

COLLECTION OF YAMATO METEORITES, EAST ANTARCTICA IN NOVEMBER AND DECEMBER 1975, AND JANUARY 1976

Yukio MATSUMOTO

*Department of Geology, Faculty of Liberal Arts, Nagasaki University,
1-14, Bunkyo-machi, Nagasaki 852*

Abstract: From November 12, 1975 to January 24, 1976 a seven-man party of the 16th Japanese Antarctic Research Expedition, 1974–1976 made an oversnow traverse to the Yamato Mountains area for the purpose of searching for meteorites and conducting geological and geomorphological surveys. A total of 307 meteorites were collected during the traverse. Forty-one pieces among 307 were found at the southeast end of the Yamato Mountains, which is the same area as that for the 1969, 1973 and 1974 collections, 249 pieces were found on the southwest side of the Mountains, the same area as the 1973 and 1974 collections, 10 pieces were found at the northeast end of the Mountains, and 7 pieces were found in the east-southeast area of Massif D in the Mountains. Two of the collected pieces were iron meteorites and the rest were stony meteorites.

1. Introduction

In December 1969 a total of 9 stony meteorites were discovered unexpectedly near the Yamato Mountains in East Antarctica. These meteorites, designated later as “Yamato-691 to -699”, were found on the surface of ice sheet free from snow (bare ice) in a very limited area of about 5×10 km centered at $71^{\circ}50'S$ and $36^{\circ}20'E$ with an average elevation of 2,300 m. The collection was made when the glaciological traverse party of the 10th Japanese Antarctic Research Expedition 1968–1970 (JARE-10) approached the southeast end of the Yamato Mountains (YOSHIDA *et al.*, 1971; KUSUNOKI, 1975).

In December 1973 a total of 12 stony meteorites were discovered at the same site as the 1969 collection and on the southwest side of the Yamato Mountains by the traverse glaciology party of the JARE-14. These meteorites were later designated as “Yamato-7301 to -7312” (SHIRAISHI *et al.*, 1975).

In November and December 1974 a total of 663 stony meteorites were discovered at the same site as the 1973 collection by the party of systematic search for the Yamato meteorites of the JARE-15. These meteorites later were designated provisionally as “Yamato-74001 to -74663” (YANAI, 1976).

The Yamato party of the JARE-16 (1974–1976) was assigned to the survey of geology and geomorphology and to the search for meteorites in the austral summer of 1975–1976. The party consisted of seven men: Y. MATSUMOTO (leader), R. SEKIGUCHI, M. MANABE, T. TAKAOKA, A. YAMAMOTO, K. TAKIGAWA

and M. FUNAKI.

During the oversnow traverse near the Yamato Mountains from November 1975 to January 1976, a total of 307 meteorites were discovered in the southern and northeastern parts of the Yamato Mountains. These meteorites were designated tentatively as Yamato-75001 to -75307. The present paper describes the occurrence of meteorites and the grid for measurement of glacier movement.

2. Occurrence of the Yamato Meteorites, Yamato-75

Since the main task of the Yamato party of the JARE-16 was the survey of geology and geomorphology and the support for the flying operation, the search for meteorites was rather limited in area. But, of course, the party could foresee the discovery of meteorites in the Yamato Mountains area, and so they concentrated their attention and efforts on this area.

Fig. 1 shows the location of the Yamato Mountains and traverse routes, and Fig. 2 shows the panorama of the Yamato Mountains. The Yamato party of

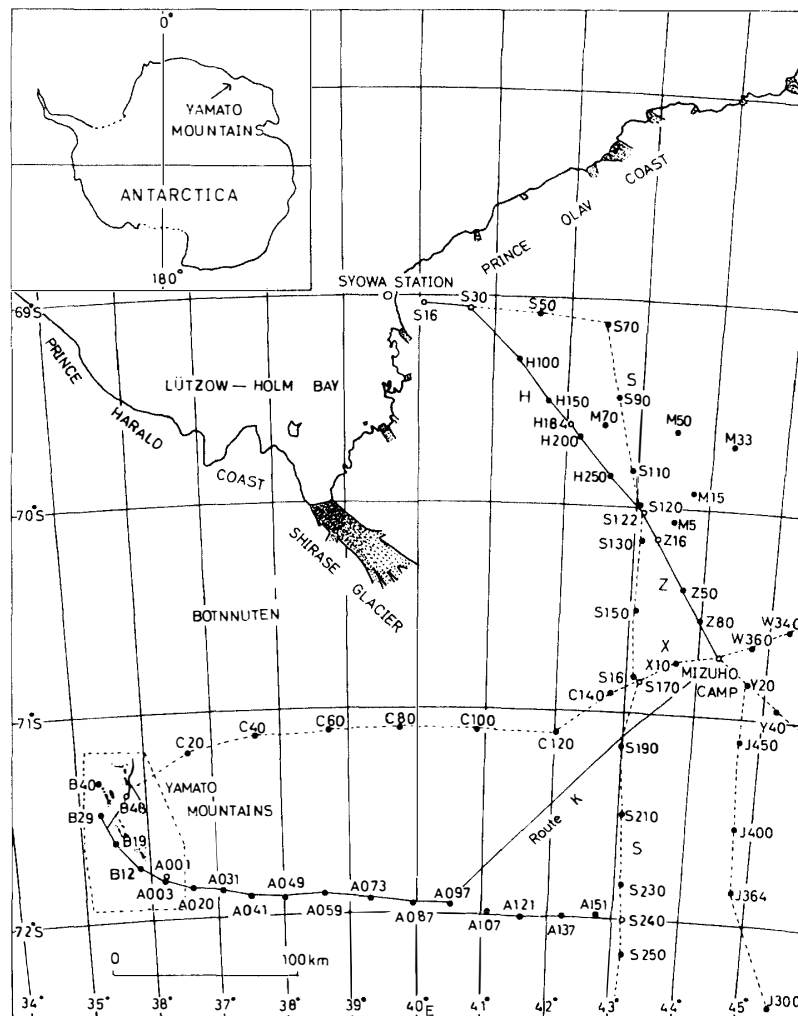


Fig. 1. Location map of the Yamato Mountains and traverse routes.

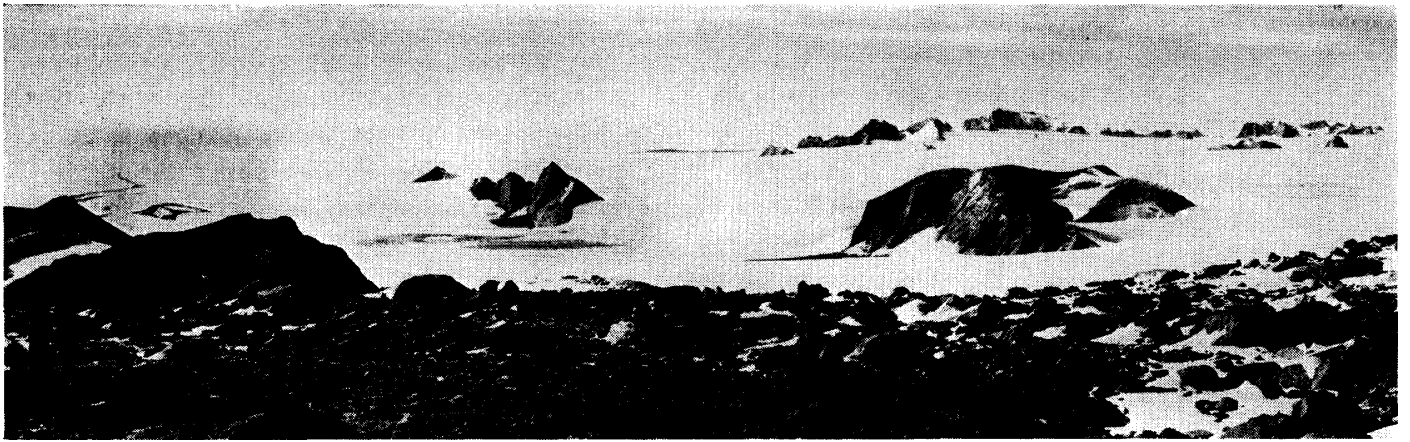


Fig. 2. The panorama of the Yamato Mountains viewed from Massif C. Massifs C, D, E and F from left to right.

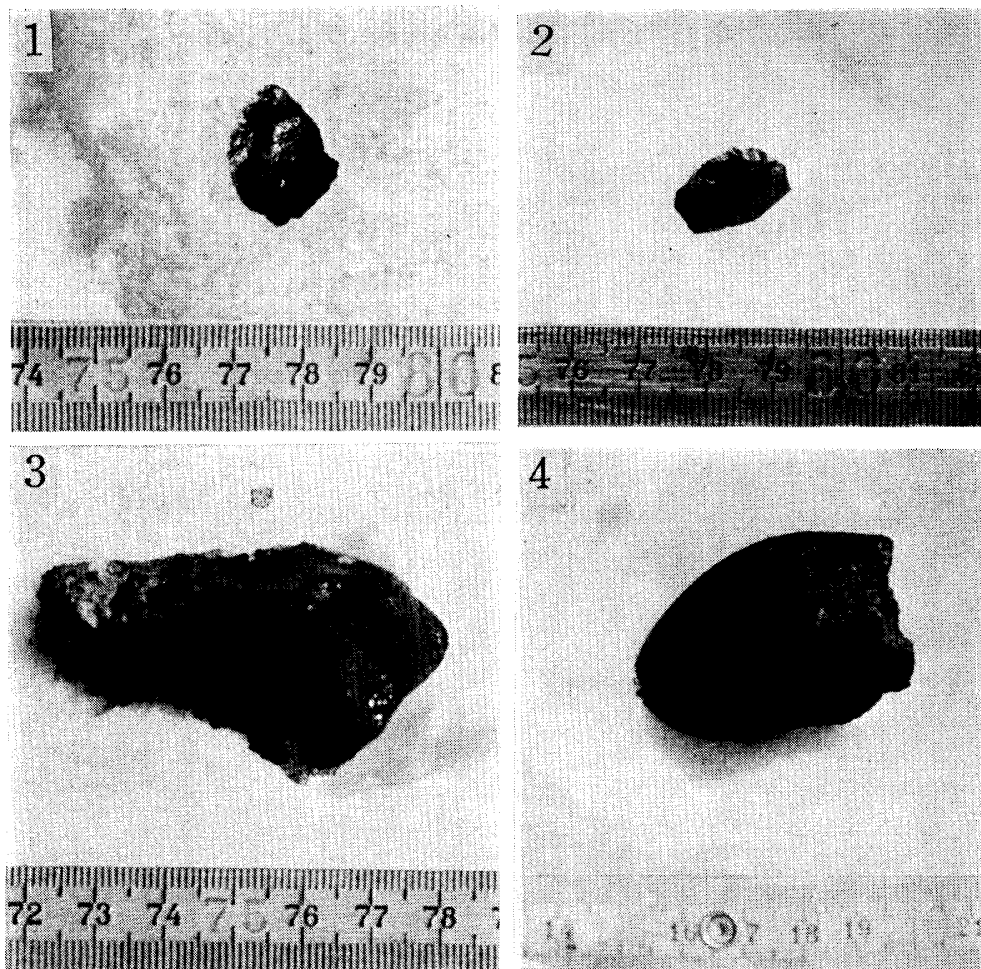


Fig. 3. Yamato meteorites photographed in situ in the Meteorite Ice Field at the southeastern end of the Yamato Mountains.

- 1) Yamato-75001, achondrite, 4.1 g.
- 2) Yamato-75003, carbonaceous chondrites, 1.5 g.
- 3) Yamato-75011, achondrite, 121.5 g.
- 4) Yamato-75012, chondrite, 69.9 g.

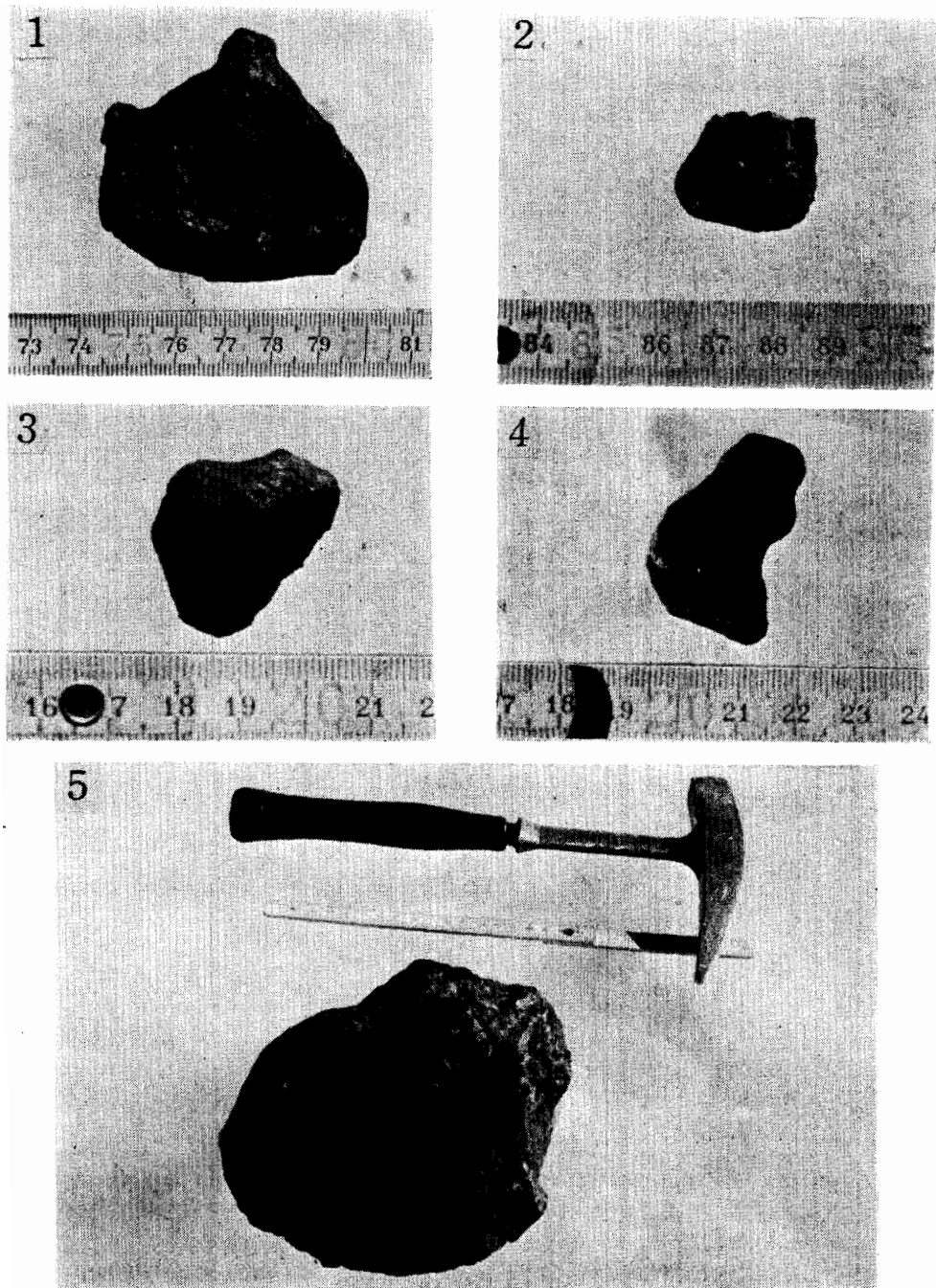


Fig. 4. Yamato meteorites photographed in situ in the northern part of Massif F and east-southeast of Mt. Fukushima.

- 1) Yamato-75017, chondrite, 87.7 g.
- 2) Yamato-75018, chondrite, 8.8 g.
- 3) Yamato-75019, chondrite, 22.7 g.
- 4) Yamato-75031, iron meteorite, 60.2 g.
- 5) Yamato-75028, chondrite, about 6.1 kg.

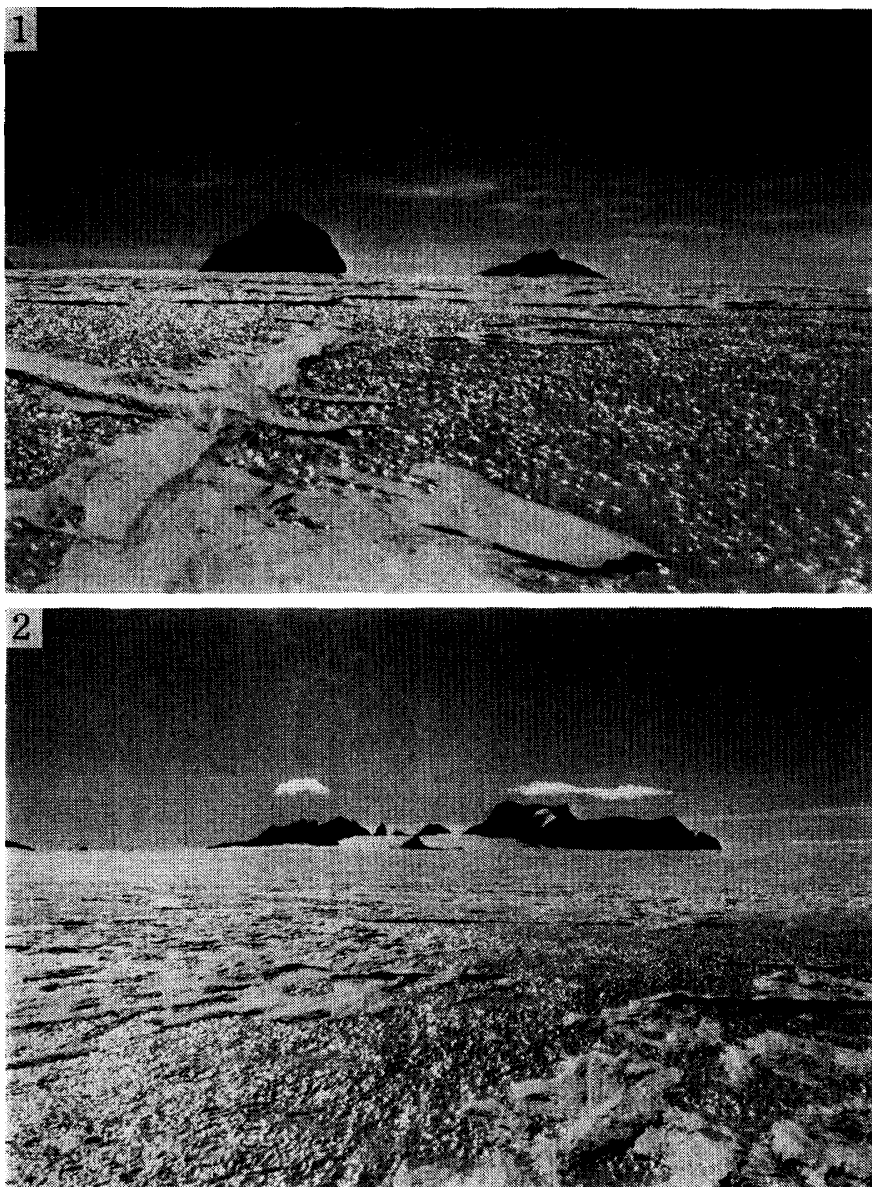


Fig. 5. Surface feature of the bare ice area near the Yamato Mountains; white part: hard snow, glittering part: blue ice.

- 1) Blue ice at about 3 km north of the eastern end of Massif F, Yamato Mountains. The Nunataks at northeast of Massif F in the background.
- 2) Blue ice about 13 km east-southeast of Mt. Fukushima in Massif D, Yamato Mountains. Massif D in the background.

the JARE-16 left Syowa Station on November 12, 1975 and returned to the station on January 24, 1976. The party approached the Yamato Mountains from the south, and arrived at station A003 located in the south of Motoi Nunatak (station A001, 214 point) on November 29. On December 2, the party arrived at station B25 located at the western foot of Massif C of the Yamato Mountains. Up to this time, the party collected 16 meteorites lying on the surface of blue ice of the Meteorite Ice Field, the southeastern end of the Yamato Mountains. Photographs of these meteorites *in situ* are shown in Fig. 3.

The party maintained a base camp at station B25 from December 2 to 21, carrying out geological and geomorphological research, as well as the search for meteorites.

From December 6 to 8, a three-man geological party (Y. MATSUMOTO, M. FUNAKI and K. TAKIGAWA) was dispatched to carry out the geological survey of Massif E, Massif F and unexplored nunataks located northeast of Massif F, and also to search for meteorites. This party collected 10 meteorites lying on the surface of the blue ice at about 3 km and 9 km north of the eastern end of Massif F, Yamato Mountains on December 6, and 6 meteorites and 1 iron meteorite lying on the surface of the bare ice at about 13 km east-southeast of

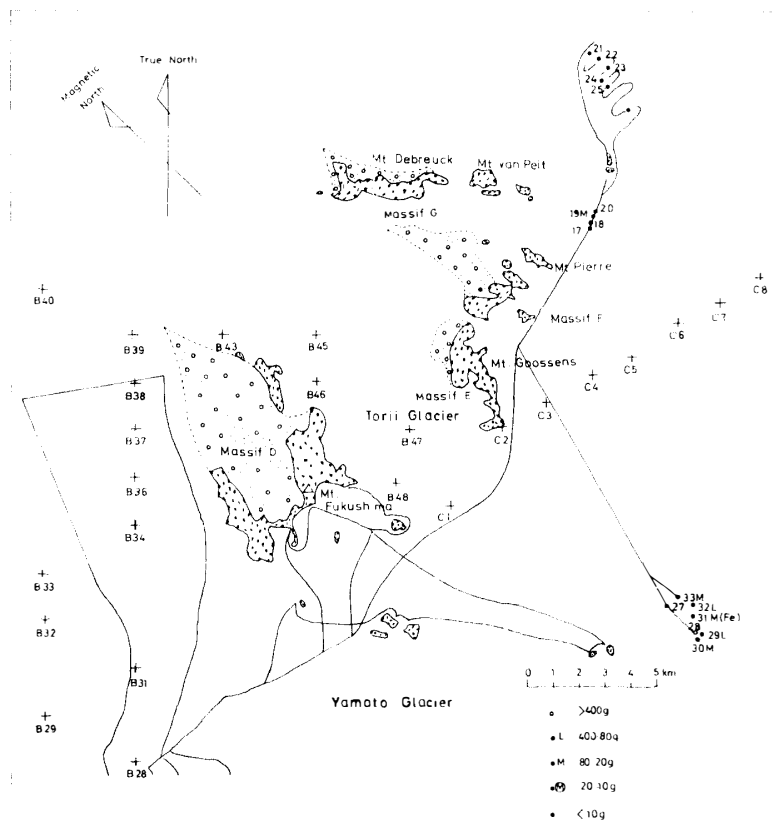


Fig. 6. Sampling sites and original sample numbers at the north-eastern end of the Yamato Mountains.

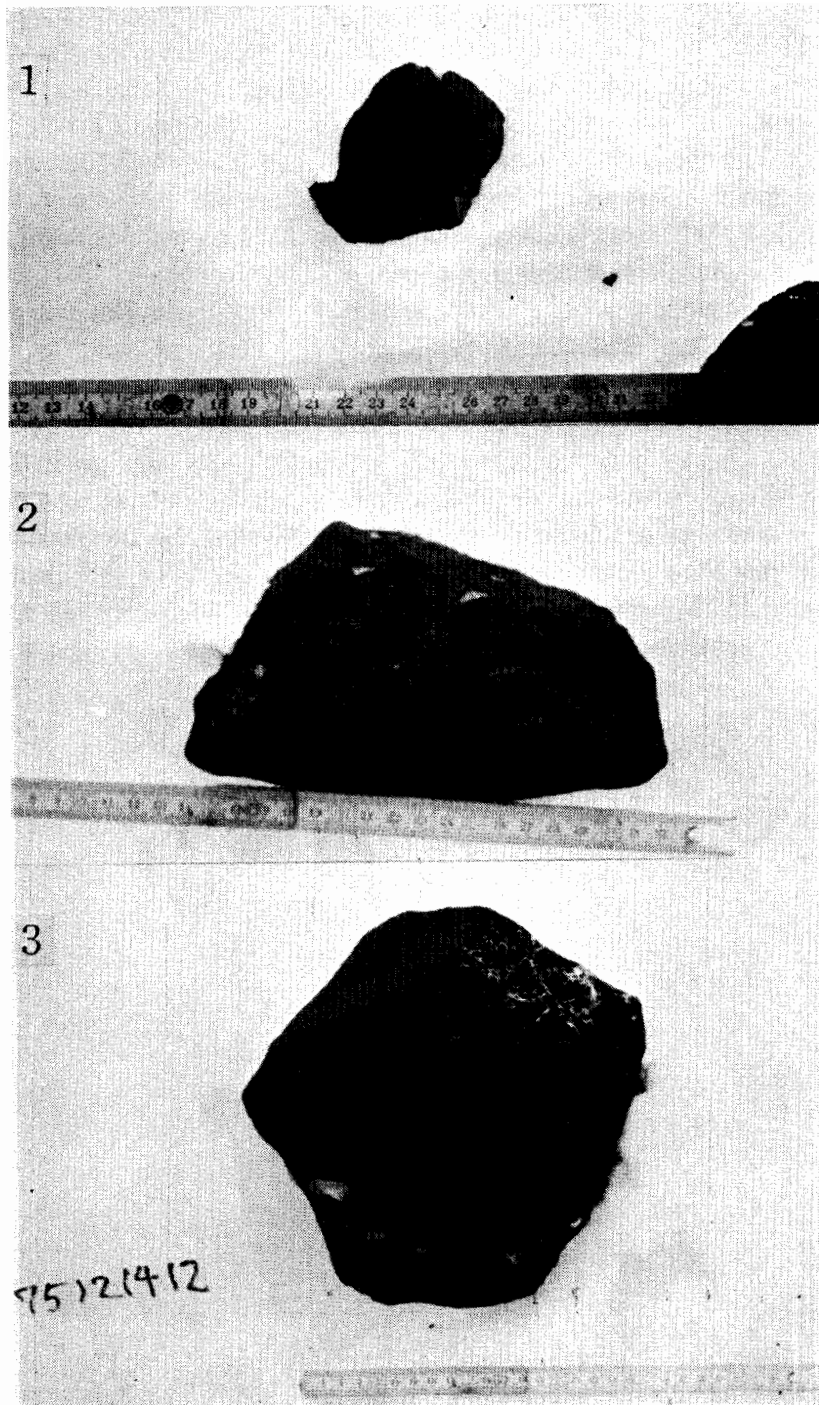


Fig. 7. Yamato meteorites photographed in situ on the southern and southwestern sides of the Yamato Mountains.

- 1) Yamato-75096, chondrite, 91.8 g.
- 2) Yamato-75097, chondrite, 2,570.2 g.
- 3) Yamato-75102, the largest meteorite in Yamato-75, chondrite, about 11.3 kg.



Fig. 8. Many meteorite fragments belonging in the same kind of chondrite (from Yamato-75108 to Yamato-75257) photographed in situ on the south-west-southern side of Massif A, Yamato Mountains.

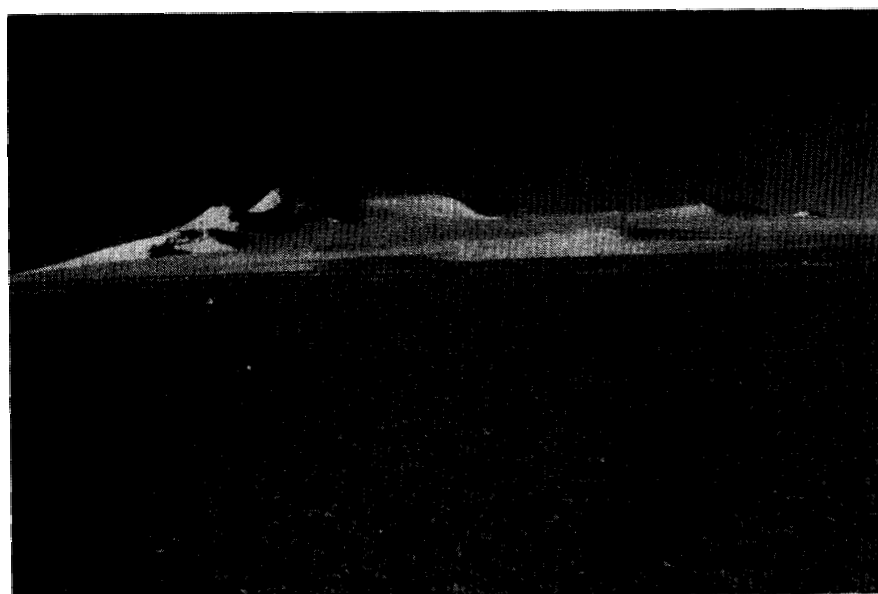


Fig. 9. Surface feature of the bare ice area in the Meteorite Ice Field, south of Massif B, Yamato Mountains. Massif B in the background.

Mt. Fukushima in Massif D on December 7. Photographs of these meteorites *in situ* are shown in Fig. 4. The blue ice area where the meteorites were found is presented in Fig. 5. Fig. 5-1 shows the sampling site at about 3 km from the eastern end of Massif F, and Fig. 5-2 shows the sampling site at about 13 km from Mt. Fukushima. These sites are new localities of the Yamato meteorites. Fig. 6 shows the route of the Yamato meteorite search, the sampling sites and the original sample numbers at the northeastern end of the Yamato Mountains.

On December 3 and 11, a two-man party (Y. MATSUMOTO and A. YAMAMOTO) tried a few hours search for meteorite on the western sides of Massif C and Massif D. There were comparatively wide bare ice fields, but the party could not find meteorite there. This fact does not necessarily deny the possibility of existence of meteorites in the area, because the time available to the search was limited.

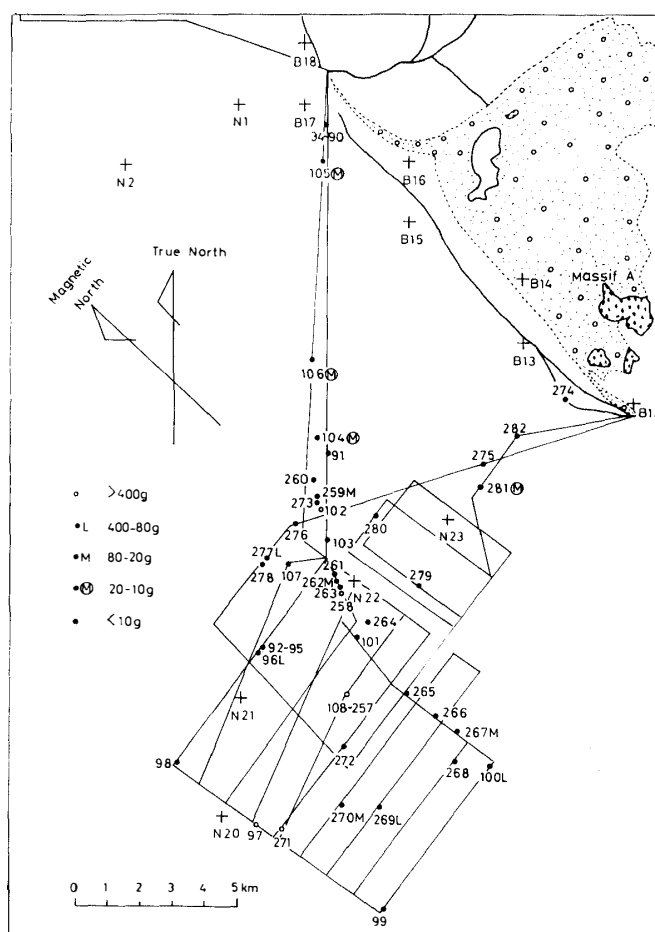


Fig. 10. Routes of the systematic search of the Yamato meteorites and original sample numbers in the Meteorite Ice Field at the southern to southeastern end of the Yamato Mountains.

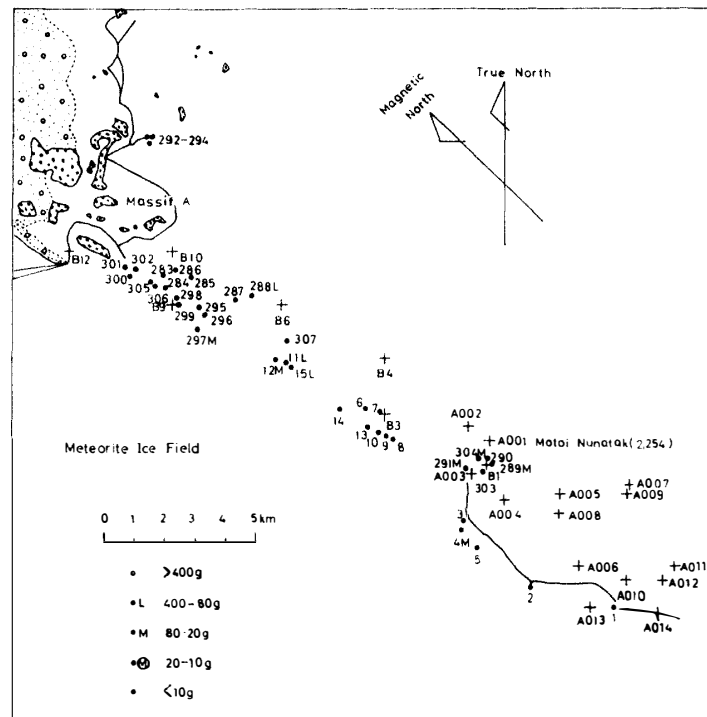


Fig. 11. Sampling sites and original sample numbers in the Meteorite Ice Field at the southeastern end of the Yamato Mountains.

For four days, December 14, 16, 21 and 24, the party carried out a systematic search for the Yamato meteorite on the southern and southwestern sides of the Yamato Mountains, and collected 249 meteorites that were lying on the surface of bare ice. Photographs of these meteorites *in situ* are shown in Fig. 7 and Fig. 8. Fig. 9 shows the surface feature of the bare ice area in the Meteorite Ice Field, south of Massif B, Yamato Mountains. Fig. 10 shows the routes of systematic search, the sampling sites and the original sample numbers in the Meteorite Ice Field at the southern to southwestern end of the Yamato Mountains.

The party maintained a base camp at station B12 and B9 from December 21, 1975 to January 5, 1976, carrying out geological and geomorphological research, looking for meteorites, and establishing a grid for measurement of glacier movement in the Meteorite Ice Field. Consequently, the party collected 25 meteorites lying on the surface of bare ice. Fig. 11 shows the sampling sites and the original sample numbers in the Meteorite Ice Field.

3. Outline of Yamato Meteorites, Yamato-75

A total of 307 meteorites were collected by the party of the JARE-16. These meteorites were designated as "Yamato-75001" to "Yamato-75307".

Of these meteorites, two examples were found as concentrated meteorite

fragments belonging in the same kind of chondrite in the limited area. One of these, 57 meteorites (from Yamato-75034 to Yamato-75090) were found in the small area of about 50×200 m, a total weight of these meteorites being 110.8 g. The other one, 150 meteorites (from Yamato-75108 to Yamato-75257) were found in the small area of about 10×50 m, their total weight being 3,969.5 g (Fig. 8).

The total weight of the Yamato-75 meteorites is about 35 kg. The largest one is Yamato-75102 and the second largest is Yamato-75028. Yamato-75102 is a chondrite, about 11.3 kg in weight and about 25 cm in maximum diameter (Fig. 7-3). Yamato-75028 is also a chondrite, 6.1 kg in weight and 19.2×11.2 cm in diameter (Fig. 4-5).

Yamato-75 meteorites are classified into several kinds, namely iron meteorite (NAGATA *et al.*, 1976; NAGATA *et al.*, 1977) (Fig. 4-4), achondrite (TAKEDA *et al.*, 1977a, b) (Fig. 3-1, Fig. 3-3), carbonaceous chondrite (Fig. 3-2) and chondrite, as follows:

Iron meteorite: 031, 105.

Achondrite: 001, 004, 007, 011, 014, 015, 032, 285, 299.

Carbonaceous chondrite: 003, 293.

Chondrite: the rest (294 pieces).

4. Outline of Grid

On December 26 and 29, 1975, the Yamato party of the JARE-16 established a grid for measurement of glacier movement to clarify the mechanism of meteorite accumulation. This grid has been laid near Motoi Nunatak (station A001) (214 point) in the Meteorite Ice Field at the southeastern end of the Yamato Mountains. The grid is hexagonal in shape, each side being about 800 m, and the center of the hexagon is station A003.

Table 1. Grid point in the Yamato Mountains (an original point is Long. 70° S, Lat. 38° E) (January 3, 1976).

Measurement point	X (m)	Y (m)	Altitude (m)	Latitude ($^\circ$ S)	Longitude ($^\circ$ E)	Direction angle of true north
214*	-200452.065	-62841.066	2341.09	$-71^\circ 47' 18'' 100$	$36^\circ 11' 55'' 600$	$-1^\circ 42' 39'' 8$
215	-199969.249	-63537.544	2366.54	$-71^\circ 47' 1.855$	$36^\circ 10' 45.282$	$-1^\circ 43' 46.4$
003	-201536.054	-63341.562	2337.20	$-71^\circ 47' 52.574$	$36^\circ 11' 0.620$	$-1^\circ 43' 32.4$
a	-200768.042	-63706.092	2320.80	$-71^\circ 47' 27.451$	$36^\circ 10' 25.411$	$-1^\circ 44' 5.6$
b	-201291.053	-64237.340	2329.32	$-71^\circ 47' 43.797$	$36^\circ 9' 28.973$	$-1^\circ 44' 59.3$
c	-202395.277	-64778.211	2339.63	$-71^\circ 48' 19.858$	$36^\circ 10' 12.879$	$-1^\circ 44' 18.0$
d	-202297.095	-62971.332	2348.19	$-71^\circ 48' 17.476$	$36^\circ 11' 36.466$	$-1^\circ 42' 58.5$
e	-201807.923	-62496.285	2349.22	$-71^\circ 48' 2.158$	$36^\circ 12' 26.998$	$-1^\circ 42' 10.4$
f	-201014.600	-62679.839	2338.89	$-71^\circ 47' 36.397$	$36^\circ 12' 10.497$	$-1^\circ 42' 25.8$

* Azimuth angle to 215 point: $306^\circ 26' 30'' 0$

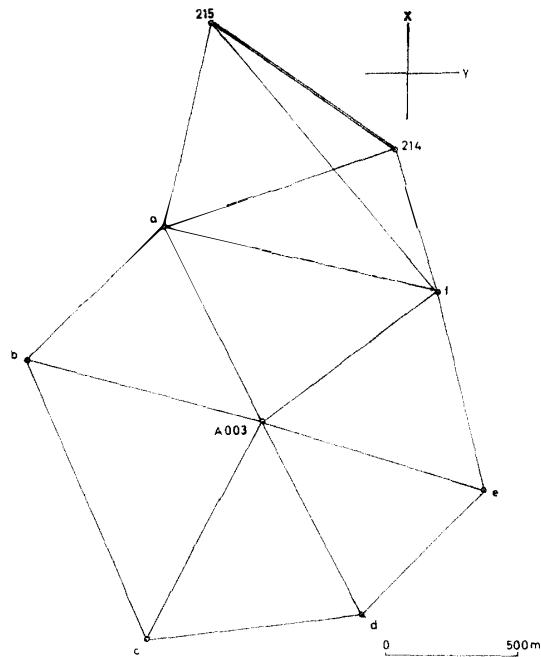


Fig. 12. Projection of the grid for measurement of glacier movement in the Meteorite Ice Field, Yamato Mountains.

On January 2 and 3, 1976 the party measured for poles of the grid. Table 1 shows the situation of the grid point and Fig. 12 shows the projection of the grid.

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References

- KUSUNOKI, K. (1975): A note on the Yamato Meteorites collected in December 1969. Mem. Natl Inst. Polar Res., Spec. Issue, **5**, 1-8.
- NAGATA, T., FISHER, R. M. and SUGIURA, N. (1976): Metallographic and magnetic properties of a Yamato iron meteorite-Yamato-75-105. Mem. Natl Inst. Polar Res., Ser. C, **10**, 1-11.
- NAGATA, T., FISHER, R. M. and SUGIURA, N. (1977): Metallographic and magnetic properties of Yamato iron meteorites-Yamato-75-031 and Yamato-75-105. The Second Symposium on the Yamato Meteorites, lecture announcement (Unpublished).

- SHIRAISHI, K., NARUSE, R. and KUSUNOKI, K. (1976): Collection of Yamato Meteorites, Antarctica, in December 1973. *Nankyoku Shiryo (Antarct. Rec.)*, **55**, 49-60.
- TAKEDA, H., MIYAMOTO, M. and YANAI, K. (1977a): Yamato inseki no achondrite ni tsuite (Achondrites in the Yamato Meteorites). The Second Symposium on the Yamato Meteorites, lecture announcement (Unpublished).
- TAKEDA, H., MIYAMOTO, M., MATSUMOTO, Y. and YANAI, K. (1977b): Yamato Meteorite 75-032 and crystallization course of pyroxene in achondrite. Mineral. Soc. Japan, an annual convention, lecture announcement (Unpublished).
- YANAI, K. (1976): 1974-nen no nankyoku-san Yamato inseki no tansa to saishû (Search and collection of Yamato Meteorites, Antarctica, in October and November 1974). *Nankyoku Shiryo (Antarct. Rec.)*, **56**, 70-81.
- YOSHIDA, M., ANDO, H., OMOTO, K., NARUSE, R. and AGETA, Y. (1971): Discovery of Meteorites near Yamato Mountains, East Antarctica. *Nankyoku Shiryo (Antarct. Rec.)*, **39**, 62-65.

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