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11. *Studies of the Thermal State of the Earth. The 12th Paper: Terrestrial Heat Flow Measurements in Hokkaido District, Japan.*

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Abstract

Terrestrial heat flow was measured at 6 localities in Hokkaido District. Of these 6 localities, 3 (Akabira, Ashibetsu, Haboro) are coal mines and the other 3 (Shimokawa, Konomai, Toyoha) are metal mines. Geothermal gradient was assessed from underground temperature distribution measured in each of these localities. The gradients are 2.48°*C*/100 *m* at Akabira, 3.08°*C*/100 *m* at Ashibetsu, 4.54°*C*/100 *m* at Haboro, 2.84–3.24°*C*/100 *m* at Shimokawa and 3.81–4.10°*C*/100 *m* at Konomai. In Toyoha, the gradient amounts to 11 °*C*/100 *m*. Geothermal heat flux was calculated combining the thermal gradient with thermal conductivity of rocks in each locality. The values of flux are 1.07×10^{-6} *cal/cm*^{2} *sec* in Akabira, 1.35×10^{-6} *cal/cm*^{2} *sec* in Ashibetsu, 1.87×10^{-6} *cal/cm*^{2} *sec* in Haboro, $1.60–1.82\times10^{-6}$ *cal/cm*^{2} *sec* in Shimokawa, $2.44–2.63\times10^{-6}$ *cal/cm*^{2} *sec* in Konomai, and in Toyoha the flux seems to exceed 5×10^{-6} *cal/cm*^{2} *sec*. The results seem to indicate that the heat flow exceeds 2×10^{-6} *cal/cm*^{2} *sec* in the western and northeastern parts of the District, while other areas show moderate heat flow i.e. on the 1×10^{-6} *cal/cm*^{2} *sec* level.

1. Introduction

The present report is the fifth and last of a series of papers describing the heat flow survey over Japanese Islands conducted by the Earthquake Research Insititute.[1)2)3)4)] In Hokkaido District there has so far been no data of terrestrial heat flow. In the present paper, 6 sets

1) S. Uyeda and K. Hôrai, *Bull. Earthq. Res. Inst.*, 41 (1963), 85.
2) S. Uyeda and K. Hôrai, *Bull. Earthq. Res. Inst.*, 41 (1963), 109.
3) K. Hôrai, *Bull. Earthq. Res. Inst.*, 41 (1963), 137.
4) K. Hôrai, *Bull. Earthq. Res. Inst.*, 41 (1963), 149.

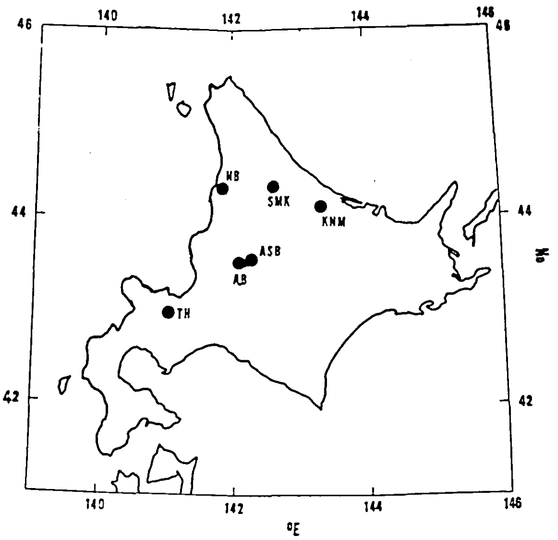


Fig. 1. Localities of heat flow stations in Hokkaido District.

HB:	Haboro	ASM:	Ashibetsu
SMK:	Shimokawa	AB:	Akabira
KNM:	Konomai	TH:	Toyoha

of data will be presented. The localities are shown in Fig. 1. They are three coal mines i. e. Akabira, Ashibetsu and Haboro coal mines and three metal mines, i, e, Shimokawa Cu–Fe mine, Konomai Au–Ag mine and Toyoha Pb–Zn–Fe mine.

2. Haboro

Underground temperature was measured in a borehole in Haboro Town (Fig. 1 and Fig. 2). The borehole in which temperature was measured is the borehole Haboro No. 2 drilled for the purpose of coal-prospecting by the Haboro Tanko Tetsudo Co., Hokkaido. The position of the borehole is indicated in Fig. 2.

Temperature was measured to a depth of 350 m along the hole. Observed temperatures are shown in Fig. 3 as a function of depth. Thermal gradient amounts to $4.55 \pm 0.05°C/100\ m$.

Core samples of the borehole Haboro No. 2 were not available, but those from the borehole Haboro No. 8 were obtained. In Fig. 2 the position of Haboro No. 8 is also marked. Rocks cut through the boreholes are interbeds of sandstone and mudstone belonging to the

Neogene formation.[5] Considering the porosity of these rocks, thermal conductivity was measured after the samples were saturated with

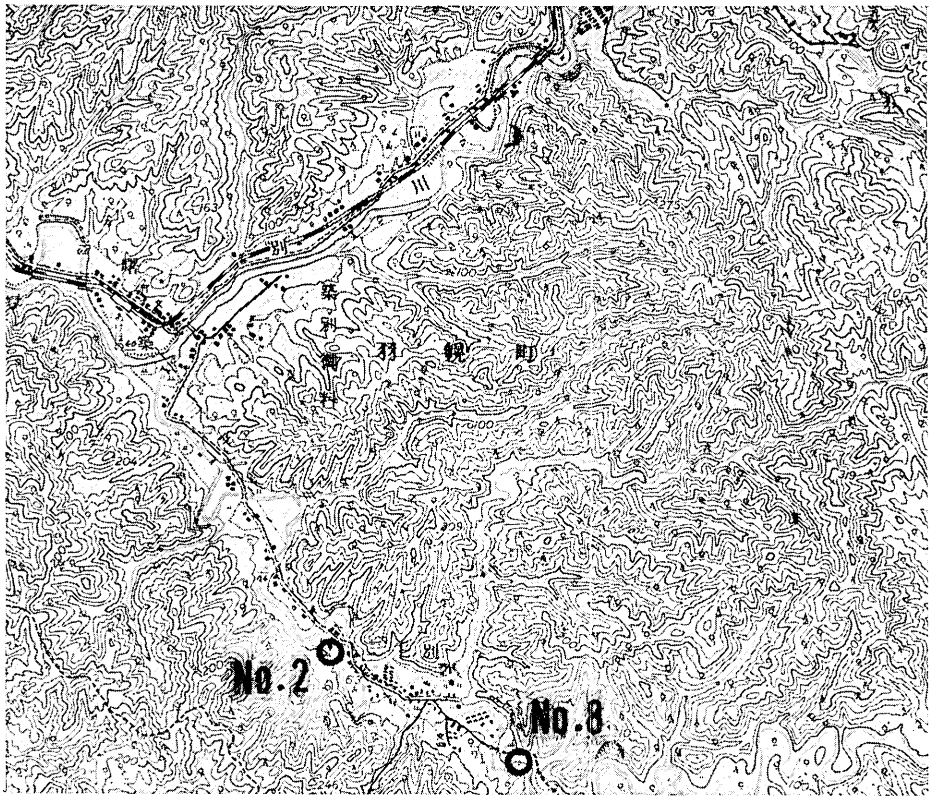


Fig. 2. Localities of the boreholes Haboro No. 2. and No. 8. The map covers the area from 44°20′ N to 44°23′ N in latitude and from 141°50′ E to 141°55′ E in longitude.

Table 1

Specimen	Rock type	Thermal conductivity $\left(10^{-3}\ cal/cm\ sec\ °C\right)$	Temperature during measurement (°C)	Density (gr/cm^3)
HB III	Sandstone	4.06 *	31.4	2.04 **
IV	Sandstone	5.82 *	31.8	2.05 **
V	Tuff	3.69 *	31.9	1.98 **
VI	Sandstone	3.70 *	31.4	2.10 **
VII	Mudstone	3.32 *	31.4	1.86 **

* Measured in water saturated state.
** Measured in desiccated state.

5) S. HÂTTORI, Private Communication.

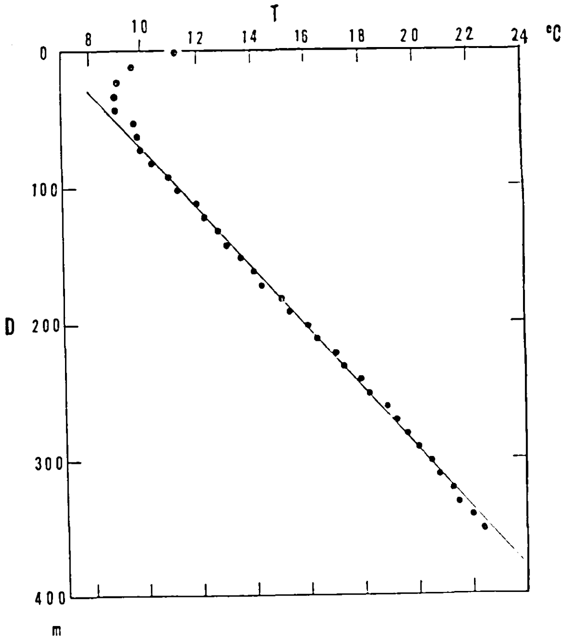


Fig. 3. Temperature-depth relation in borehole Haboro No. 2.

water. The result is listed in Table 1. Mean thermal conductivity is $4.12 \times 10^{-3} (\frac{R}{2}=0.61 \times 10^{-3})$ *cal/cm sec* °*C*.

Heat flow in this area was estimated to be 1.87×10^{-6} *cal/cm*^{2} *sec* combining the thermal gradient with the thermal conductivity obtained here.

3. Shimokawa

Heat flow measurement was made at Shimokawa Mine (Fig. 1, Fig. 4), Hokkaido. Rock temperature was measured in the boreholes in the

Table 2. Temperature stations is Shimokawa Mine

Level	Altitude of site (*m* above sea level)	Depth from surface (*m*)	Rock temperature (°*C*)
3, upper	349	149	8.5
1, upper	293	257	12.0
Adit	260	290	13.0
2, lower	193	399	15.2
4, lower	142	458	17.1
6, lower	82	493	18.8
7, lower	53	533	19.7

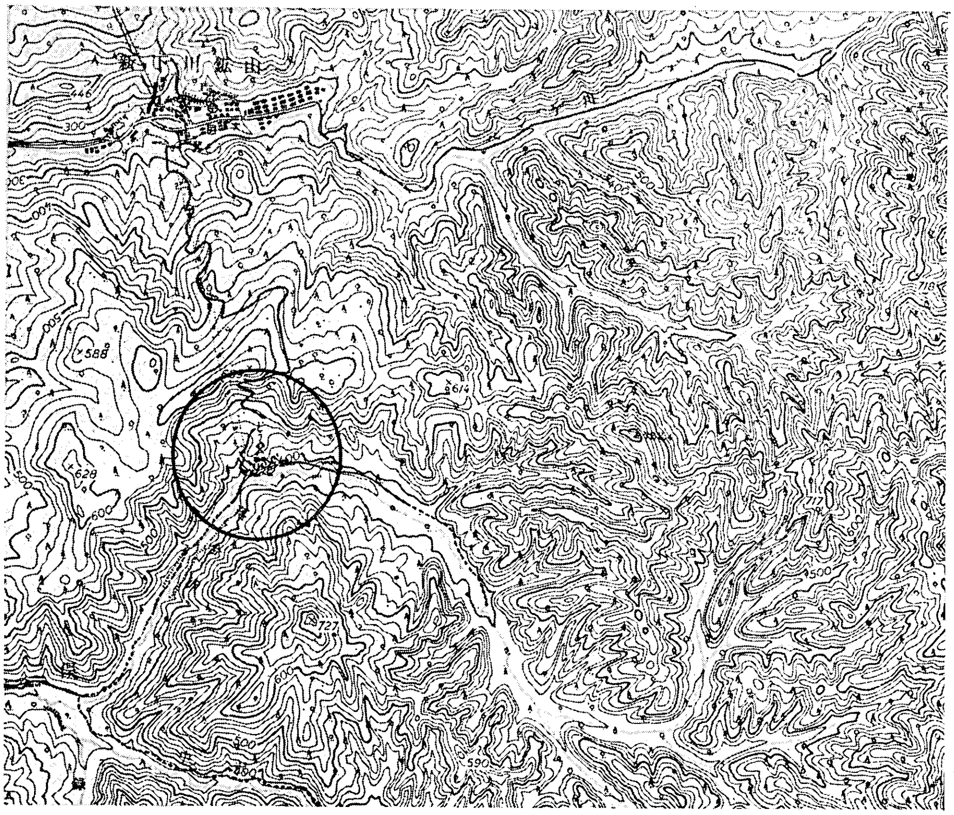


Fig. 4. Area under investigation in Shimokawa Mine. The map covers the area from 44°12′ N to 44°15′ N in latitude and from 142°40′ E to 142°45′ E in longitude.

drifts of the mine (44°13′N, 142°41′E). The depth of the drifts varies about 300 *m* ranging from 50 *m* to 350 *m* above sea level as shown in Table 2. In Fig. 4, the area under investigation is indicated.

The result of temperature measurement is shown in Fig. 5 and Fig. 6. In Fig. 5 the altitude of the location where temperature was measured is taken as the ordinate against temperature, while in Fig. 6 the depth of the location from the ground surface is taken as the ordinate. Both figures show fairly clear linear relation between temperature and depth or altitude. This feature indicates that whether the isotherms are horizontal regardless of the surface topography or are parallel to the surface is indeterminate from the data obtained here. Thermal gradient is 2.84 $\pm 0.12°C/100\,m$ on the assumption of parallel isotherm and 3.24 ± 0.06 $°C/100\,m$ on the assumption of horizontal isotherm.

Rocks around the area under investigation are slate and spilite belonging to the Hidaka group.[6] Thermal conductivity was measured on the spilite samples only (Table 3), because no slate samples could be shaped owing to their fragility. Mean thermal conductivity of spilite is 5.63×10^{-3} *cal/cm sec °C*.

Heat flux amounts to 1.60 or 1.82×10^{-6} *cal/cm² sec* corresponding to the values of thermal gradient. Some indefiniteness will remain with the heat flow values thus determined, due both to the alternative isotherm types and to the incompleteness of thermal conductivity data of the strata concerned.

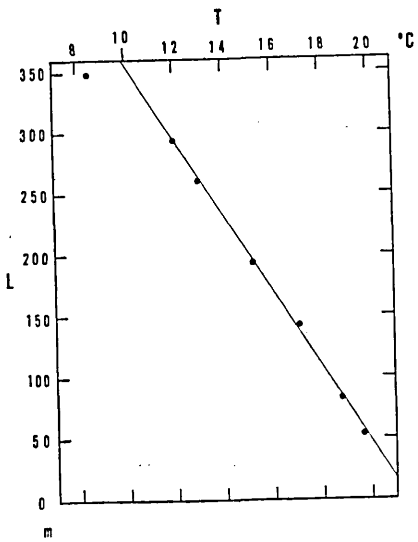


Fig. 5. Underground temperature in Shimokawa Mine plotted against the altitude.

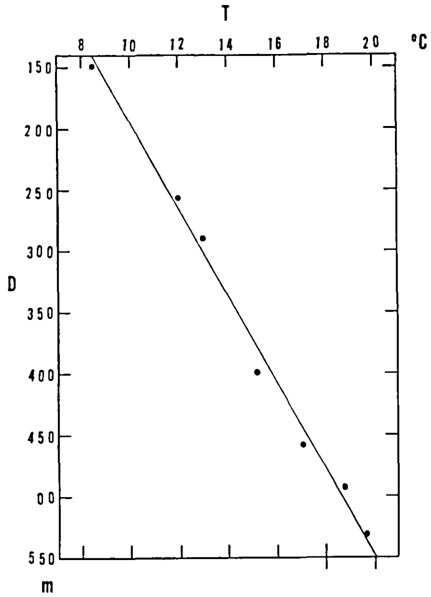


Fig. 6. Underground temperature in Shimokawa Mine plotted against the depth.

Table 3

Specimen	Rock type	Thermal conductivity (10^{-3} *cal/cm sec °C*)	Temperature during measurement (°C)	Density (*gr/cm³*)
SMK I	Spilite	6.18	32.7	2.85
II	Spilite	5.08	32.9	2.85

6) T. WATANABE, Ed., *Progress in Economic Geology* (Fuzanbo, Tokyo, 1956).

4. Konomai

Thermal gradient was assessed from the temperatures in the drill holes cut in the drifts of Konomai Mine, Hokkaido (Fig. 1, and Fig. 7).

Temperature was measured in 17 boreholes in the mine. Of these 17 boreholes, No. 1, No. 2, No. 5 are boreholes drilled vertically or slantwise, in which temperature was measured every 10 *m*, while the other 14 boreholes are cut nearly horizontally to the walls of the drift in which temperature was measured at the furthest end. The temperature stations mentioned above are listed in Table 4.

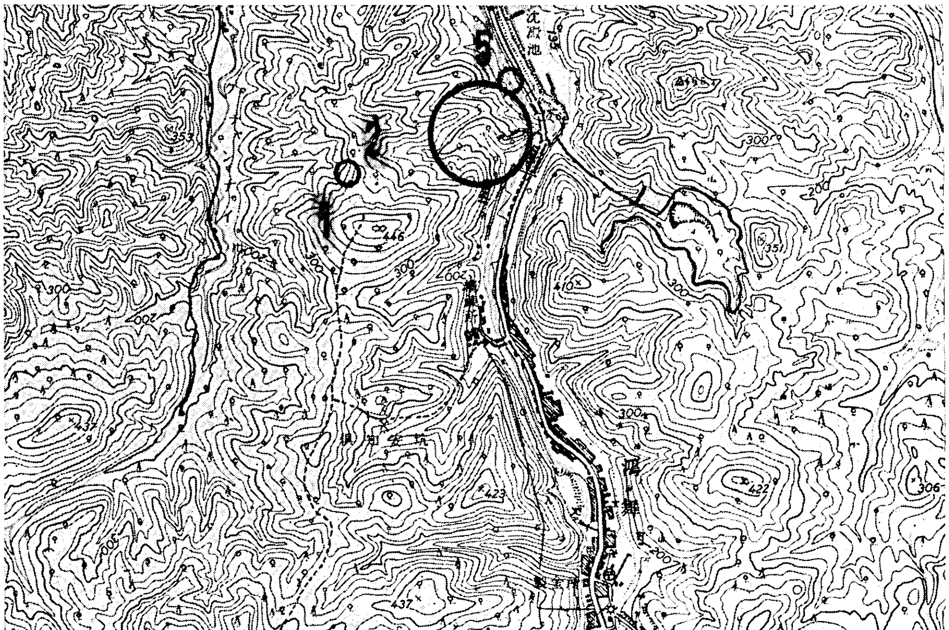


Fig. 7. Localities of boreholes used in Konomai Mine. Boreholes other than No. 1, No. 2 and No. 5 are situated around the large circle indicated. The map covers the area from 44°07′ N to 44° 10′ N in latitude and from 143°18′ E to 143°23′ E in longitude.

The temperatures are shown in Fig. 8. Thermal gradient is 4.10 ± 0.06°C/100 m along the 235 m long vertical borehole (No 5), and 3.81 ± 0.09°C/100 m along the 145 m long vertical and slant boreholes (No. 1 and No. 2) cut in nearly the same place. All the data from shallower

Table 4. Temperature stations in Konomai Mine

No.	Locality of boring site	Dip of bore	Altitude of site (m above sea level)	Depth of site (m)	Rock temperature (°C)
1	430 ML, W 90 B	−90°	−61	381	see Fig. 8
2	430 ML, W 90 B	−73°	−61	381	see Fig. 8
3	430 ML, E 230 B	0°	−53	256	15.1
4	430 ML, E 260 B	0°	−53	243	15.8
5	430 ML, E 300 B	−90°	−49	163	see Fig. 8
6	430 ML, E 310 B	0°	−48	159	13.9
7	390 ML, E 290 B	0°	−14	159	11.9
8	390 ML, E 300 B	0°	−13	133	14.8
9	350 ML, E 275 B	0°	+17	183	13.1
10	350 ML, E 310 B	0°	+19	114	10.0
11	350 ML, E 310 B	0°	+19	116	10.7
12	310 ML, E 285 B	0°	+57	113	11.6
13	310 ML, E 330 B	0°	+58	61	9.4
14	310 ML, E 330 B	0°	+58	63	9.4
15	270 ML, E 165 B	0°	+90	125	12.7
16	270 ML, E 165 B	+15°	+90	125	12.7
17	270 ML, E 185 B	0°	+91	111	11.9

Table 5

Specimen	Rock type	Thermal conductivity (10^{-3} cal/cm sec °C)	Temperature during measurement (°C)	Density (gr/cm³)
KNM I	Propylite	6.16	33.1	2.39
II	Propylite	5.70	31.7	2.69
III	Shale	5.38	31.8	2.45
IV	Quartz vein	7.70	31.9	2.53
V	Tuff	4.18	31.9	1.99
VI	Siliceous tuff	6.84	31.5	2.38
VII	Liparitic tuff breccia	6.74	31.5	2.39
VIII	Liparitic tuff breccia	9.21	31.7	2.48
IX	Liparite	5.75	31.8	2.17

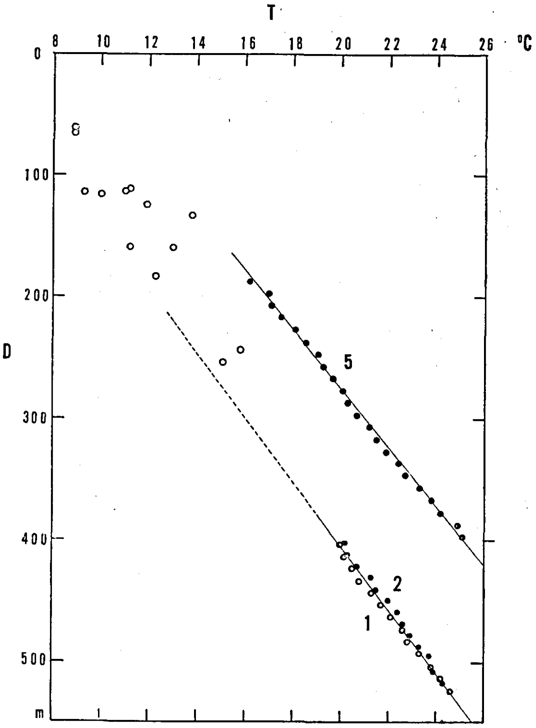


Fig. 8. Temperature-depth relations in Konomai Mine. Numbers refer to the names of boreholes. Hollow circles are for shorter horizontal boreholes.

horizontal boreholes are also plotted in Fig. 8. They seem to support the data from the deeper holes but were not used in computation of the geothermal gradient.

Geology around the mine is composed of the Hidaka group belonging to the pre-Tertiary ages, and the Konomai and Shanabuchi groups and volcanics belonging to the neo-Tertiary covering or intruding the pre-Tertiary formation.[7] Rock samples of shale, tuff, liparite, and propylite were collected and their thermal conductivity was measured. The result is as indicated in Table 5. Mean thermal conductivity is 6.41×10^{-3} *cal/cm sec °C* ($\frac{R}{2} = 1.90 \times 10^{-3}$ *cal/cm sec °C*).

The heat flow is computed to be 2.63×10^{-6} *cal/cm² sec* from the above-mentioned data.

7) T. AMAMORI, Private communication.

5. Akabira

Underground temperature was measured using boreholes drilled from the surface and in the drifts of Akabira coal mine, Hokkaido (Fig. 1 and Fig. 9). The boreholes used and the temperature in them are listed in Table 6, and shown in Fig. 10.

Thermal gradient was assessed to be $2.49 \pm 0.04°C/100\,m$ combining the data of temperature measurement made by the borings drilled from the surface and those cut in the drifts as is shown in Fig. 10. The deepest drift used was about $700\,m$ beneath the earth surface. In Fig. 9, the location of the borings is indicated.

Rocks in the area investigated are sandstone belonging to the old-Tertiary formation and schist presumably belonging to the Kamuikotan metamorphic zone.[8] Thermal conductivity was measured on the samples of sandstone and schist collected from the walls of the drift of the mine. The result is listed in Table 7. The mean value of the conductivity is $4.31 \times 10^{-3}\,cal/cm\,sec\,°C$ $(\frac{R}{2} = 0.72 \times 10^{-3}\,cal/cm\,sec\,°C)$.

The heat flux, thus, amounts to $1.07 \times 10^{-6}\,cal/cm^2\,sec$ according to the above-mentioned data.

Table 6. Temperature stations in Akabira Mine

Borehole	Depth from ground surface (m)	Rock temperature ($°C$)	Remarks
A 19	15.6	9.0	Surface boring
	25.6	9.1	
	35.0	9.2	
U 15	15.6	9.1	Surface boring
	25.6	9.2	
	35.6	9.5	
	45.6	9.9	
	55.6	10.1	
	65.6	10.2	
	73.4	10.5	
−550 ML, No. 1	700	26.0	Short borehole from the drift.
−550 ML, No. 2	700	26.6	
−550 ML, No. 3	700	24.8	
−350 ML, No. 1	500	21.9	
−350 ML, No. 2	500	21.3	

8) S. YOSHII, Private communication.

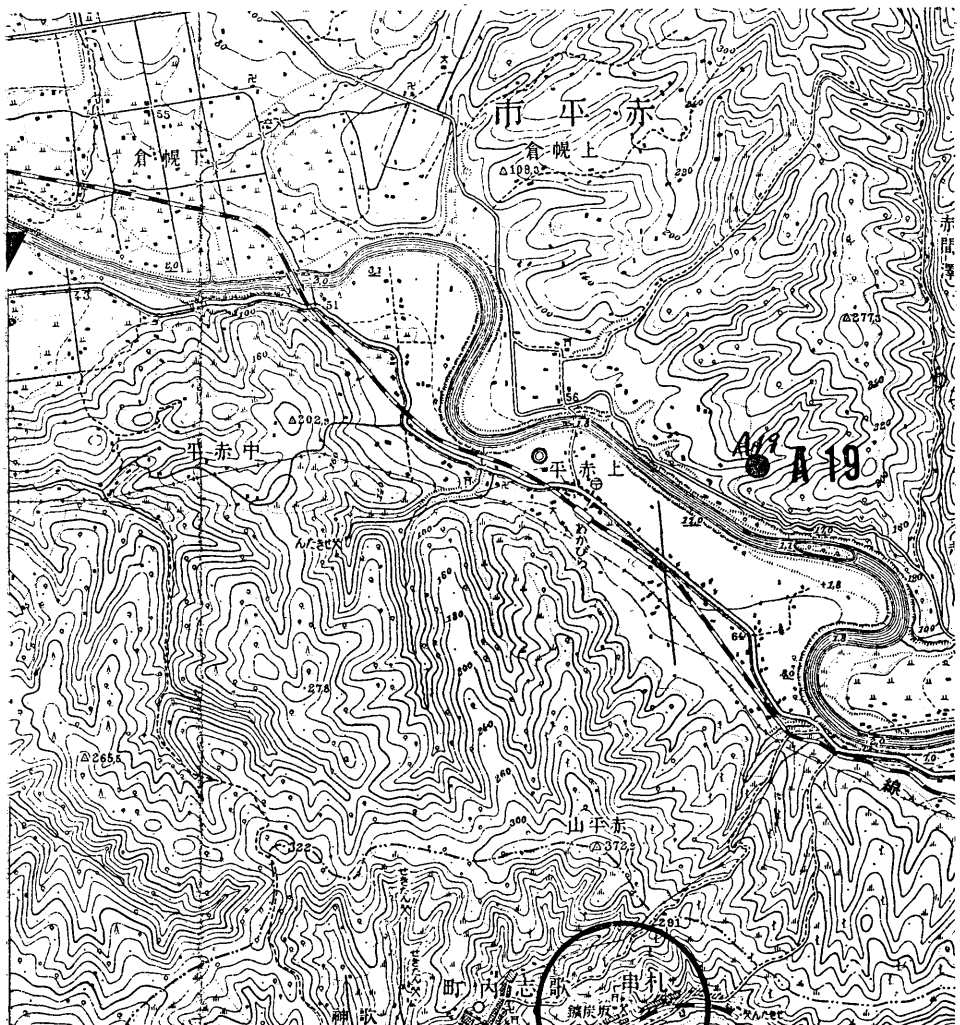


Fig. 9. Localities of boreholes used in Akabira Coal Mine. The map covers the area from 43°30′ N to 43°35′ N in latitude and from 142°00′10″4 E to 142°05′10″4 E in longitude.

Table 7

Specimen	Rock type	Thermal conductivity (10^{-3} $cal/cm\ sec\ °C$)	Temperature during measurement (°C)	Density (gr/cm^3)
AB Ia	Schist	3.44	29.2	2.52
Ib	Schist	3.75	29.0	2.50
IIa	Sandstone	5.23	29.7	2.48
IIb	Sandstone	4.82	29.4	2.48

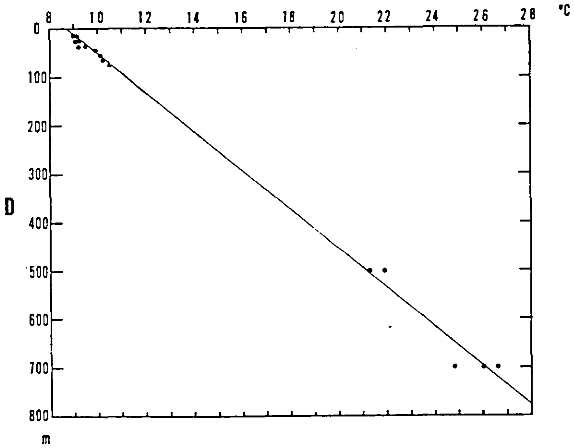


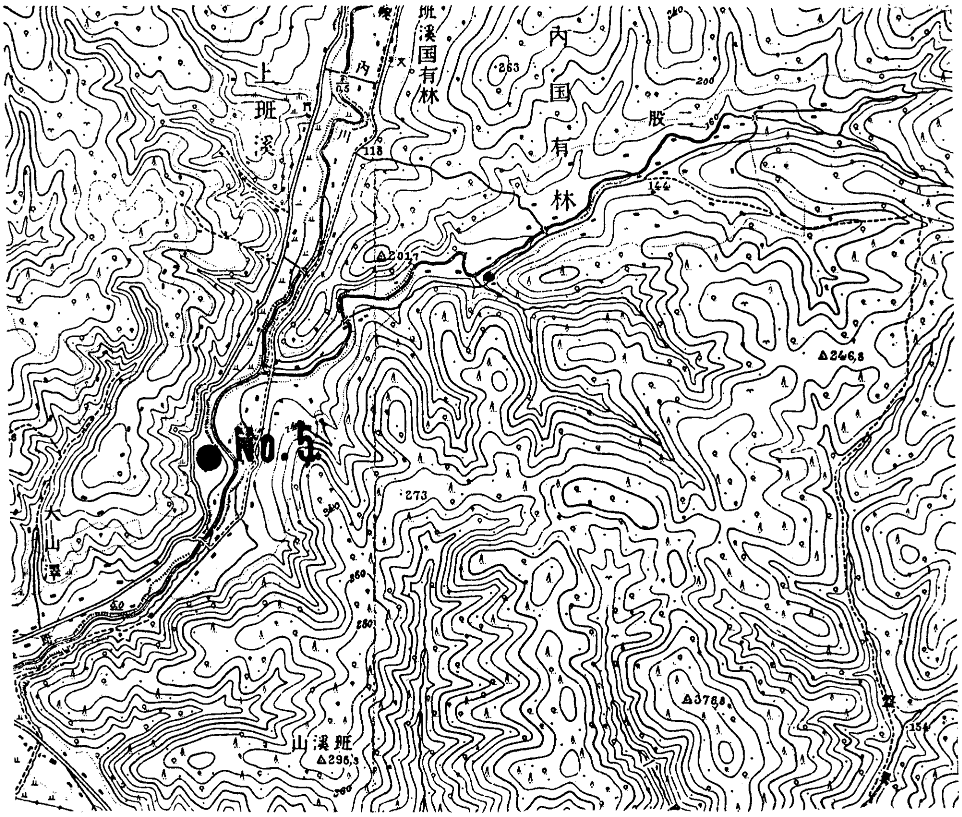
Fig. 10. Temperature-depth relation in Akabira Coal Mine.

6. Ashibetsu

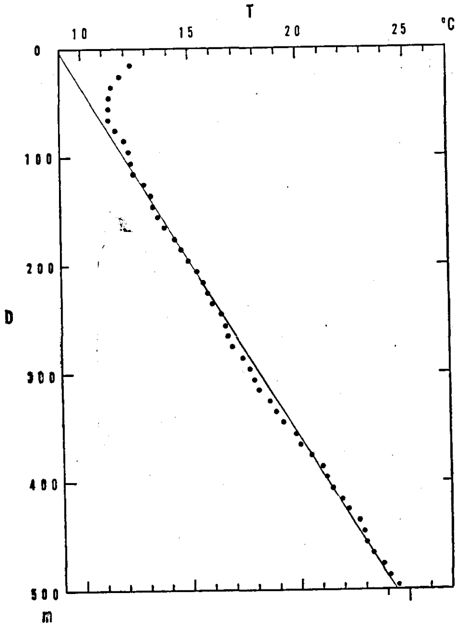
A borehole (Ishikari No. 5 at 43°33′N, 142°12′E), drilled from the surface for prospecting of coal by the Mitsui Mining Co., was used for our underground temperature survey in Ashibetsu Coal Mine (Fig. 1 and Fig. 11). The depth of the borehole was about 500 m at the time of measurement, and the geothermal gradient obtained from the data, shown in Fig. 12, is 3.08 $\pm 0.03°C/100\ m$.

The geology of the strata penetrated by the borehole is an interbedding of shale and sandstone of older Tertiary age.[9] Thermal conductivity measurements were made on specimens of the core samples recovered from the borehole. The mean value of the conductivities shown in Table 8 is $4.38\times10^{-3}\ (\frac{R}{2}=0.72\times10^{-3})\ cal/cm\ sec\ °C$. The amount of heat flux is estimated as $1.35\times10^{-6}\ cal/cm^2\ sec$ from the above data.

9) H. IFUKU, Private communication.



↑ Fig. 11. Locality of the borehole used in Ashibetsu Coal Mine. The map covers the area from 43°32′ N to 43°35′ N in latitude and from 142°10′ E to 142°15′ E in longitude.



← Fig. 12. Temperature-depth relation in the borehole Ishikari No. 5, Ashibetsu Coal Mine.

Table 8

Specimen	Rock type	Thermal conductivity (10^{-3} cal/cm sec °C)	Temperature during measurement (°C)	Density (gr/cm^3)
ASB I	Shale	3.50	28.0	2.49
II	Shale	5.00	28.1	2.49
III	Shale	4.83	28.0	2.49
IV	Shale	3.77	28.1	2.47
V	Shale	3.61	28.3	2.55
VI	Sandstone	5.58	28.5	2.51

7. Toyoha

Detailed investigation of the underground rock temperature distribution was carried out at Toyoha Mine (Fig. 1 and Fig. 13), Toyoha Mining

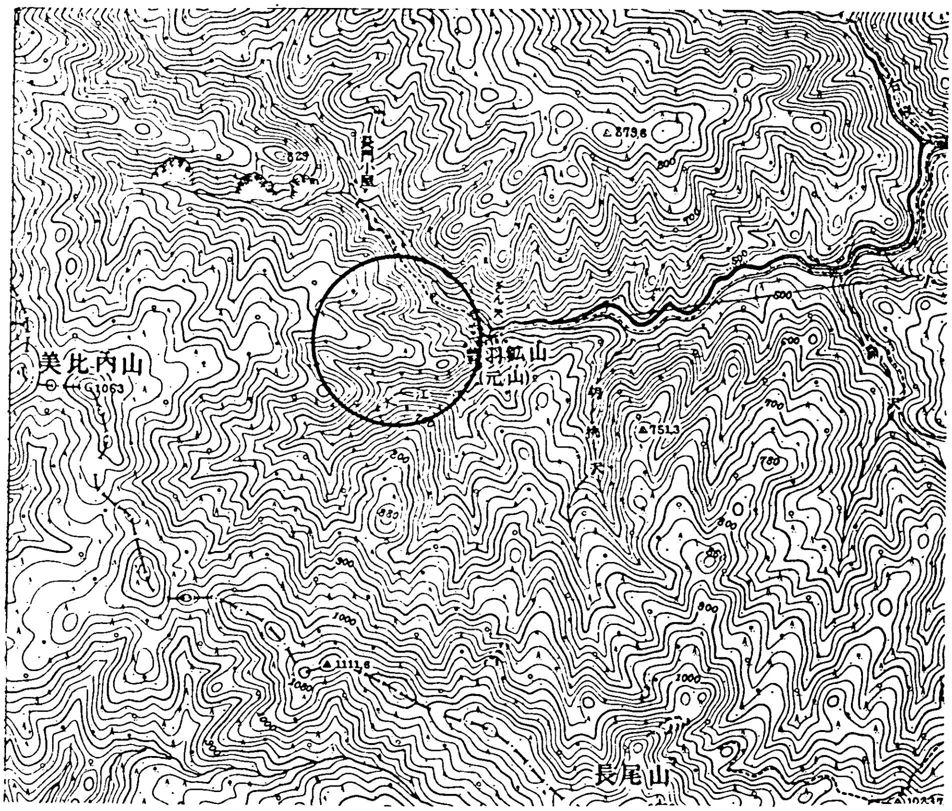
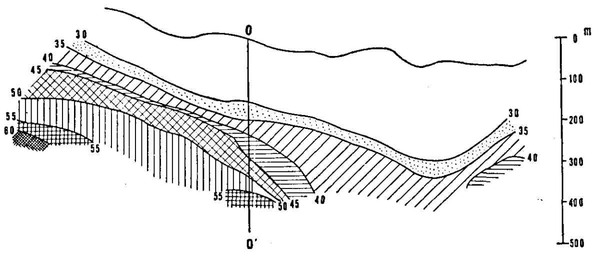


Fig. 13. Area under investigation in Toyoha Mine. The map covers from 42°57′ N to 43° 00′ N in latitude and from 141°00′10″4 E to 141°05′10″4 E in longitude.

Fig. 14. Underground temperature distribution (Vertical E-W section of the Mine) obtained by M. Iso of Toyoha Mining Co. (with permission of Mr. Iso and Toyoha Mining Co.) The numbers represent the temperature.



Co., Sapporo by Mr. M. Iso of this company.

According to his data, the area surveyed (42°58′N, 141°02′E), is a geothermal area with hot springs accompanying the ore veins. In Fig. 14, one of his results is reproduced, with the permission of Mr. Iso and the Toyoha Mining Co. This figure indicates the distribution of the "virgin" temperature of rocks measured at the front of the drift soon after the front is extended to the untouched area of the mine.

To assess the general thermal gradient in this area, we made in Fig. 15 a diagram of vertical temperature distribution along the vertical line O–O′ indicated in Fig. 14. As seen in Fig. 15, the thermal gradient amounts to $11.3°C/100\,m$ in this area. It is indeed a very high geothermal gradient.

Geology in the vicinity of the mine belongs to younger Tertiary formation composed of rocks such as shale, tuff and propylite.[10] As there is no special reason for these rocks being of the kind particularly

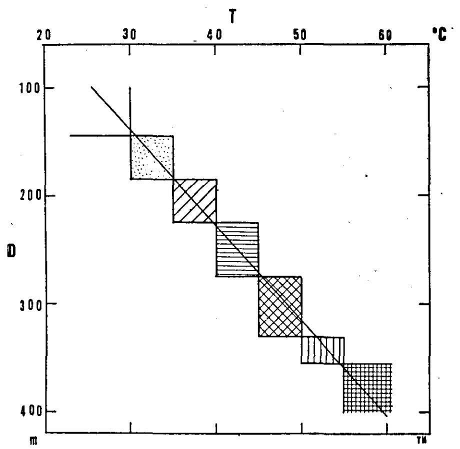


Fig. 15. Temperature-depth relation obtained from the data shown in Fig. 14, in Toyoha Mine. Section O–O′ in Fig. 14 has been used.

10) M. Iso, Private communication.

low in thermal conductivity, the heat flow conducting upwards through the area will not be less than, say, 5×10^{-6} *cal/cm² sec*.

8. Conclusion

The data on terrestrial heat flow in Hokkaido District is summarized in Table 9. Although data is still lacking in the south-eastern part of the District, the following feature may be pointed out regarding the general distribution of heat flux in Hokkaido. a) Southwestern part of Hokkaido seems to be an area with high heat flux ($>2 \times 10^{-6}$ *cal/cm² sec*). This area, including Toyoha, will probably account for the continuation of the high heat flow zone established in the Japan Sea side of the Honshu.[11] b) North-eastern part of Hokkaido, though data is still meagre, may be another region of high heat flux. The region here and its extension toward the inner zone of the Kurile Islands is geologically considered as similar to the inner zone of the Japanese Islands, or so called "green tuff" area. c) The area other than the above two seems to have a more or less normal heat flow i. e. on the 1×10^{-6} *cal/cm² sec* level.

Table 9. Terrestrial Heat Flow in Hokkaido District

Locality	Abbreviation	Site	Latitude (N)	Longitude (E)	Geothermal gradient (°C/100 m)	Thermal conductivity (10^{-3} cal/cm sec °C)	Terrestrial heat flow (10^{-6} cal/cm² sec)	Remarks
Haboro	HB	Coal mine	44°21′	141°52′	4.54	4.12	1.87	
Shimokawa	SMK	Cu mine	44°14′	142°41′	3.04	5.63	1.71	
Konomai	KNM	Au, Ag mine	44°08′	143°21′	3.96	6.41	2.54	
Akabira	AB	Coal mine	43°32′	142°02′	2.48	4.31	1.07	
Ashibetsu	ASB	Coal mine	43°33′	142°12′	3.08	4.38	1.35	
Toyoha	TH	Pb, Zn, Fe mine	42°54′	141°05′	11.3	(~5.00)	>5.00	*

* Geothermal area.

11) *loc. cit.*, 1)—4).

11. 地球熱学 第12報 北海道地方に於ける地殻熱流量測定結果

東京大学大学院数物系研究科
地球物理学専門課程 宝 来 帰 一

1. 北海道地方の6地点で地殻熱流量測定を行ない，この地方の地殻熱流量分布について基本的な傾向を知ることができた．個々の測定点に関する要点を以下に述べる．

2. 羽幌 羽幌炭礦鉄道株式会社が地下探査の目的で掘鑿したボーリングを利用して地下温度の測定を行なつた．ボーリングの深さは約 350 *m*，所在地は北海道天塩国羽幌町，その概略の位置は北緯 44°21′，東経 141°52′ である．温度測定値から求めた地下温度増加率は 4.54°*C*/100 *m* であつた．この付近の地質は新第三紀層に属する砂岩泥岩等の互層からなる．ボーリングコアの中からこれらの適当な試料をえらび，岩質が porous であることを考慮して水で飽和させた状態で熱伝導率を測定した．それらの平均は 4.12×10^{-3} *cal/cm sec °C* で，地殻熱流量は 1.87×10^{-6} *cal/cm² sec* となる．測定にあたつて同社山元本社部地質課の服部幸雄氏，新谷邦夫氏のお世話になつた．

3. 下川 北海道上川郡下川町の三菱金属鉱業株式会社下川鉱業所の坑道内数地点で温度測定を行ない，地下温度増加率を求めた．測定地の概略の位置は北緯 44°14′，東経 142°41′，利用した坑道の高低差は約 300 *m* である．この地域の地下温度増加率は地下等温面が地表面に平行であるとの仮定のもとに 3.24°*C*/100 *m*，地表面の形にかかわりなく水平であるとの仮定のもとに 2.84°*C*/100 *m* である．温度測定地付近の地質は日高層群に属する粘板岩，spilite であるが，粘板岩が剝落しやすく，適当な試料を整形することが不可能であつたので，spilite 試料についてのみ熱伝導率の測定を行なつた．その結果は 5.63×10^{-3} *cal/cm sec °C* である．この値を用いると地殻熱流量は，地下等温面の形に関する仮定に応じて $1.60\sim1.82\times10^{-6}$ *cal/cm² sec* となるが，上述の理由で幾分の不定が伴なうとみなければならない．調査にあたつて同鉱業所地質課の三宅輝海課長，伊東潤二氏はじめ各位の御助力をえた．

4. 鴻之舞 北海道北見国紋別市鴻之舞の住友金属鉱業株式会社鴻之舞鉱業所の坑道内で試錐孔数本を利用して地中温度測定を行なつた．測定地の概略の位置は北緯 44°08′，東経 143°21′ である．地下温度増加率は，長さ約 235 *m* の垂直試錐孔について 4.10°*C*/100 *m*，長さ約 145 *m* の垂直及び傾斜試錐孔について 3.81°*C*/100 *m* であつた．鉱山付近の地質は先新第三紀の日高系を基盤とし，これを被覆または貫入する新第三紀の鴻之舞・社名淵層群および火山岩類からなるといわれる．それらの地層を構成する岩石（頁岩・凝灰岩・石英粗面岩・変朽安山岩等）の試料について熱伝導率を測定し，平均値 6.41×10^{-3} *cal/cm sec °C* を得た．地殻熱流量は，地下温度増加率の2つの値に応じてそれぞれ 2.44×10^{-6} *cal/cm² sec*，2.63×10^{-6} *cal/cm² sec* となる．調査に当つて同鉱業所地質課の雨森武雄課長・近藤皓二技師はじめ各位の御助力をいただいた．

5. 赤平 北海道赤平市字赤平の住友石炭礦業株式会社赤平礦業所の地下坑道および地表からの探査用試錐を用いて温度測定を行ない，地下温度増加率 2.48°*C*/100 *m* をえた．利用した坑道のうち最深のものの地表からの深さは約 700 *m* である．測定地付近の地質は古第三紀に属する砂岩と神居古譚変成帯に属すると考えられる片岩である．坑道内で採集した砂岩・片岩等の試料について熱伝導率を測定した．平均値は 4.31×10^{-3} *cal/cm sec °C* である．地殻熱流量は 1.07×10^{-6} *cal/cm² sec*．調査にあたつて同砿業所企画係長入江伸氏，鉱務係長吉井収造氏ほか各位のお世話になつた．

6. 芦別 北海道芦別市西芦別町の三井鉱山株式会社芦別鉱業所の探査用ボーリングによつて地下温度測定を行なつた．ボーリングの所在地の概略の位置は北緯 43°33′，東経 142°12′，測定時のボーリングの深さは約 500 *m*，測定された地下温度増加率は 3.08°*C*/100 *m* であつた．ボーリングの地質柱状図をみると，地表から深さ約 300 *m* までは下部幌貝層，300 *m* 以深 500 m までは美唄夾炭層で，いずれも古第三紀層に属し，頁岩・砂岩の互層によつて構成されている．ボーリングコアの中からこれらの適当な試料をえらび，熱伝導率を測定した．平均の熱伝導率は 4.38×10^{-3} *cal/cm sec °C*．地殻熱流量は 1.35×10^{-6} *cal/cm² sec* となる．測定にあたつて同鉱業所鉱務課長久我正芳氏，地質係長井福秀夫氏，弥吉久氏特に野外作業では笹田勘三郎氏はじめ各位のお世話になつた．

7. 豊羽　北海道札幌市定山渓の日本鉱業株式会社豊羽鉱業所では，同社採鉱課磯順夫氏らの手によつて坑道内岩盤温度が詳細に調査されているため，それらの資料によつて地下温度分布の状態を知ることができた．鉱山の概略の位置は北緯 42°54′，東経 141°05′ である．鉱山および付近の地域には鉱脈と熱泉の湧出とが相伴なつた局部的温度擾乱がみとめられ，平均的な地下温度増加率も 11°C/100 *m* に達する．地質は新第三紀層に属すると考えられる頁岩・緑色凝灰岩・変朽安山岩等であるが，これらの岩石の熱伝導率が特に小さいとは考えられないから，この地点の地殻熱流量は $5\times10^{-6}\ cal/cm^2\ sec$ を超えるであろう．調査あるいは資料の提供等に関して同鉱業所採鉱課長奈良勲氏，副課長阿古目邦夫氏，採鉱係長足立清氏，磯順夫氏はじめ各位の御尽力をいただいた．

8. 北海道地方東南部に適当な測定地点が得られなかつたため，測点の分布がやや偏してはいるが，以上に述べた測定結果から，北海道地方の地殻熱流量分布に関して次の事実を指摘することができる．α) 北海道地方西南部は地殻熱流量の大きい ($>2\times10^{-6}\ cal/cm^2\ sec$) 地域に当ると考えられること．この地域は豊羽を含み，本州の内帯にみられる地殻熱流量の大きい地域の延長とみることができる．β) 北海道北東部に地殻熱流量の大きい ($>2\times10^{-6}\ cal/cm^2\ sec$) 地域があること．この事実は鴻之舞における地殻熱流量によつて示唆される．この地域が地質学的には東北日本の内帯に発達した第三紀火成活動地域と同種の地域であることは，それらの地域での地殻熱流量分布の特徴と考え合せて興味が深い．γ) これら以外の地域では，地殻熱流量は $1\times10^{-6}\ cal/cm^2\ sec$ よりも大きく $2\times10^{-6}\ cal/cm^2\ sec$ よりも小さい．

以上の調査研究に際して，必要な便宜を計られ，貴重な資料を提供されるなど，理解と協力を惜まれなかつた各鉱山会社，鉱業所の方々に心から感謝の意を表したい．また豊羽・赤平・芦別での調査に同行して測定その他の仕事を共にされた北海道大学理学部地球物理学教室の横山泉氏，清野政明氏にも感謝する次第である。