SEARCH FOR YAMATO METEORITES IN DECEMBER 1981

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Abstract: Search for Antarctic meteorites was carried out by the wintering party of the 22nd Japanese Antarctic Research Expedition in the Meteorite Ice Field in the vicinity of the Yamato Mountains in December 1981. Search in the hexagonal experiment area showed that the emergence of meteorites from the ice sheet due to ablation of ice took place at a rate of one meteorite per year per 2 km^2 during two years. Collected specimens are 133 in number and 25.928 kg in weight, and consist of ordinary chondrites, carbonaceous chondrites and diogenites. Distribution of occurrence sites suggests that a bare ice field near small nunataks is the meteorite-concentrated area, as was pointed out before.

1. Outline of the Field Survey

Search for Antarctic meteorites in the Yamato Mountains region (Fig. 1) has been carried out by the Japanese field parties since 1974, guided by the unexpected discoveries in 1969 and 1973. In particular, systematic search by the 20th Japanese Antarctic Research Expedition (JARE-20) in 1979 brought the fruitful collection of over 3300 meteorite specimens (YANAI, 1981). JARE-22 conducted field surveys in the Yamato Mountains region in December 1981, which consisted of meteorological and glaciological observation in the POLEX-South programs and earth science programs as part of the three-year project in 1979–1981.

Earth science programs in the Yamato Mountains region consisted of the following items; 1) search for meteorites, 2) gravity survey, 3) surface geology and geomorphology, and 4) support for air operation from the temporary airstrip in the Yamato Mountains region for aerophotography and aeromagnetic survey of the Sør Rondane Mountains 300 km to the west.

A 4-man party with two snow-vehicles and one snowmobile left Mizuho Station on December 2 and arrived at the foot of Motoi Nunatak, southeasternmost part of the Yamato Mountains, on December 11. Search for meteorites was carried out for two purposes: 1) search in the hexagonal experiment area established in 1976 and searched in 1976 and in 1979 for the measurement of the rate of meteorite emergence from the ice sheet, and 2) collection of meteorite specimens from the bare ice area as many as possible. Search in the experiment area was done from December 11th to

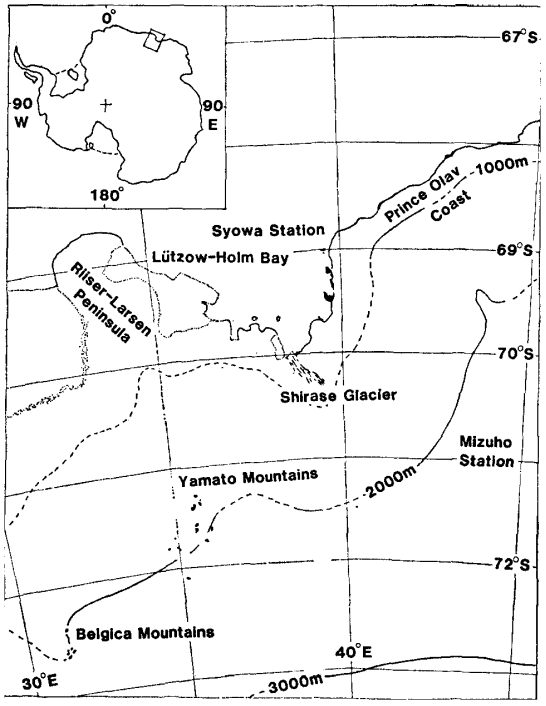

Fig. 1. Location map of the Yamato Mountains.

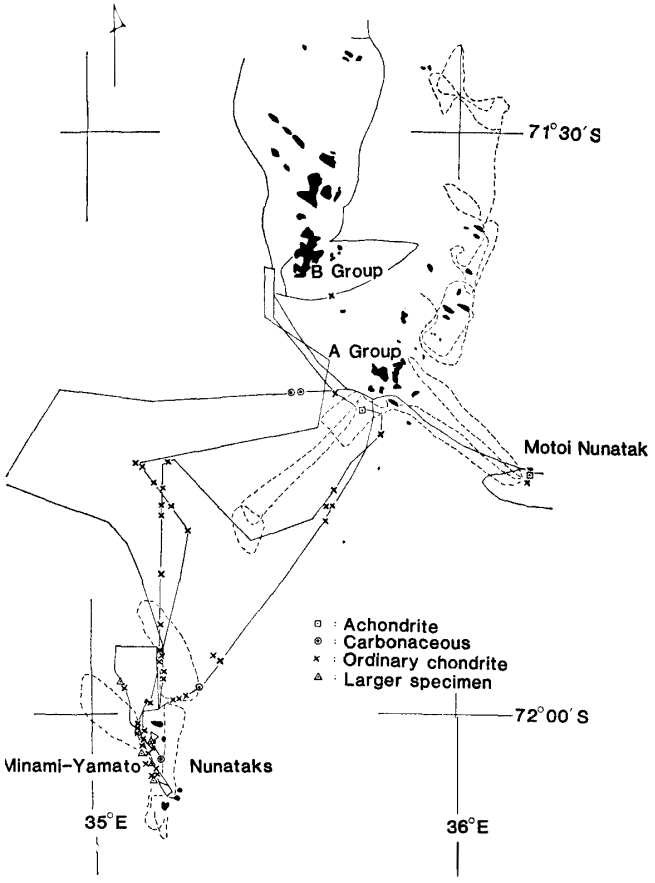

Fig. 2. Search routes and sites of meteorite occurrence in December 1981. Solid lines show search routes in 1981. Dashed lines indicate the intensively searched areas in the 1979–1980 field season.

13th. Search in the wider fields was conducted from 14th to 18th and from 26th to 30th in the southwestern Meteorite Ice Field, and from 21st and 25th around the five massif groups (Fig. 2).

2. Search for Meteorites in the Experiment Area

The bare ice area near Motoi Nunatak was one of the most fruitful sites for meteorite search (YANAI, 1976). The JARE-16 field party established the hexagonal grid on a bare ice area immediate south of Motoi Nunatak for the measurements of the flow rate of ice and the rate of meteorite emergence from the ice sheet in January 1976 (MATSUMOTO *et al.*, 1977). The JARE-20 field party carried out search in the grid and found seventeen meteorite specimens which were thought to have emerged from the ice in the period from 1976 to 1979. The hexagonal grid with each side about 800 m long has an area of about 2 km^2. Thus the rate of meteorite emergence was estimated to be two meteorites per year per square km (YANAI and MATSUMOTO, 1981).

Search by the JARE-22 field party resulted in the finding of two small specimens in the same experiment area (Fig. 3). From the measurement of the heights of grid bamboo stakes, the ablation of ice surface is estimated to be 6.4 cm/year for six years average. This value is quite similar to that obtained by YOKOYAMA (1975) in the same area. It may not be always easy to remove meteorites completely from the wide ice surface. It is considered, however, that almost perfect collection can be accomplished

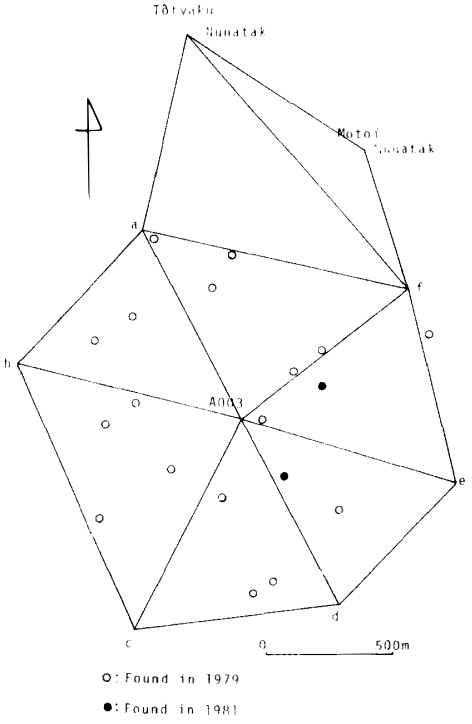

Fig. 3. Hexagonal experiment area near Motoi Nunatak set up in January 1976. Solid circles indicate meteorites found in 1981, and open circles show meteorites found in the 1979–1980 field season.

by the search along densely spaced routes in the relatively small area. The estimation of the emergence rate of meteorite by YANAI and MATSUMOTO (1981) is based on this view. On the same assumption, the emergence rate of meteorite due to 6.4 cm/year ablation of ice is estimated to be one meteorite per year per 2 km^2 in the period from December 1979 to December 1981. The rate itself is not significant at this stage of research but suggests that the emergence of meteorites from the ice sheet is going on under the existing environmental conditions. Searches in 1979 and 1981 are believed to become the basis for further study.

The surveying of stake positions was attempted using a Wild T_2 theodolite and an electrotachymeter. However, results obtained are not fit for the detailed examination of small amount of stake movement, having been disturbed by strong wind with drifted snow. The surveying was also difficult in 1979.

3. Search in Wider Bare Ice Areas

The searched areas were the Meteorite Ice Field within a triangle connecting Minami-Yamato Nunataks, Kabuto Nunatak and the western side of the A group of the Yamato Mountains, and the area along the traverse route encircling the Yamato Mountains. But no more than one meteorite specimen was found in the latter area. The search was done by a large snow-vehicle and a small snowmobile because of a shortage of vehicles and fuel. Therefore, it was difficult to conduct the search along densely survey lines in a wide area.

Collected meteorites are 133 in number, and the total weight is 25.928 kg. Classification by weight is as follows: 94 below 10 g, 21 between 10 and 50 g, 8 between 50 and 100 g, 5 between 200 and 500 g, and 5 over 1000 g. The largest one is 10.79 kg in weight. Preliminary examination by K. YANAI, National Institute of Polar Research, suggests that the collection consists of 47 H chondrites, 74 L chondrites, 2 diogenites, 9

Fig. 4. An example of a mode of meteorite occurrence.

carbonaceous chondrites and one unclassified (terrestrial?) specimen.

The modes of occurrence of meteorites are almost the same as those of the previous findings. They sit on the bare ice surface, seemingly emerging from the ice sheet caused by sublimation of ice (Fig. 4). No sign of thawing of ice is found at a site of meteorite occurrence. This indicates that the cooling by strong wind does not allow the thawing of ice around a meteorite by solar radiation to form a cryoconite hole.

70% of collected specimens were obtained in the vicinity of Minami-Yamato Nunataks. This area was investigated intensively in the 1979–1980 field season (Fig. 2). It is difficult to know whether the collected specimens have emerged from the ice sheet after the previous search, because many of them are small in size and accordingly could have escaped from the previous search eyes. However, it can be safely said from the above result that the Minami-Yamato Nunataks area is one of the meteorite-concentrated places in the Yamato Mountains region. Any inland bare ice area where conspicuous thawing of ice does not occur can carry meteorites on its surface, taking the former results of meteorite search into account, because a bare ice area itself is thought to be an exposed part of a lower ice layer which may contain meteorites. In particular, subglacial rock rise near small nunataks causes sluggish and upward ice flow but does not impede ice movement completely. As a result, accumulation of meteorites on the ice surface may proceed more effectively in such areas than in other bare ice areas. Therefore, bare ice areas around small nunataks such as Minami-Yamato and Motoi Nunataks seem to be the most promising areas for meteorite search, as was pointed out before (YANAI, 1981).

4. Concluding Remarks

Search for meteorites in the previously established experiment area near Motoi Nunatak indicates that the emergence of meteorites from the ice sheet due to ablation of ice is going on under the existing environmental conditions. Collected meteorite specimens are 133 in number and 25.928 kg in weight, and consist of ordinary chondrites, carbonaceous chondrites and diogenites. Distribution of their occurrence sites suggests that the bare ice area around a small nunatak is the meteorite-concentrated area where the future search may be highly promising.

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