

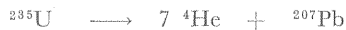
## Exploration of Helium Gas Resources in Japan

By

Koji Motojima\*

The exploration work of helium gas resources in Japan was started in 1962 with five-year plan by the Geological Survey of Japan.

In the earthcrust, helium gas is produced mainly by the radioactive disintegration of uranium and thorium, of which equations are shown in the following.



The productive rates of helium by these equations are

$$1.16 \times 10^{-7} \text{ cc/g U/year}$$

and

$$2.43 \times 10^{-7} \text{ cc/g Th/year.}$$

Japan is located on the island arc and has very complicated geology. Helium gas is obtained as one component of natural gas from the earthcrust. In Japan, we can obtain the natural gas from various geologic environments, such as oil and natural gas fields, coal fields, hot spring regions, volcanoes and geothermal provinces. Therefore, we have many targets to survey from Hokkaido to Kyushu, and Fig. 1 shows these localities.

According to the above-mentioned geological divisions, we can summarise these localities as follows.

1. Natural gas fields and oil fields.

Geologically, these fields consist mainly of Neogene marine sediments, and generally the basement rocks are Paleozoic sediments (alternation of sandstone and slate) and granite.

The localities of this group are as follows.

Tenpoku, Abashiri, Akita, Yamagata, Niigata, Yajizu, the region around the lake Biwa, Shimane, Okayama, southern Shikoku, Miyazaki.

2. Coal fields with gas accumulations.

Geologically, the coal fields consist mainly of Paleogene marine to fresh-water sediments, and generally the basement rocks are Cretaceous sediments, crystalline schist and granitic rocks.

The localities are as follows.

Ishikari, Kushiro, Joban, Omine, Ube, northern Kyushu.

3. Natural gas fields in which the hot springs are located. Geological settings of the gas fields are same as 1, but these fields are distinguished from 1 by the existence of hot springs in them.

The localities are as follows.

Southwestern Hokkaido, Yamagata basin, Hokuriku province, border region of Nagano and Niigata prefecture, Suwa, southeastern Kii peninsula, Narugo.

\* Technological Department

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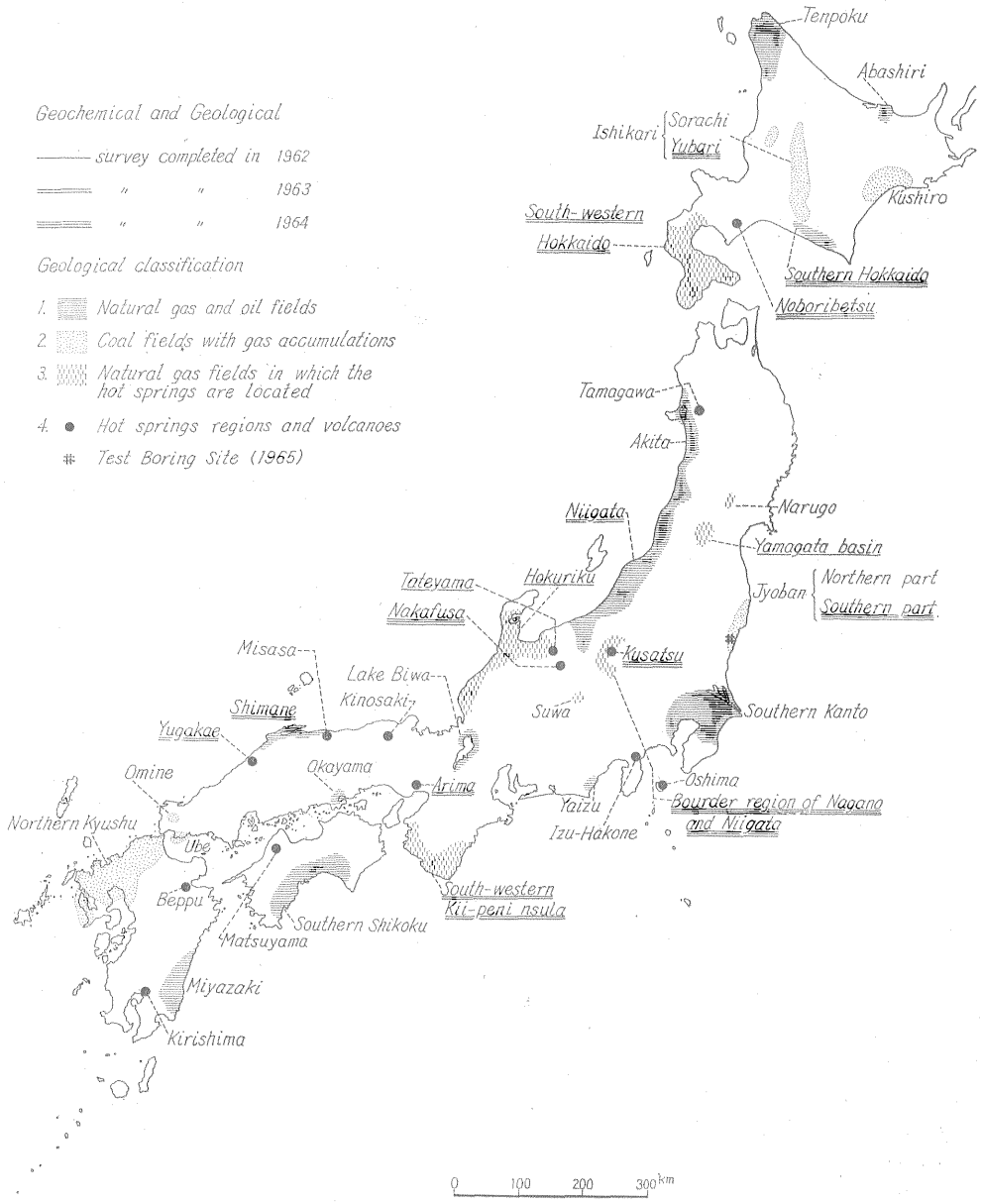


Fig. 1 Important regions for the survey of helium gas resources in Japan (April, 1965)

4. Hot spring regions and volcanoes.

The localities are as follows.

Noboribetsu, Tamagawa, Kusatsu, Nakafusa, Izu-Hakone, Oshima, Arima, Matsuyama, Kinoshita, Misasa, Yugaké, Beppu, Tateyama, Kirishima.

Principally, geochemical and geological methods have been used by the Geological Survey of Japan. But at the first stage of the survey, the quantitative analysis of natural gas samples from various fields were very important. Therefore, the geochemical methods were mainly used in this stage, and the contents of the geochemical method are as follows.

a) Number of surveyors.

One party	geologist	1
	geochemist	1 ~ 2
	assistant	1 ~ 2
	car (jeep) driver	1

b) Speed of survey.

This depends on various conditions, such as traffic situations, geology, topography and climate. However, generally speaking, we can examine three or four important geochemical points a day.

c) Materials for chemical analysis and the chemical components to be obtained.

Ground water---water temperature, pH, T.S.M., free CO<sub>2</sub>, HCO<sub>3</sub><sup>-</sup>, CO<sub>3</sub><sup>2-</sup>, NH<sub>4</sub><sup>+</sup>,

Localities which are producing helium-bearing natural gas (He>0.5%)

Locality	He content (vol.%)	Geological classification
Joban coal field Takahagi city	0.59	2
Hokuriku province Wakura hot spring	0.50	3

Localities which are producing natural gas with high He concentration (0.5%>He>0.1%)

Locality	He content (vol.%)	Geological classification
Hokuriku province		
Yamada (hot spring well)	0.273	3
Yamada (natural gas well)	0.115	3
Yunotani hot spring	0.193	3
Yuwaku hot spring	0.134	3
Kuronagi hot spring	0.237	3
Katayamazu hot spring	0.258	3
Awara hot spring	0.146	3
Yamagata basin		
Hirashio mineral spring	0.127	3
Sagaé hot spring	0.112	3
Niigata natural gas and oil field		
Tsukioka hot spring	0.152	1
Kira hot spring	0.184	1

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KMnO<sub>4</sub> consumption, Ca<sup>2+</sup>, Mg<sup>2+</sup>, SO<sub>4</sub><sup>2-</sup>, K<sup>+</sup>, Na<sup>+</sup>, Br<sup>-</sup>, I<sup>-</sup>, B, Fe<sup>2+</sup>, Fe<sup>3+</sup>, Mn, Si, dissolved CH<sub>4</sub>, dis. N<sub>2</sub>, dis. Ar, dis. CH<sub>4</sub>, dis. C<sub>2</sub>H<sub>6</sub>, H<sub>2</sub>S.

Natural gas--- He, H<sub>2</sub>, H<sub>2</sub>S, CO<sub>2</sub>, Ar, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, CO, SO<sub>2</sub>, heavy hydrocarbon gases.

Natural gas is analysed by the gas-chromatograph. In the period between 1962 and 1964, the following localities are recognized the most important by the geochemical survey.

We briefly describe three hopeful helium gas regions in the following.

### 1) Joban coal field

The basement rocks consist of Paleozoic schist and granite. The natural gas flows out from the basal part of Paleogene coal-bearing formations, from coal seams and from sandstone beds.

The estimations of the present daily production of natural gas from the Joban coal field and of the average helium concentration are about 150,000 m<sup>3</sup> and 0.04% respectively. This region will be surveyed in detail by drilling in 1965. The proposed drilling site is near Takahagi, Ibaragi prefecture, and the depth of the bore hole is 800m.

### 2) Hokuriku province

In this province, natural gas from many localities has high helium concentration. This province belongs to one of the hopeful oil and natural gas regions in Japan, and at Kojiro gas field the initial daily production of gas well was about 1,500 m<sup>3</sup>. So, in this province, detailed survey is very necessary.

### 3) Yamagata basin

This province also belongs to the hopeful oil and natural gas regions in Japan. Recently, the prospecting for hydrocarbon resources has been done by the joint work of the Government of Yamagata Prefecture and the Japan Petroleum Exploitation Company. If the results are hopeful for the helium exploration, we have to plan the detailed survey.

The main equipments for survey and the budget are as follows.

Equipments	jeep		2
	portable gas-chromatograph		4
	helium extraction apparatus		1
Budget	1962	3,607,000 Yen	(\$10,019)
	1963	5,060,000 Yen	(\$14,056)
	1964	5,167,000 Yen	(\$14,353)
	1965	9,194,000 Yen	(\$25,539)