Report on Geomagnetic Observation at Syowa Base, 1960

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第5次南極地域観測隊地磁気部門報告

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要　旨

昭和基地における地磁気永年変化は，この3年間に約 $\varDelta$H＝－60γ, $\varDelta$Z＝＋340γ, $\varDelta$D＝－37′であることが知られた．なおここで注意すべきは，変化の割合が，1960年は前年よりかなり小さくなっているように見えることである．また，直視磁力計によって得られた昭和基地のK指数に，南極地域の他の7基地のK指数を加え，その平均値をKpと比較した結果，先の論文に述べた結論，即ち 1) 小擾乱は昼間の極域に多く，大擾乱は夜の極域に多いこと，及び，2) 昼間の小擾乱は夜の極域が極めて静穏なときにも現われていること，が再確認された．

Abstract Geomagnetic secular variation at Syowa Base is briefly discussed on the data of absolute measurements during the period from 1958 to 1960. Some discussions are also given on the relationship of K_p to K_s 1959 (the mean K at 8 stations in the southern polar region), concluding that in the dark polar region may occur extremely severe magnetic disturbances as compared with the sunlit polar region, while a slight perturbation persists in the sunlit polar region even for the extremely quiet period in the dark polar region.

1. Introduction

The activity of geomagnetic observation and other related observations in 1960 at Syowa Base is as follows;

1) Continuous recording of geomagnetic three components by a flux-gate electronic magnetograph.

2) Continuous recording of geomagnetic three components by an ordinary optical system of low sensitivity.

3) Absolute measurements by an ERI-type magnetometer.

4) Continuous recording of earth current.

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5) Rock sampling for palaeo-magnetic studies.

The continuous recordings and the absolute measurements were carried out in succession to those in 1959, at the same site and by the same instruments.

2. Geomagnetic secular variation at Syowa Base

The results of absolute measurements at Syowa Base in 1960 are shown in Table 1. The values are combined with the values so far obtained, and the general aspect of secular variation at Syowa Base, reported in the earlier paper,[1] has been almost confirmed by adding the new data of 1960. Namely, the geomagnetic north component decreases slightly at a rate of about -20^{γ}/year, the vertical component increases more rapidly at the rate of $+113^{\gamma}$/year, and the declination shifts westwards about 12′/year, with a little reduction of the changing rates in 1960. The tendency of the reduction of the rates in 1960 seems to be quite important, if it is true, because the fact seems to suggest that the geomagnetic field values at Syowa Base are now close to their maximum (or minimum) values, and that they may recover in the near future. It is, however, difficult to reach a definite conclusion at present, because of the short term of observation.

3. *K*-indices at Syowa Base in 1960

K-indices of 1960 were derived from the data of flux-gate electronic magnetograph, in continuation of the previous values[2] of 1959, with the minimum range in $K=9$ of 2500 gammas. The indices thus obtained in 1960 are given in Table 2, where the period of recording trouble is left in blank.

The statistical treatments have shown that the results of 1960 are as a rule in good agreement with those of 1959; namely, 1) the total distribution pattern of the indices is quite similar to that obtained in 1959, 2) that the pattern in the daytime shifts to larger side than in the nighttime, so that the most frequent K values in the daytime (about 4) are about twice those in the nighttime, and 3) that the large K values are larger than corresponding K_p, whereas the small K are smaller than corresponding K_p, in north summer (June solstice).

4. Relationship between K_p and mean value of K in the southern polar region.

This section is an outgrowth of the previous papers[2),3)] which attempted to clarify the relationship between the magnetic activities in the northern polar region and those in the southern polar region. In this attempt, the previous work was not satisfactory because the data were only those at Syowa Base in the southern polar region. The data used here were obtained in 1959 at 8 stations in the southern polar region, namely Syowa Base, Mawson, Wilkes, Mirny, Vostok, Hallett, Scott and Macquarie

Island. The mean value of the 8 stations' K is regarded as the representative of the storminess in the southern polar region.

Table 1. The result of absolute measurements.

Date		Time (G. M. T.)	D	H	Z
Mar.	22	1325	44° 15′	w 18960γ	43340γ
		1349	44 19	18912	43190
Apr.	11	1254	44 27	18866	43182
		1326	44 28	18841	43182
May	27	1048	44 49	18791	42868
June	17	0901	44 35	—	—
		1042	44 40	19045	43326
		1057	44 33	18868	43078
July	8	1029	44 48	18977	43254
		1102	44 47	19003	43252
	28	0651	45 07	18819	43095
		1040	44 43	18925	43130
		1059	44 30	18728	42829
Aug.	25	0617	44 33	19011	43352
		0634	44 41	19096	43477
		0647	44 40	18963	43200
Oct.	21	1115	44 40	18876	43160
		1130	44 37	18976	43362
		1150	44 34	18963	43205
		1209	44 37	—	—
		1215	44 37	—	—
Nov.	9	1051	44 39	19056	43496
		1115	44 36	19120	43784
		1155	44 38	18917	43172
		1104	44 36	18991	43332
		1124	44 40	—	—
	30	1052	44 37	18929	43158
		1105	44 44	18982	43297
		1115	44 41	18932	43139
		1130	44 29	18940	43168
		1140	44 32	18905	42877
Dec.	12	1400	44 37	18933	43000
		1410	44 32	19037	43209
		1422	44 36	19001	43176
		1434	44 32	19020	43164
		1443	44 33	18778	42677
Jan.	5	1228	44 40	—	—
		1242	44 42	—	—
		1258	44 44	19026	43373
		1308	44 41	18982	43225
		1319	44 37	18945	43142
		1332	—	18905	43205
	15	1120	44 40	19085	43370
		1135	44 42	19043	43390
		1158	44 47	18937	43192
		1212	44 41	18893	42970
		1326	44 32	18954	43136
		1344	44 33	18969	43242

Table 2. The three hour range index *K* at Syowa Base.

Day \ Month	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	14422110	55322353	79567676	65543325	57644212	55543253	55323224	12211113	56544366	45222236	58655677
2	14223445	54533245	66554444	56332322	20101112	65443212	45432235	12213335	67644556	55333245	35334455
3	34323446	55433345	57843333	33221112	00111135	34322235	43322114	66622134	43332124	64333245	45222332
4	45333454	43214445	24221236	23110144	46642224	55332334	54232121	45764478	32213666	57645445	22213323
5	33334435	35422256	44522533	32332335	66653333	54432235	21122022	75664456	55323436	45323222	23213332
6	55532322	34321233	44333345	64333667	66432212	63232211	21231222	55631236	77776577	22232233	33233456
7	44222222	31111012	45222445	54344546	65322123	01110112	54111100	43333356	87665566	44320011	34223346
8	22333332	23323113	55332324	58686646	46432247	22101000	23322455	55322322	65333345	02211203	45533222
9	44223111	32232212	45432223	54332311	65532341	20111012	76632122	55332235	66633347	43212212	44334345
10	23322222	23342443	44333357	23223236	32110223	44111124	43431343	43322453	66222245	12122212	44232333
11	12122443	55333444	53333334	56742135	54211120	33221123	36333332	55221235	44523223	34343324	23223///
12	43221222	43223313	76552336	25633215	11211100	53323102	55533223	44332133	31111125	32224766	///33465
13	12231045	32100124	56643225	53322234	32101110	54413244	43222223	56421145	12111112	78998786	4664322/
14	45423376	11112200	53322234	45532112	32223133	25332444	44222356	65311123	22113111	55433466	/3332///
15	22223332	11112455	46422223	12222122	31332223	33334778	54110101	22213112	23212545	55536678	—
16	54332436	66531456	54224456	21113545	33300000	76644546	31023566	31120011	43211114	77655545	—
17	54433345	34431253	65333355	41313212	43001122	65542335	78654546	34210255	41211123	64323454	—
18	55642343	34521005	64532313	33310002	43323221	45411422	43432113	44321114	54423464	54210101	—
19	33332465	32222222	33212222	41311123	44442244	12553356	32211356	41211125	34311134	23222101	—
20	54323225	33210101	21113221	12100011	54323124	53222246	24722235	11111125	33222324	33332213	—
21	55433323	22222200	23321002	31011000	46433344	46212214	55441346	51211335	32211124	25545545	—
22	21222244	12011013	21112011	00111311	55221124	44421226	63311134	43110134	21110001	54323435	—
23	33212301	41010003	12111035	21112365	54401224	73210003	4431121/	44430116	31110133	43322233	—
24	22111001	54120233	55632357	55633256	44322364	44211123	43321222	65542333	22122445	43222335	—
25	22111123	11210004	65544566	54322345	43322476	12200023	22212221	11220123	23655966	46444465	—
26	22112313	42120000	65331346	75432336	76533335	11111225	11101125	32210135	56644456	34233244	—
27	44523334	33110000	52211257	65210134	86642456	33110012	54211344	55412243	55344457	43333454	—
28	32221111	12132344	65653545	22212154	43453445	11111014	25412222	32222233	66544544	55334123	—
29	44522134	44432116	66643467	65433244	66511346	65513554	67632255	31212345	64444546	42222134	—
30	—	62221345	77668876	42334223	66423345	64434222	58733334	45323455	54443446	35222334	—
31	—	55566658	—	33121214	—	76652436	55333214	—	64333455	—	—

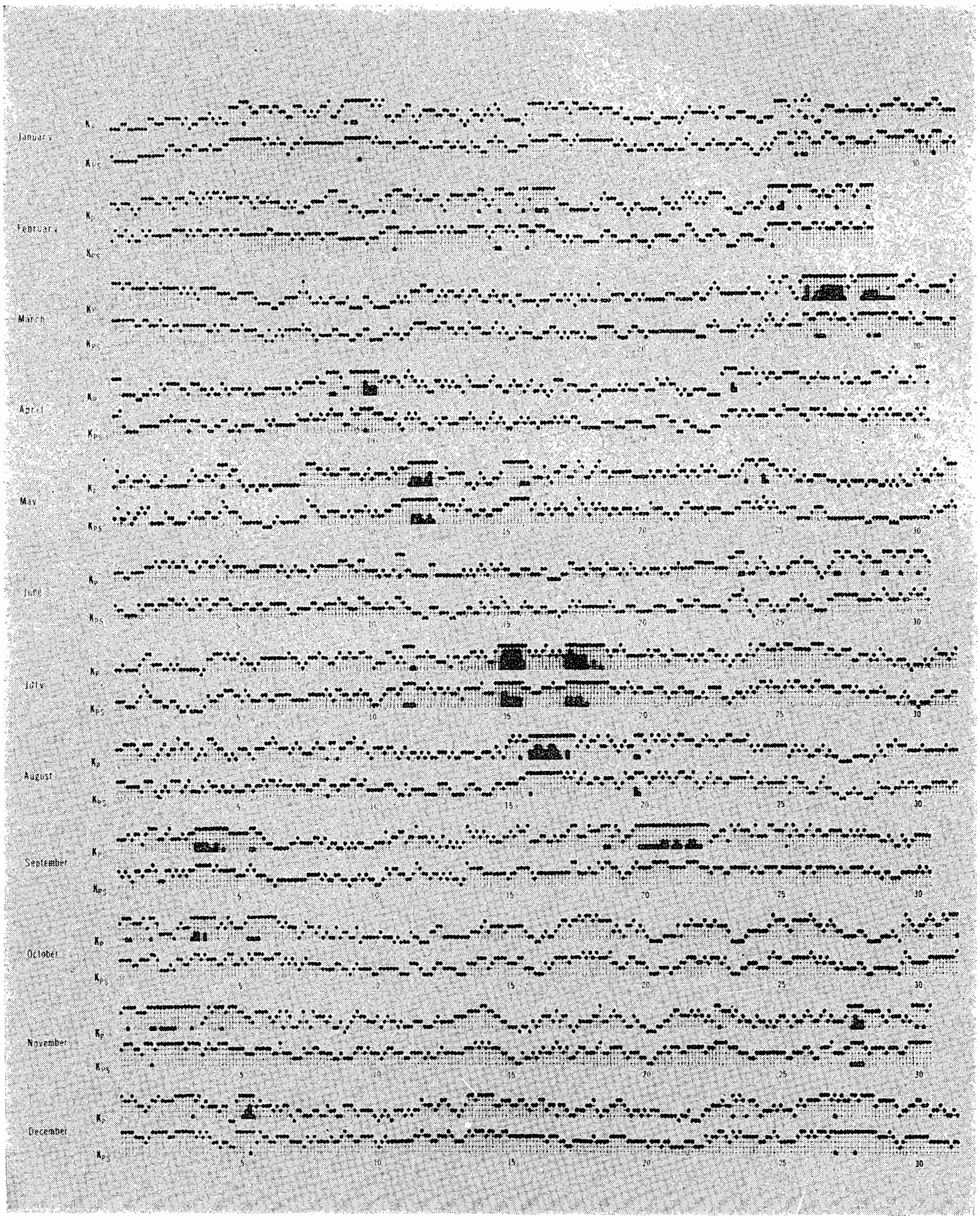

Fig. 1. Average K indices at 8 stations in the southern polar region in connection with K_p in 1959.

The mean values of K's ($\overline{K_s}$) are compared with the corresponding K_p values, and the result is diagrammed in Fig. 1 where the parallelism of changes in both K_p and $\overline{K_s}$ is clearly shown. In order to examine the seasonal change in the relationship, the results shown in Fig. 1 is reproduced in the form of correlation between K_p and $\overline{K_s}$ as seen in Fig. 2. In the figure, each regression line represents the mean relation between K_p and K_s in each solstice. The figure seems to give a strong indication of the validity of the conclusion mentioned in 3-3 to be further extended to the average relationship in the activity between the northern polar region and the southern polar region.

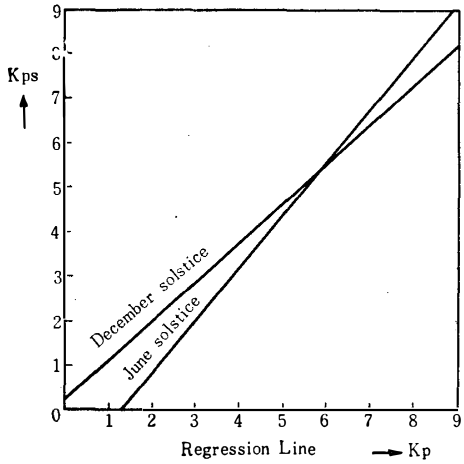

Fig. 2. Correlation between $\overline{K_s}$ and corresponding K_p.

The results may be summarized as follows;

As has been already noticed in the previous paper, here in Fig. 2 is seen also systematic seasonal change in the relationship between $\overline{K_s}$ and K_p. That is, the severe disturbances prefer the dark polar region to the sunlit polar region, while the small disturbances persist in the sunlit polar region even for the extremely quiet period in the dark polar region.

The fact may give a clue to what is happenning in partition of energy brought from solar plasma into the northern and the southern polar regions. It suggests that the energy inflow into the earth's atmosphere is continual and no (or a little) reservation of energy takes place in the sunward polar region and the situation is almost contrary in the dark polar region. In other words, the inflow is dammed by a weak barrier which is overflowed frequently with a small energy efflux for one occasion into the earth's atmosphere in the sunward polar region, while in the dark side, the inflow is reserved by a strong barrier which is overflowed much less frequently and with a large energy efflux. Perhaps it is due to the change in configuration of instable region,[4] relative to the solar stream, of the boundary layer of the magnetosphere, which may be identified intuitively to the boundary region intersected perpendicularly by the geomagnetic lines of force.

The nature of the instable region must be examined further, especially in a theoretical way, in order for the nature of the instable region to be the dominant cause of the barrier against the energy inflow, though here in this paper is given only the observed fact as an introductory remark.

5. Rock sampling for palaeomagnetic studies

Sampling of rocks for palaeomagnetic studies during the fourth wintering was carried out mostly around the Sirase Glacier, the Yamato Mountains and the Kasumi Rock (Mondai-iwa). The locations are shown in Fig. 3.

The palaeomagnetic studies are now going on.

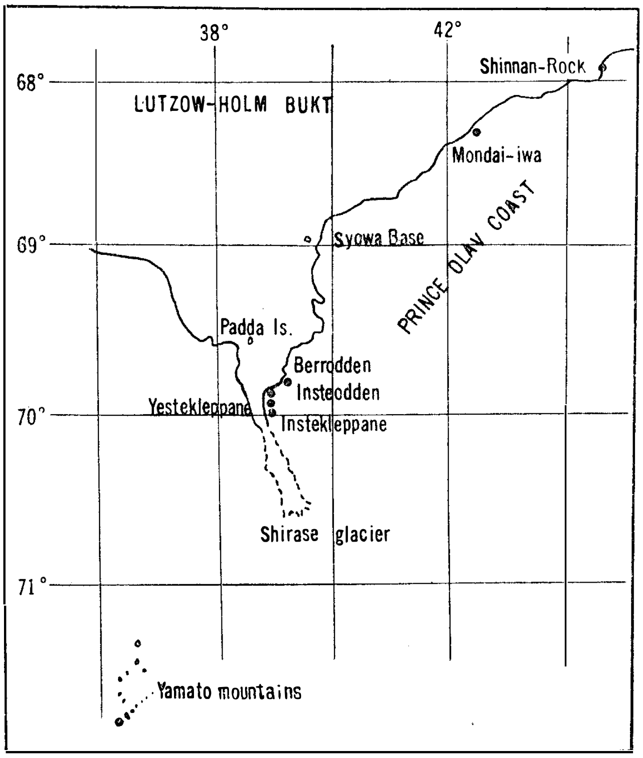

Fig 3. Location of rock sampling.

References

1) T. Nagata: Antarctic Rec., No. **11**, 217 (1961).
2) T. Nagata and S. Kokubun: ibid., No. **11**, 204 (1961).
3) T. Oguti: ibid., No. **13**, 10 (1961).
4) for example, D. B. Beard: J. Geophys. Res., **65**, 3559 (1960).

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