magnetic declination and precise position of the survey reference points and target points in early 19 century's Japan are gradually elucidated. When we compare the analysis of declination from Santou-Houi-Ki to Noaa's Historical Declination Viewer, NOAA's progress of declination west is always 5 to 6 years late than the analysis of Santou-Houi-Ki. And differences are more remarkable in western Japan. We must supply the analysis data from Santou-Houi-Ki to NOAA.

Keywords: 山島方位記 Santou-Houi-Ki, 伊能忠敬 Tadataka Inoh, magnetic compass survey, geomagnetic declination, reference point, target point, Historical declination viewer

Fig.1 Tadataka Inoh (Inoh Tadaka Museum)

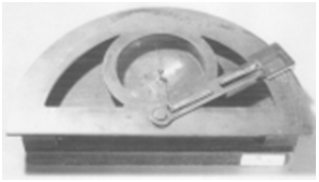

Fig.2 Semicircular theodolite (Inoh Tadaka Museum)

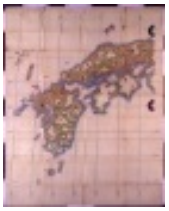

Fig.3 Inoh's Small Scale Map of Western JAPAN (Kobe city museum)

It including a part of Korea (Kojedo, Katogdo, Busan's Mountains, etc.) by the result of the survey from Tsushima Island Japan by Tadataka Inoh in1813. (City museum of Kobe)

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Discussion

Example of descriptive content of page in Santou –Houi-Ki.

It including a part of Korea (Kojedo, Katogdo, Busan's Mountains, etc.) by the result of the survey from Tsushima Island Japan by Tadataka Inoh in1813.

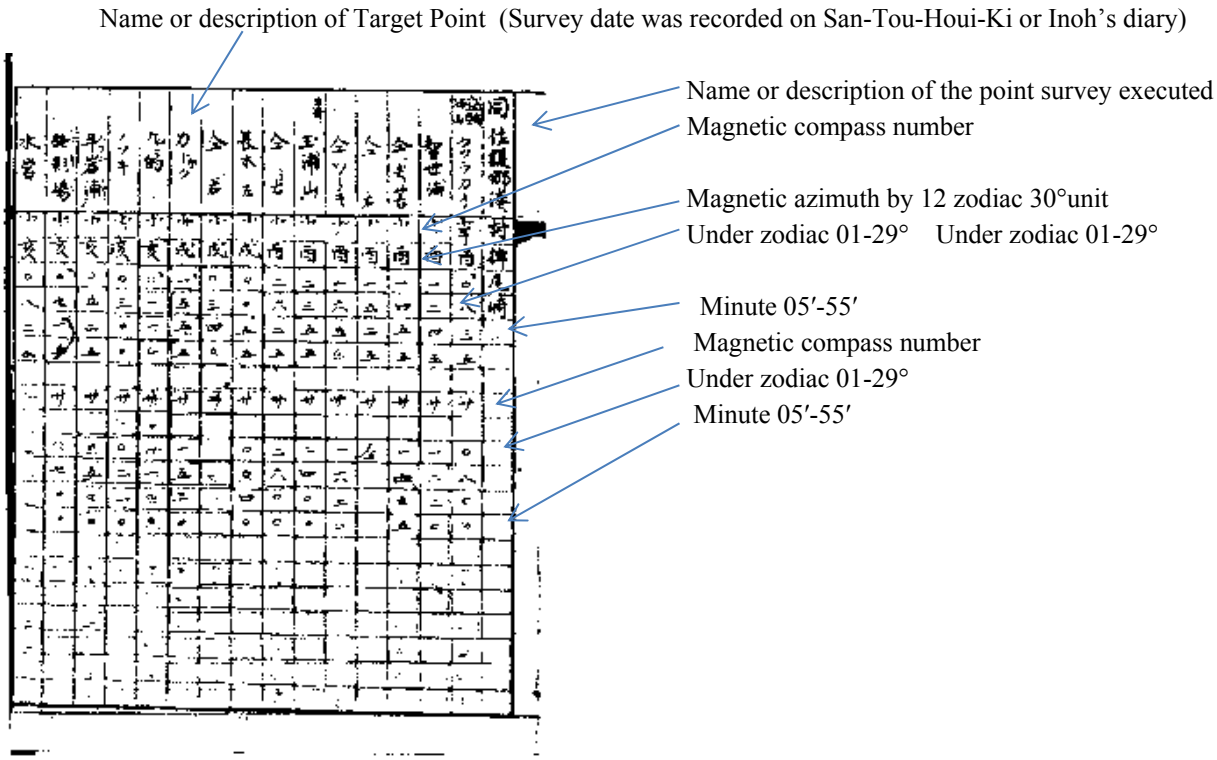
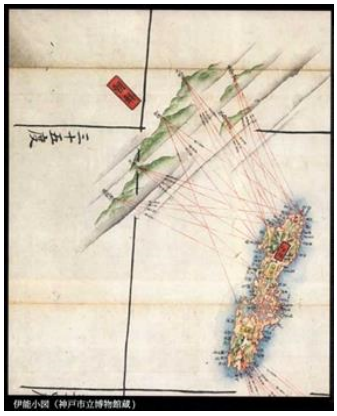
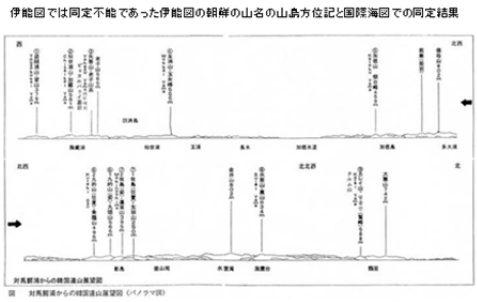


Fig.4 Santou Houi Ki Vol. 59, ledger of magnetic survey azimuths, On Tsushima Island. Targets are Korean mountains from Tsushima Island, by Tadataka Inoh (Inoh Tadataka Museum)

Analyze the magnetic declination from the data of magnetic compass survey azimuth to domestic mountains in Tsushima Island, at same reference point, where those survey to Korean Mountains exceeded. Apply the analyzed magnetic declination to the magnetic compass survey azimuth in Santou-Houi-Ki by Inoh, reflect it on International Sea Chart and able to identify those survey target mountains in 慶尚南道 Gyeongsangnam-do Korea.





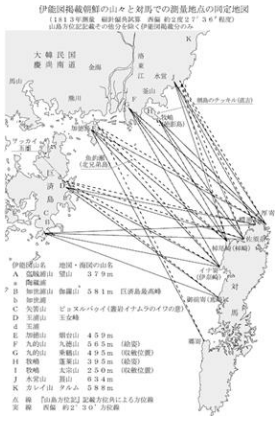


Fig.5. A part of Inoh's Small Scale Map of Western JAPAN. Tsujimoto identified more than 9 mountains of Korea (around Kojedo, Katogdo, Busan). **Fig.6** Identification panorama from Tsushima,(Tsujimoto)

Fig.7 Identification map of Korean mountains in Inoh map from north western coast of Tsushima Island.(Tsujimoto)

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Ⅰ.Concept of Geomagnetic declination and secular variation.

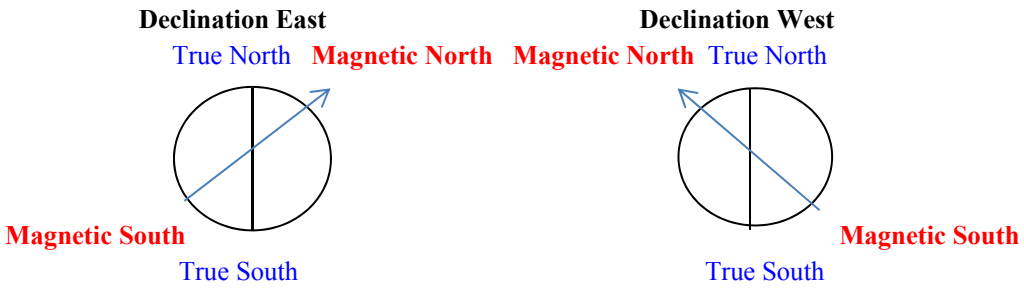

Fig.8. Geomagnetic Declination on a Magnetic Compass.

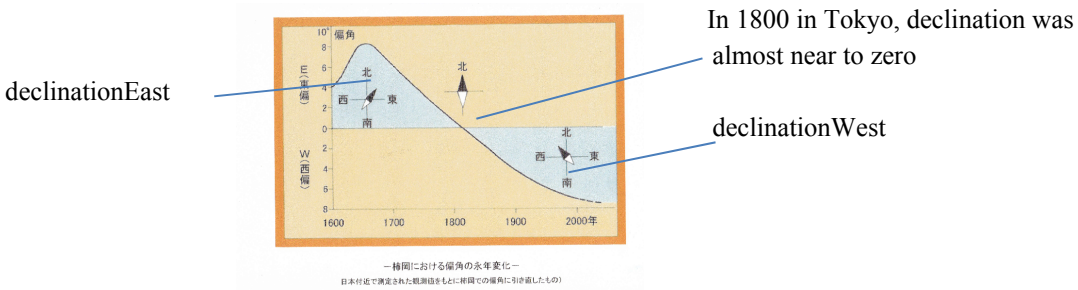

Fig9. Secular variation of geomagnetic declination in Japan. Inoh started magnetic compass survey from Tokyo in 1800, the 0 point from declination E to W.
(National observatory of geomagneticism of Japan HP)

Ⅱ. Concept of simultaneous interdisciplinary analysis of geomagnetic declination and local history.

Caliculate back ward the point of magnetic compass survey executed (Latitude, Longitude) from the Latitude and Longitude of target point and magnetic compass survey azimuth.

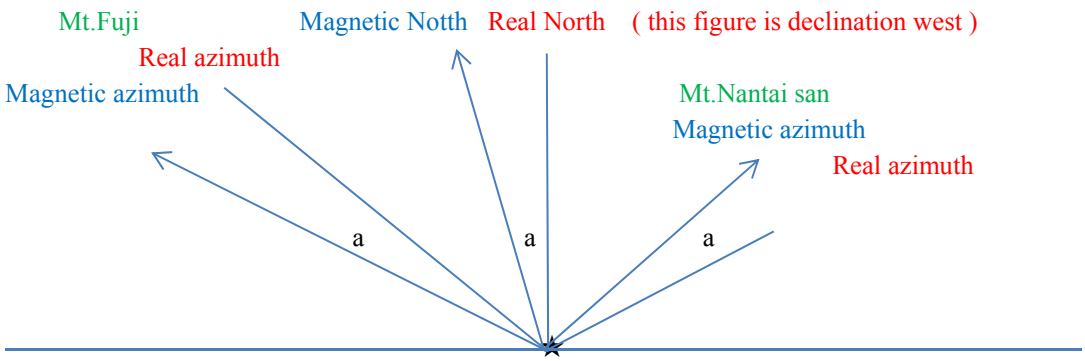

Fig10. Where is the point of magnetic compass survey excuted (Latitude, Longitude)? (byTsujimoto)
At the reference point, magnetic declinations are equal at each magnetic compass survey azimuth to any target points.
Magnetic declination = Real azimuth - Magnetic compass survey azimuth

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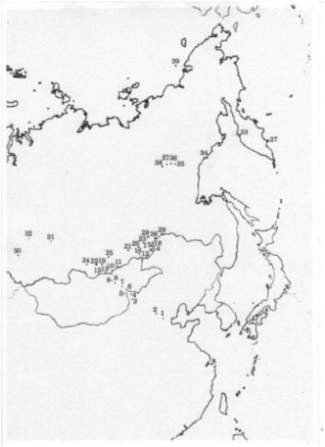
Ⅲ Improve the accuracy of historical isogonic map surrounding area of Japan by analysis of geomagnetic declination from Santou-houi-K.i



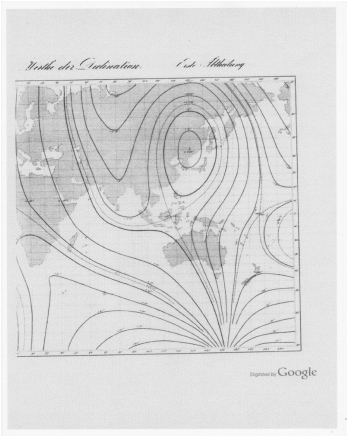


Fig11. Distribution map of observation points in Asia by Christopher Hansteen contrasted from Gauss and Weber. Tsujimoto restored this map from pp33-34 Gauss's comparison table of calculation and Observation."Vergieichung der Rchnung und Beobachtungin" Gauss and Weber's Atlas des Erdmagnetismus 1840. consisted without data from Japan or Korea to Hawaii or Australia.(by Tsujimoto)

Isogonic map produced by Gauss and Weber is basically correct, but the accuracy in surrounding area of Japan is low

Fig 12. Gauss and Weber's Atlas Des Erdmagnetismus 1840. From Google books.

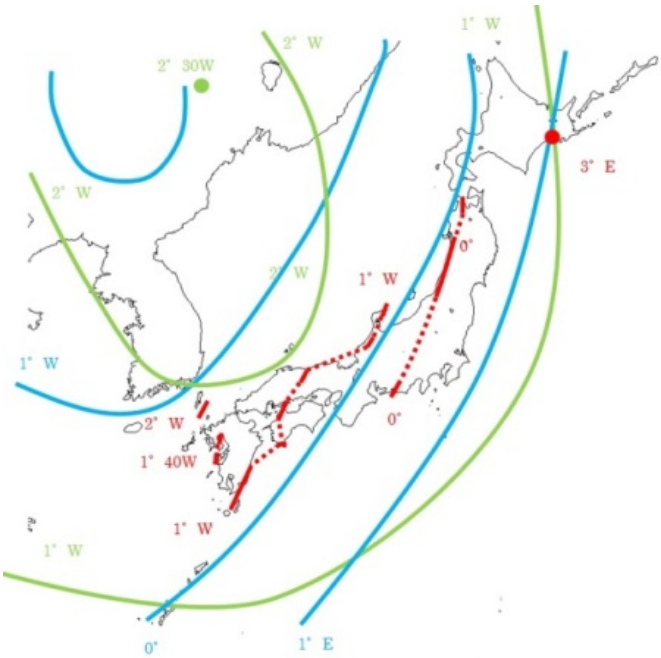


Fig.13.The comparison of isogonic line by Gauss and Weber in 1830,NOAA1800-1815,Inoh1800-1815.(Tsujimoto)

In1830 by Carl Friedrich Gauss and Wilhelm Weber's Atlas des Erd Magnetismus published in1837

●2°30′W is Untrue pole of declination

Analysis from Inoh's Santou- Houi- Ki (1800-1816) by Motohiro Tsujimoto, Akitoshi Omotani. 1800-1814

Appendix: From Table.1No.10,No.11 line of declinatioon 0° pass Akadomari in Sado Island and down to south across sea to Port Teradomari Niigata pref . Table.1 No.1 Akkeshi 2° 29′ E(not3° E)

NOAA's Historical declination Viewer ,founded on Andrew Jackson Gufm1.

★Those year's magnetic declination in Japanese archipelago was very near to zero, was the best era for magnetic compass survey. Magnetic anomaly : Red is analyzed data from Santou –Houi-Ki is advanced to declination west than NOAA. Blue is slow. **Notice:** It is not necessarily able to analyze all of magnetic compass survey azimuth data in Santou Houi Ki. Do not choose the data uneven distribution.

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Ⅳ. Utilize unknown vast data source of magnetic declination in the world Inoh's Santou–Houi-Ki

From 17 century to mid 19 century, Japan closed the country to Europe except Holland, and Japan was remain in extremely lacking area of geomagnetic declination in the world, but we must change it, to analyze the such a high precision source which contribute to the global geomagnetism and geosciences. Analysis of Tadataka Inoh's Santou-Houi-Ki.(national treasure) is the duty to Japanese researcher who study carrtography of Japan. (table. by Tsujimoto)

Table 1.Summary of comparison of the geomagnetic declination analysed from Santou-Houi-Ki recorded by Tadataka Inoh with historical declination viewer by NOAA

	Position	latitude N	longitude E	AD	Inoh	NOAA	remainder	Appendix
1	Akkeshi	43°02′ N	144°50′ E	1800	2°29′ E	1°14′ E	1°15′	gravel?
2	Matsumae	41°25′ N	140°05′ E	1800	0°44′ E	0°02′ E	0°46′	
3	Cape Tappi	41°16′ N	140°21′ E	1802	0°18′ E	0°01′ E	0°17′	
4	Aburakawa Aomori	40°51′ N	140°42′ E	1802	0°12′ E	0°12′ E	0°00′	
5	Hachinohe	40°32′ N	141°35′ E	1801	0°09′ E	0°29′ E	0°20′	
6	Yuzawa Akita	39°10′ N	140°30′ E	1802	0°01′ E	0°19′ E	0°18′	
7	Choushi	35°44′ N	140°30′ E	1801	0°24′ E	1°00′ E	0°36′	
8	Edo(Tokyo)	35°44′ N	140°50′ E	1802-3	0°19′ E	0°40′ E	0°21′	
9	Edo(Tokyo)	35°45′ N	139°48′ E	1814	0°40′ w	0°15′ E	0°25′	
10	Akadomari Sado Isl	37°52′ N	138°25′ E	1803	0°14′ w	0°05′ W	0°09′	
11	Teradomari Niigata	37°38′ N	138°46′ E	1803	0°01′ E	0°02′ W	0°03′	
12	Cape Kongou Noto P	37°31′ N	137°21′ E	1803	3°49′ W	0°15′ W	3°34′	igneous rock
13	Teraiye Noto Pen	37°29′ N	137°20′ E	1803	0°57′ W	0°19′ W	0°38′	
14	Wajma Noto Pen	37°24′ N	136°54′ E	1803	0°57′ W	0°23′ W	0°34′	
15	Chikuma Nagano	36°33′ N	138°08′ E	1814	0°44′ W	0°46′ W	0°02′	
16	Chino Nagano	35°59′ N	138°09′ E	1811	0°33′ E	0°26′ W	0°07′	
17	Okitsu Shizuoka	35°03′ N	138°31′ E	1803	0°29′ E	0°23′ E	0°06′	
18	Hamamatsu Shizuoka	34°43′ N	137°41′ E	1803	0°07′ W	0°14′ E	0°21′	
19	Cape Morozaki	34°42′ N	136°58′ E	1803	0°14′ W	0°07′ W	0°07′	
20	Kuwana Mie	35°04′ N	136°42′ E	1805	0°11′ W	0°10′ W	0°01′	
21	Mt.Ise Asama	34°28′ N	136°47′ E	1803	1°58′ W	0°02′ W	1°56′	serpentinite
22	Toba Mie	34°29′ N	135°08′ E	1805	0°14′ W	0°03′ W	0°11′	
23	Kooriyama Nara	34°37′ N	135°45′ E	1808	0°35′ W	0°30′ W	0°05′	
24	Wakayama	34°13′ N	135°08′ E	1805	0°26′ W	0°21′ W	0°05′	
25	Akashi Hyogo	34°39′ N	135°00′ E	1805	0°48′ W	0°27′ W	0°21′	
26	Sumoto Awaji Isl	34°21′ N	134°54′ E	1808	0°44′ W	0°34′ W	0°10′	
27	Komatsu Ishikawa	36°25′ N	136°24′ E	1803	0°54′ W	0°20′ W	0°34′	
28	Tsuruga Fukui	35°40′ N	136°04′ E	1806	1°07′ W	0°29′ W	0°38′	
29	AmanoHashidate	35°36′ N	135°11′ E	1806	0°56′ W	0°38′ W	0°18′	
30	Tottori	35°32′ N	134°11′ E	1806	1°05′ W	0°47′ W	0°18′	
31	Hashizu	35°30′ N	135°53′ E	1806	1°15′ W	0°49′ W	0°26′	
32	Yonago	35°30′ N	133°20′ E	1806	1°03′ W	0°55′ W	0°08′	
33	Mihonoseki	35°34′ N	133°18′ E	1806	1°03′ W	0°52′ W	0°09′	
34	Izumo Ohtsu	35°21′ N	132°47′ E	1806	1°00′ W	0°57′ W	0°03′	
35	Toujiou Kushiro	34°52′ N	133°16′ E	1811	1°06′ W	1°03′ W	0°03′	
36	Jinseki Sasao	34°46′ N	133°20′ E	1811	1°04′ W	1°02′ W	0°02′	
37	Fukuyama Abuto	34°22′ N	133°21′ E	1806	0°54′ W	0°41′ W	0°13′	
38	Tadanoumi Takehara	34°20′ N	132°59′ E	1806	1°05′ W	0°44′ W	0°11′	
39	Iyo Nagahama	33°36′ N	132°27′ E	1808	0°53′ W	0°48′ W	0°05′	
40	Kochi Hijima	33°34′ N	133°33′ E	1808	0°40′ W	0°39′ W	0°01′	

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41	Cape Ashizuri	32°44′ N	133°01′ E	1808	1°08′ W	0°35′ W	0°33′	
42	Tsushima nowthwest	34°29′ N	129°18′ E	1813	2°30′ W	1°27′ W	1°03′	sedimentary rock?
43	Iki (Wakamiyajima)	33°44′ N	129°41′ E	1813	1°55′ W	1°19′ W	0°36′	
44	Mt. Tokami Iki Isl	33°46′ N	129°43′ E	1813	0°36′ W	1°16′ W	0°40′	igneous rock
45	Kitakyushyu Ashiya	33°54′ N	130°31′ E	1812	1°16′ W	1°13′ W	0°03′	
46	Cape. Kanenosaki	33°53′ N	130°31′ E	1813	2°09′ W	1°14′ W	0°55′	igneous rock
47	Kounominato	33°51′ N	133°01′ E	1812	1°27′ W	1°14′ W	0°13′	
48	Sadowara Miyazaki	32°01′ N	131°30′ E	1810	0°51′ W	0°44′ W	0°07′	
49	Shibushi	31°29′ N	131°06′ E	1810	1°10′ W	0°41′ W	0°29′	
50	Cape Sata	31°00′ N	130°39′ E	1810	1°01′ W	0°39′ W	0°22′	
51	Tanegashima Isl ave	30°39′ N	130°56′ E	1810	0°57′ W	0°39′ W	0°16′	
52	Ushizu Saga	33°15′ N	130°12′ E	1812	1°39′ W	1°09′ W	0°30′	
53	Mt. Yasuman	32°20′ N	129°28′ E	1813	0°00′ W	1°11′ W	1°11′	igneous rock
54	Gotou Kushijima Isl	32°57′ N	126°59′ E	1813	1°35′ W	1°13′ W	0°22′	
55	Amakusa Tomioka	32°32′ N	130°03′ E	1810	1°01′ W	0°39′ W	0°22′	

Ⅴ. Restoration of the detail position of magnetic compass survey was excuted from analysis of Santou-Houi-Ki.

Ⅴ-1 Kitayama high way No,2 pint in Kochi city in Shikoku Island.

Fig.14 Santou- Houi-KI Vol. 22 Kitayama High Way's No.2 point. Inoh Tadataka Museum.

Fig.15 Inoh Map large scale. 1/36000 Congress Library of State USA. Simultaneous interdisciplinary analysis for Geomagnetism and local history. Without Santou-Houi-Ki. There are no sources to restore so exact and accurate position of the survey reference point under second in latitude and longitude. Kitayama high way No.2 point disused and forgotten corner street in Kochi city in1808. NOAA

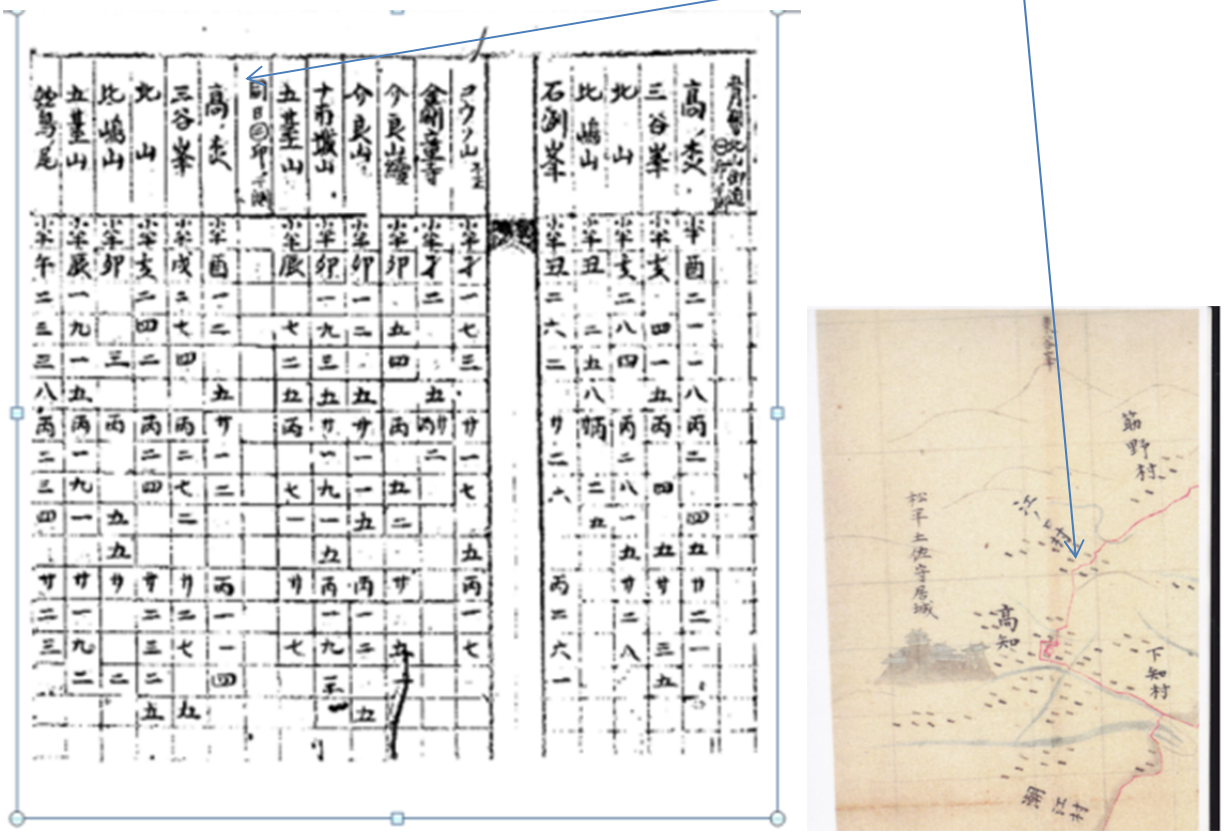

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Table2. The analysis by Excel formula in Kochi city. reference point (latitude and longitude under second)

Geomagnetic declination (by Tsujimoto)

Analysis of Santou-Houi-Ki

Ver091118

測定基点	
survey reference point	1808.5.25 Kitayama HighWay No.2 Kochi city
todays adress	On the Road 3chome HijimaChou Kochi city

対象点までの平均距離 (L)	4.221 km
誤差半径 (L*sin2σ)	23.5 m

Survey reference point	Deg	min	sec
North Latitude	33	34	16.66
East Longitude	133	32	53.92

	total	effect	usage
Survey Reference Poir	6	6	5
total data	18	18	15

Kitayama highwayend the function,by opening of new high way 150 years ago. 40 years ago end the function as road intercepted by apartmentcomplex Real point is 1.35m from south shoulder contrived2010.3.14Motohiro Tsujimoto exell formulawas compiledby A Omotani

Magnetic declination			(件数) 5
	decli	deg	min	sec
average declin	西	0	41	34.7813
root mean square		0	42	40.049
standard deviation(		0	9	34.3842
max west dist	西	0	51	24.5102
max east dist	西	0	26	51.6957

Survey target point		Aver Mag Azimuth					real azimuth			real azimuth-Magntic azimuth				
NO	Survey Target point	deg	min	sec	NO	Target(Today's name)	deg	min	sec	decli	deg	min	sec	dist km
1	Mt.Konomori	281	55	0	1	Mt.Kounomori (鴻ノ森△299)	281	3	35.49	西	0	51	24.51	4.89
2	Mt. Mitanimine	327	21	40	2	Mt. Mitanimine Elv・512	326	33	32.58	西	0	48	7.42	4.42
3	Mt. Kitayama	353	55	0	3	Mt. Kitayama △379.3	353	21	20.81	西	0	33	39.19	2.88
4	Mt.Hijimayama	90	35	0										
5	MtGodaisan	139	15	0	5	Mt. Godaisan (五台山△139.3)	138	27	8.90	西	0	47	51.10	3.67
6	Mt.Washinoosan	203	26	0	6	Mt. Wshinoo鷲ノ尾 Elv・306	202	59	8.30	西	0	26	51.70	5.24

Target point. Magnetic compass survey azimuth Real azimuth west geomagnetic declination distance

First page of Excel Formula for Interdiciplinary and simultaneous analysis of Santou Houi-Ki.

This is a example of analysis in Kochi city. Restoration of former corner of Kitayama high way at Today's address is 3chome……,Hijima-cho Kochi city Kochi prefecture.

On the center of the road southern in front of 3chome . The translation page of magnetic compass survey azimuth recoded in classic Japanese description.

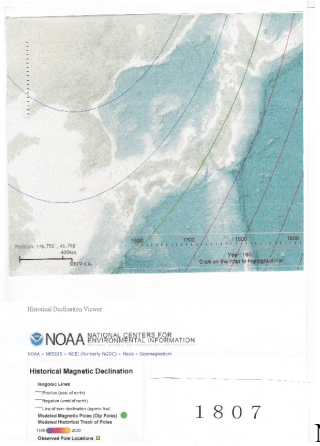
Fig.16 NOAA Historical declination Viewer 1807.

Record of Santou-Houi-Ki

Total of data	件数	修正	effect	use
	18	18	18	15

Targetpoint		Number of data				Average of distance		
NO	Name of Target point	item	modif	effect	tota;	deg	min	second
1	Mt.Konomori	3	3	3	3	281	55	0
2	Mt. Mitanimine	3	3	3	3	327	21	40
3	Mt. Kitayama	3	3	3	3	353	55	0
4	Mt.Hijimayama	3	3	3	-	90	35	0
5	MtGodaisan	3	3	3	3	139	15	0
6	Mt.Washinoosan	3	3	3	3	203	26	0
7		-	-	-	-			
8		-	-	-	-			
9		-	-	-	-			
10		-	-	-	-			
11		-	-	-	-			
12		-	-	-	-			
13		-	-	-	-			
14		-	-	-	-			
15		-	-	-	-			
16		-	-	-	-			
17		-	-	-	-			
18		-	-	-	-			
19		-	-	-	-			

Survey Record									
NO	target point identifyed	magnet azimuth Zod	deg	min	note	magnetic azimut deg	min	sec
1	Mt.Konomori	酉	12	5		282	5	
1	Mt.Konomori	酉	12	0		282	0	
1	Mt.Konomori	酉	11	40		281	40	
2	Mt. Mitanimine	戌	27	40		327	40	
2	Mt. Mitanimine	戌	27	20		327	20	
2	Mt. Mitanimine	戌	27	5		327	5	
3	Mt. Kitayama	亥	24	20		354	20	
3	Mt. Kitayama	亥	24	0		354	0	
3	Mt. Kitayama	亥	23	25		353	25	
4	Mt.Hijimayama	卯	0	30		90	30	
4	Mt.Hijimayama	卯	0	55		90	55	
4	Mt.Hijimayama	卯	0	20		90	20	
5	MtGodaisan	辰	19	15		139	15	
5	MtGodaisan	辰	19	10		139	10	
5	MtGodaisan	辰	19	20		139	20	
6	Mt.Washinoosan	午	23	38		203	38	
6	Mt.Washinoosan	午	23	40		203	40	
6	Mt.Washinoosan	午	23	0		203	0	



NOAA0° 39′ W

Table3. Name of target point and magnetic compass survey azimuth recorded in Santou-Houi-Ki in classic Japanese and translate it in today's numeral.(by Tsujimoto)

Survey target point

		North Latitude			East Longitude			distance
NO	Survey Target point	deg	min	sec	deg	min	sec	(km)
1	Mt.Kounomori (鴻ノ森△299)	33	34	47.07	133	29	47.81	4.89
2	Mt. Mitanimine Elv・512	33	36	16.4	133	31	19.41	4.42
3	Mt. Kitayama △379.3	33	35	49.55	133	32	40.99	2.88
4	Mt. Hijimayama exeption near	33	34	17.06	133	33	3.32	0.24
5	Mt. Godaisan (五台山△139.3)	33	32	47.55	133	34	28.22	3.67
6	Mt. Wshinoo鷲ノ尾 Elv・306	33	31	40.02	133	31	34.59	5.24
7								

Table4. Today's name of Target point and latitude and longitude under second and real distance(by Tsujimoto)**.**

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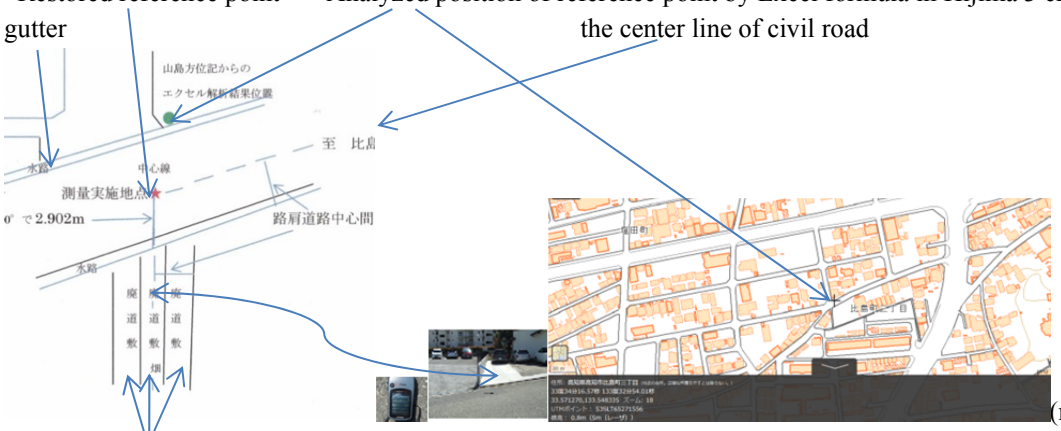
Fig17. Spot of reference point collating with registered drawing.of reference point.(by Tsujimoto)

Restored reference point gutter　　Analyzed position of reference point by Excel formula in Hijima 3 choume Kochi city the center line of civil road



(map GIA of Japan)

Disused Kitayama high way's total width is satisfy the high way rule of old Tosa clan 3 間 ken=5.45m　More than a century ago, abolished road was divided in three, the trace of middle part remained.

Ⅴ－2.Restoration of the detail position of magnetic compass survey was excuted from analysi of Santou-Houi-Ki Mt.Hiyoriyama (weather observatory site for sea navigation on mountain)in port town Mihonoseki in Shimane peninsula.

Matsutaro Nanba wrote "Hiyoriyama"2001（the research throughout Japan, Japanese historical weather observatory site mountain for sea navigation by sail ship. Nanba visited Mihonoseki excuted exploration and legwork. He gained different information of Hiyoriyama as Mt.Otokoyama in east side of town and Mt.Hifuriyama in west side of town and temporarily he specify Hifuriyama. But Mt.Hiyoriyama is not A or B below.

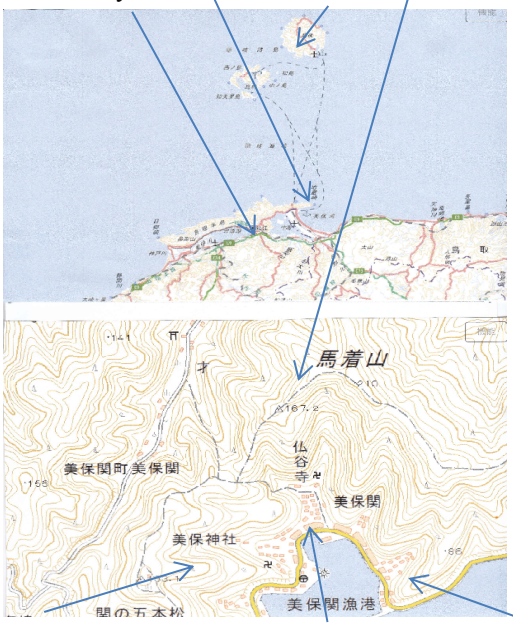
A.　Mt.Otokoyama in east side of town　N35° 33′ 43.13″　E133°18 ′47.47″　86.2m

B.　Mt.Hifuriyama in west side of town N35° 33′ 40.29″ E133° 18′ 9.48″　132.8m

Excel　Mt.Hiyoriyama is in north distance of town N35° 34′04.98″　E133°18′ 29.78″　178.3m

From this position able to have wide and far landscape than the others, cf. Inoh's Survey diary. We can recognize same description on 出雲十郡絵図"Izumo Juugun Ezu' (The Country map of Izumo consisted with ten county) or Inoh map middle scale.　But analyzed position of Santou-Houi-Ki by Excel formula is apparently detail than those maps. Fig.17 Santou-Houi-Ki Vol.20 Mihonoseki Hiiyori Yama 1806.　Fig.18, Fig.19, Fig. 20, Historical declination Viewer NOAA.

Fig.19,**Fig,20.**Mihonoseki　Mt.Hiyoriyama in Matsue city　　Oki Islands



Mt. Hifuriyama　　port town of　Mihonoseki　Mt. Otokoyama

Table.4 Mihonoseki Hiyoriyama in1806 (by Tsujimoto)

N35° 34′04.98″ **E133° 18′**29.78″　**declination 1°11′**W　NOAA 0°　52′　W

山島方位記　記録解析　　Ver091022

測定基点			
方位記名	日和山		
現在地名	馬着山　頂上西尾根　（辻本）		
測定基点経緯度	度	分	秒
北緯	35	34	4.98
東経	133	18	29.78

	計	有効	使用
測定対象地点数	36	35	32
測定数	148	146	136

辻本地名データ使用
文化3年6月19日－22日
6月26日－7月2日三保関滞在
1806.8.3-8.6と8.10-15　仮に
六月二十一日、日和山迄測量の
日を測量日とすると1806.8.5

対象点までの平均距離（L）	44.684	km
誤差半径（L*sinΣα）	168.3	m

磁針方位－方位角				（件数） 32
	偏	度	分	秒
平均	西	1	3	12.9637
2乗平均平方根		1	3	32.7971
標準偏差(σ)		0	6	28.3916
西方向最大偏角差	西	1	19	20.4305
東方向最大偏角差	西	0	50	19.2463

測定対象地点		平均磁針方位			方位角					磁針方位－方位角				
NO	対象地点名	度	分	秒	NO	対象名(現在)	度	分	秒	偏	度	分	秒	距離km
1	知夫里岬	330	38	0	12	三度崎	329	32	46.37	西	1	5	13.63	64.20
2	知夫里高	333	20	45	1	赤禿山	332	14	27.72	西	1	6	17.28	56.81
3	焼火山	337	14	0	2	焼火山	336	7	30.66	西	1	6	29.34	61.53
4	高笥山	338	56	15	3	高崎山	337	52	20.12	西	1	3	54.88	67.45
5	知々井岬	347	6	40	34	知々井岬灯台	345	56	13.56	西	1	10	26.44	58.01
6	御林山松島左岬	348	3	20	10	御林松島西岬	347	11	27.11	西	0	51	52.89	61.13
7	同　中心	348	40	0	9	松嶋中心	347	43	58.37	西	0	56	1.63	60.83
8	同　岬	349	0	0	11	御林松島右岬	348	1	48.54	西	0	58	11.46	61.02
9	大森島高	350	35	0	8	大森島高	349	15	39.57	西	1	19	20.43	64.37
10	高尾山													
11	ツゾラオリ	1	32	30	5	鳶尾山	0	27	54.65	西	1	4	35.35	78.91
12	大満寺山	2	42	0	6	大満寺山	1	29	40.50	西	1	12	19.50	76.46
13	横尾山	356	24	20	7	横尾山	355	18	15.66	西			4.34	75.77
14	大山続高	128	51	15	13	甲ケ山	127	49	7.47	西	1	2	7.53	31.50
15	河原山	134	0	0	15	孝雲山	132	56	19.12	西	1	3	40.88	21.20
16	大山右高	137	5	30	14	弥山	136	1	21.65	西	1	4	8.35	30.33
17	大山左高	136	10	0	31	大山剣ケ峰	135	13	2.53	西	0	56	57.47	30.74
18	大山右続高	148	31	0	16	金ケ谷山	147	33	59.37	西	0	57	0.63	42.32
19	甲	153	59	36	17	毛無山	153	0	56.00	西	0	58	40.00	41.36
20	乙	155	38	15	32	毛無山南西	154	33	3.41	西	1	5	11.59	41.75
21	丙	165	0	50	18	明智岬南東	163	56	14.22	西	1	4	35.78	45.85
22	丁	170	40	0	19	花見山	169	35	32.73	西	1	4	27.27	46.87
23	経来寺山	214	8	45	20	経羅木山	213	5	40.99	西	1	3	4.01	23.96
24	星上山	219	27	0	21	星神山	218	20	41.56	西	1	6	18.44	25.43
25	天狗山	220	0	30	23	天狗山	218	59	16.63	西	1	1	13.37	32.57
26	備後比丘尼山	233	50	0	23	男三瓶山	232	58	21.93	西	0	51	38.07	78.39
27	羽倉山	242	1	40	23	和久羅山	241	11	20.75	西	0	50	19.25	20.97
28	笹山	244	30	50	26	高山	243	36	3.40	西	0	54	46.60	20.33
29	仏教山	252	23	45	24	鼻高山	251	16	53.20	西	1	6	51.80	53.30
30	米子天水桶	172	5	0										
31	米子城山	175	59	0	28	湊山	174	46	46.37	西	1	12	13.63	15.92
32	朝日山	262	0	0	30	三坂山	261	1	15.71	西	0	58	44.29	18.84
33	福浦山	263	4	0	27	高尾山	261	55	18.70	西	1	8	41.30	6.29
34	安安木湊天水桶	209	22	30										
35	十神山	197	20	45	29	十神山	196	9	17.61	西	1	11	27.39	15.50
36	馬ノ口山	278	2	30										

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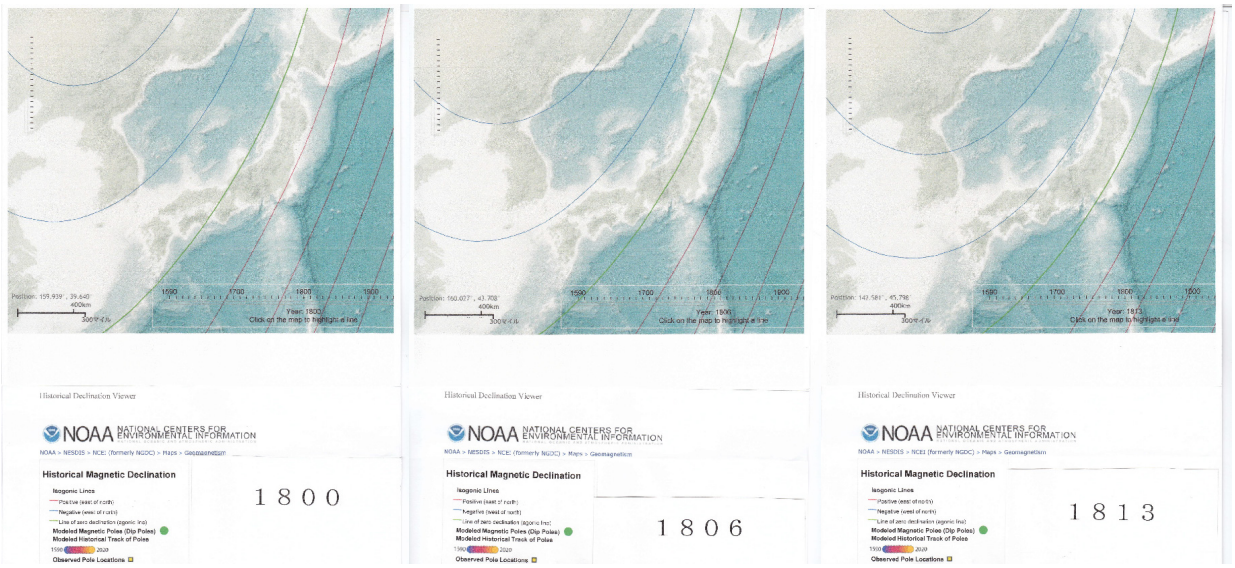
Fig.21 Santou-Houi-Ki vol. 20 Mihonoseki Mt.Hiyoriyama (Inoh Tadataka museum)

Fig.22.23.24 NOAA Historical Declination viewer: declination west, declination 0°, declination east,



Conclusion Proffesor Ryokichi Otani wrote analysis of Santou-Houi-Ki magnetic compass survey azimuth data at only known position of Inoh's retirement home in Fukagawa Edo (Tokyo)1802-3 in his work "Inoh Tadataka"1916, and gave up continuing research by difficulty. Tsujimoto started to research in 1999, from analysis in Tsushima Island, and Akitoshi Omotani compiled Excel formula by the detail order and desire from Tsujimoto. It is impossible to read the content of Santou-Houi-Ki (national treasure of Japan) without mutual verification between research of local history and the highest cartographic analysis in latitude and longitude per under seconds or less, including geomagnetic declination.

From 1639 to 1854, Japan closed the country to Europe except Holland, and Japan was remain in extremely lacking area of historical geomagnetic declination data in the world, but we can change it by this interdisciplinary simultaneous analysis of Santou-Houi-Ki.

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