Discovery of the Yamaot-69 Meteorites: A Firsthand Account

Masaru Yoshida, invited talk, Workshop on Antarctic Meteorites: Search, Recovery, and Classification.
July 26-27, 2008, Matsue, Japan　（特別招待講演記録、2008 年 7 月 26 日）

Title: Sl-1

I. Introduction: briefly (Sl-2, importance of Yamato Meteorite discovery)

II. Prologue (Sl-3)

1. Suggestion by Professor Gorai to Yoshida

i) Sl-4, Professor Gorai who suggested to bring meteorite from Antarctica was the member of Special Committee of Antarctic Research of Science Council of Japan. Yoshida, who had respected Prof. Gorai visited him just before the departure to Antarctica in Autumn 1968.

ii) Sl-5, Yoshida proposed Gorai, that he will bring some gift rocks from Antarctica. Gorai said “I am now not interested in metamorphic rocks from Antarctica; rather, please bring me a gift of meteorite”.

2. (Sl-6) Reason why Gorai happened to realize meteorite from Antarctica.

Gorai explained, “Because all are snow-covered white, and meteorites will be easily found”.

3. (Sl-6) Background why Gorai suggested meteorite

Professor Gorai was a very advanced petrologist who was interested in the evolution of magma and the earth. His interests in those days were ultramafic rocks and meteorites.

II. Discovery and collection of meteorites

i) JARE 10 inland survey program: glaciological survey (Sl-7, 8, 9, 10, 11, 12, 13, 14, 15)

ii) First discovery of Yamato Meteorites, Figs. 3, 4, 5, Tb-1 of Yoshida, 2003. (Sl-16 onwards)

iii) Locations of the discoveries Fig. 8 (Sl-20)

iv) Field note description of the first discovery: translation from field notes by Naruse and Ageta.　Fig. 6, 9, Tb. 2 of Yoshida, 2003 (Sl-18, 19, 20) .

III. Storage and transportation of meteorites

i) (Sl-24) Packing tape and soft-tip pen

ii)　Packing in tin-can with other rock samples, for shipping

IV. Identification of meteorite and reports.

i) Sl-25, The meteorites were passed to Prof. Gorai as gifts from Antarct6ica.

ii) Telegram and letters (English translation). Sl-26, 27

Table of reports 1970-1971 (Sl-29). Akahata report (Sl-30).

IV. Concentration mecamins, prediction of future collections, and start of the meteorite collection project

Understanding of concentration mechanism at those times. Fig. 10, Sl-30, 31, 32, 33).

Akahata notes English translation (Sl-34).

Extraction from Yoshida et al., 1971 (a paragraph) Sl-34.

Start of the meteorite collection program by Geology Group of JARE. (Sl-35)

SI-1　タイトルスライド

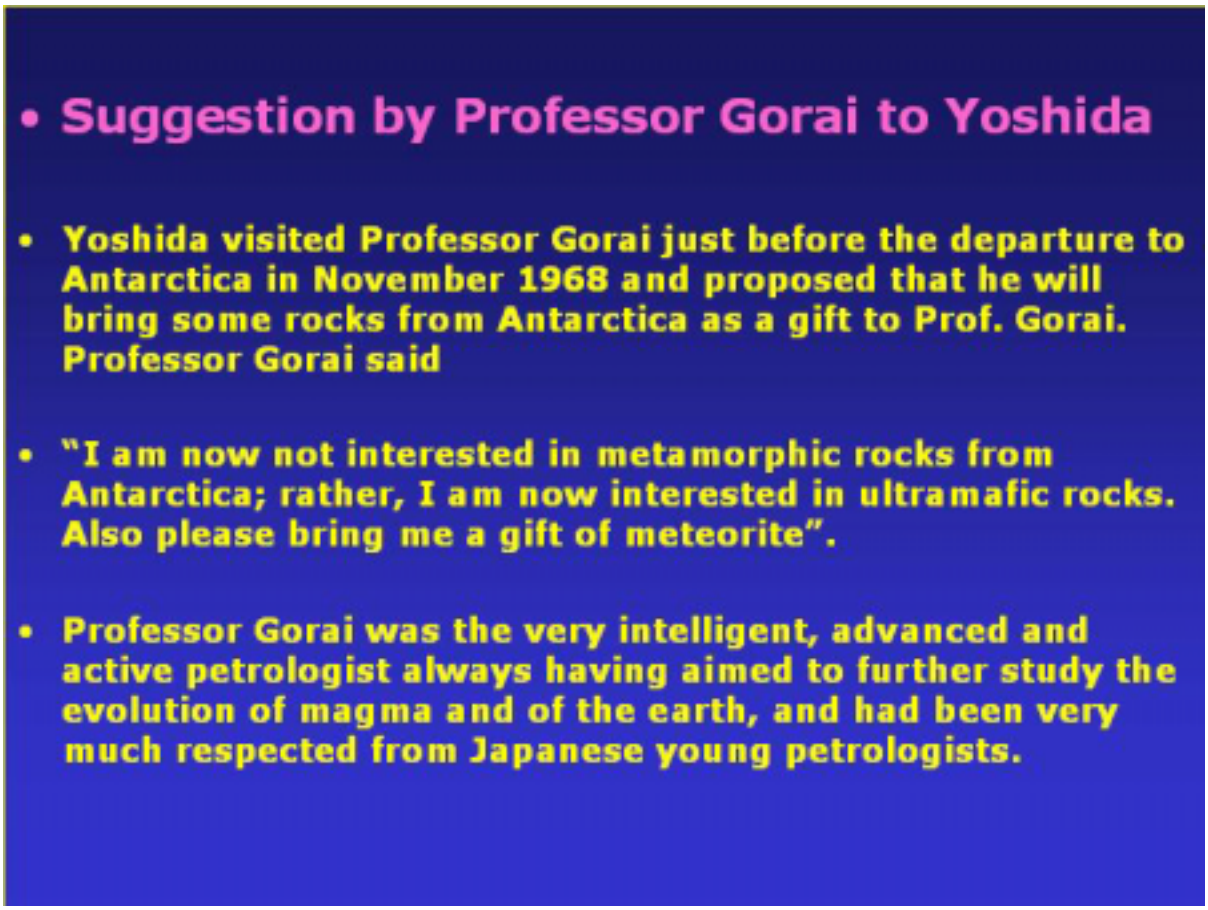
SI-2　やまと隕石発見の重要性と本報告の意義

- **Prologue: Some Initiatives for the Discovery**

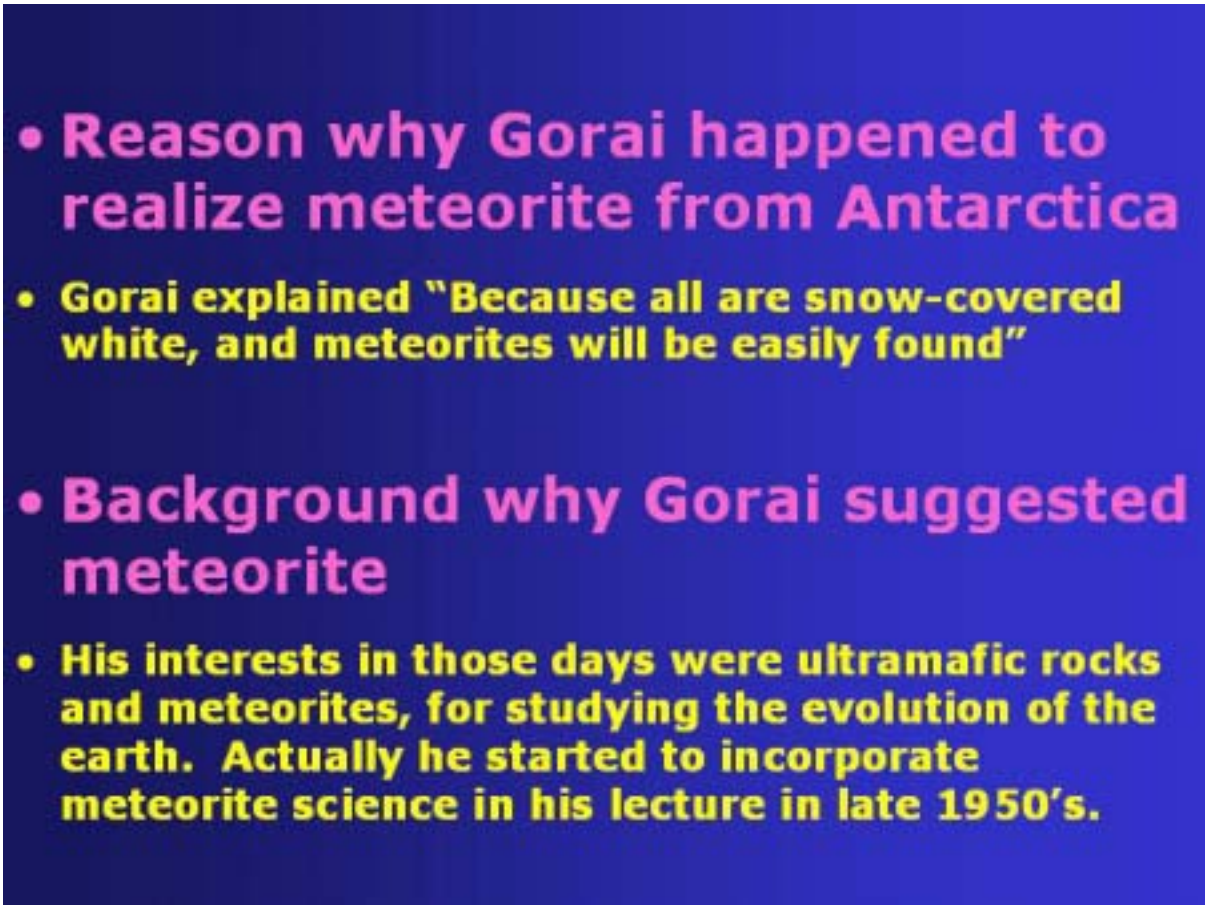
- Late Professor M. Gorai, who was the member of Special Committee on Antarctic Research of Japan Science Council, requested Yoshida, as a half joke, to bring meteorite as a gift from Antarctica.

SI-3

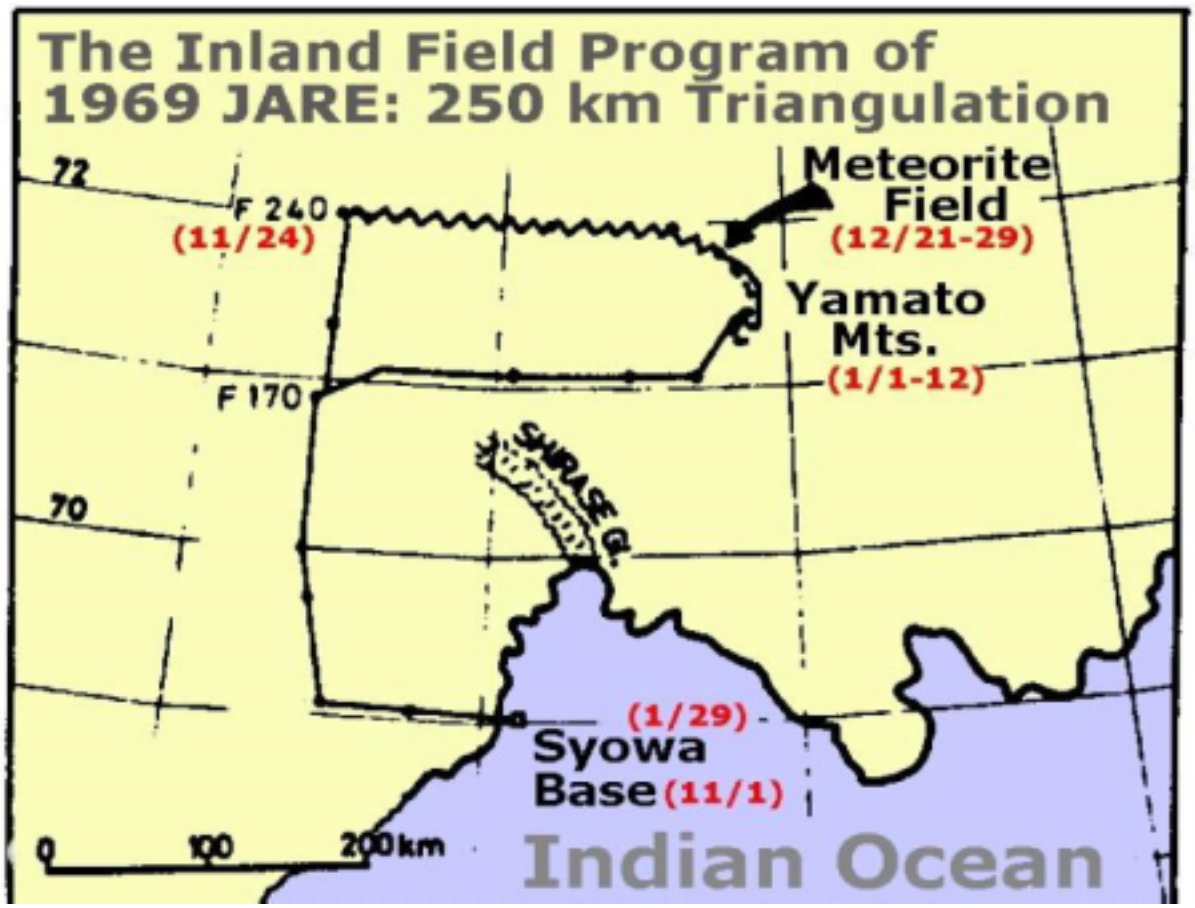
SI-4 南極の隕石収集を吉田に話した故牛来正夫教授



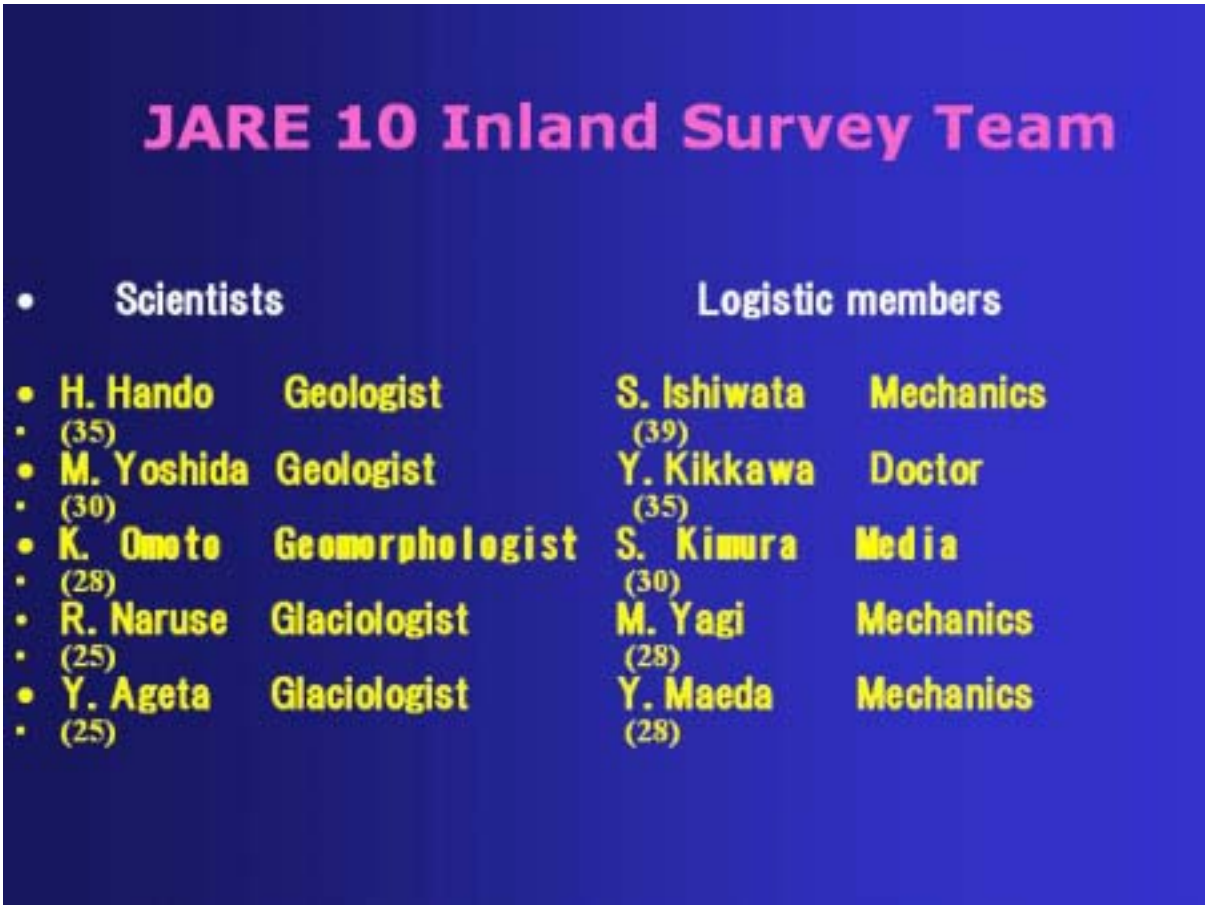
Sl-5　牛来教授による隕石採集の示唆内容



Sl-6　牛来教授が隕石を示唆した理由



SI-7　内陸調査隊のコース



SI-8　第十次越冬隊の内陸観測隊メンバー構成

Sl-9　A群山頂ですっかり満足の内陸隊一同（木村隊員撮影）

Sl-10　南極大陸の雪原を走る内陸隊

SI-11　雪上車隊の構成、先頭車は大陸氷厚測定のアイスレーダー車

SI-12　やまと山脈初見参

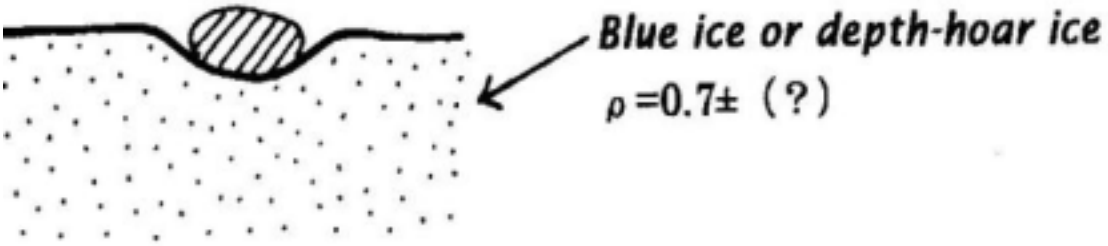
SI-13　やまと山脈とかげろうの海（隕石氷原付近の様子）

SI-14　三角鎖測量でついに基点露岩（ミカターク）に到着、測量する小元隊員

SI-15　A群ヌナタークスからやまと山脈を望む

SI-16　上田隊員による第二隕石発見時の写真

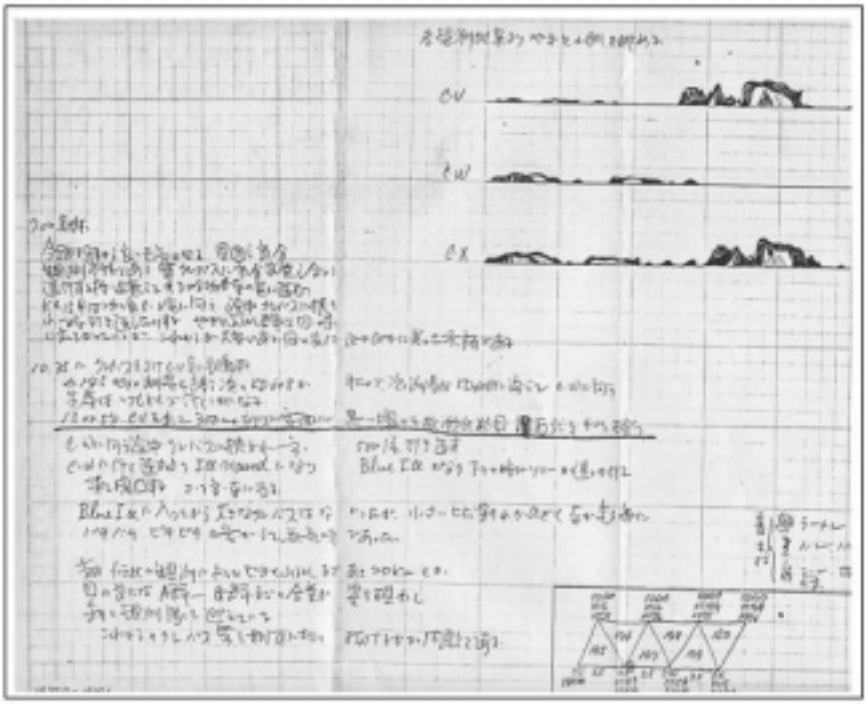
)ccurrence of the No.1 meteorite
Field sketch by R. Naruse)



The ice here is not the insitu formation, but should be glacier ice
flew from inland. (if so, then the ice is not so deep-origin).
We tried to dig for about 20 cm, but found noting except ice.
Only one sample shown on the figure occurred isolated.

SI-17　成瀬隊員による最初の隕石の産状

Dec. 21st, 1969, Field note by Kikkawa.



7:00 got up.
Today the view is clear and geodetic measurement is possible. We departed, after cautioning by each on crevasse danger. At 9:30, each car proceeded for their own measuring point. We were forced to go back sometimes, when crevasse hindered our way. Although the Yamato Mountains is seen in front of us, the way to the mountain is especially difficult from now onwards. Brilliant ice is extending ahead of us.

At 10:35, arrived at CV point, shifting from crevasses. Geodetic measurement of only the point 145 is completed. The following KD608 has shortly arrived, and then we forwarded for OW point, passing the measurement work to DK608. As such, the top is always the KC car. *At about 13:00, after driving for 300 meters from CV, Naruse found and collected a black massive block, possibly meteorite.* ....(later part of the note is abbreviated)

SI-18　最初の隕石発見メモ（吉川隊員のノートから）

Translation of a part of field note description of Ageta, Dec. 21st, 1969

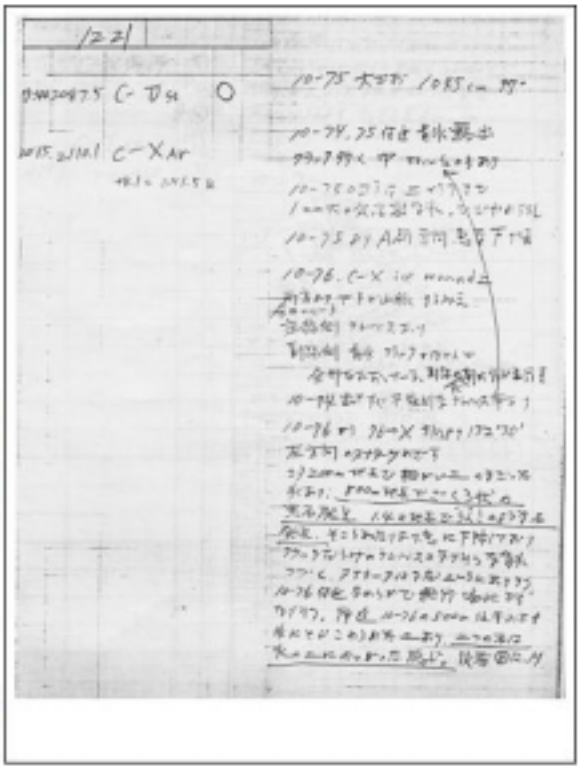
.....

.....

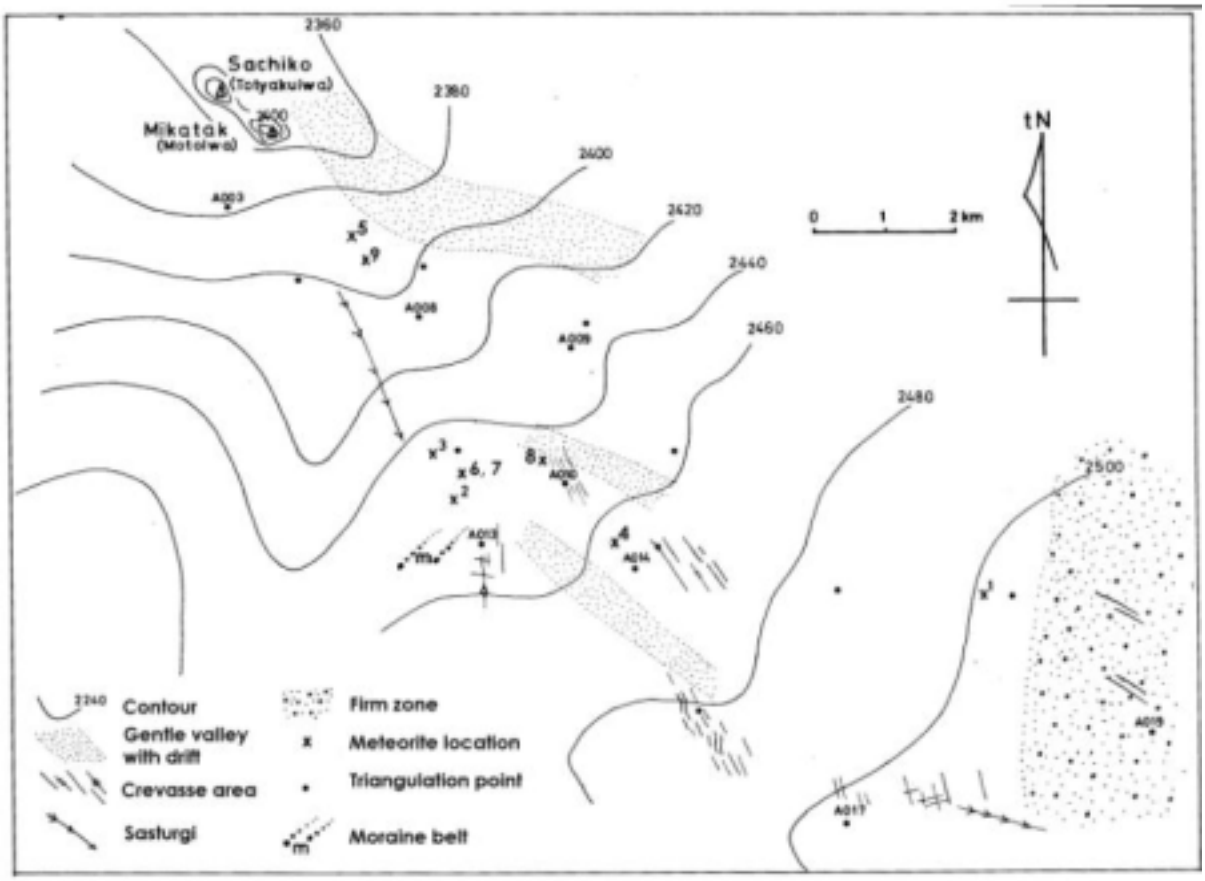
Soon after departing from 10-74 point, we encountered an irregular crevasse zone. From 10-76 point, we forwarded to the left-hand nunatak, towards 132o30′ from the line delineated from 76 to X. After driving 800 meters, ***a black rock something like a pomeganate was found, and at about 1.4km point, a rock something like feces was found.***

.....

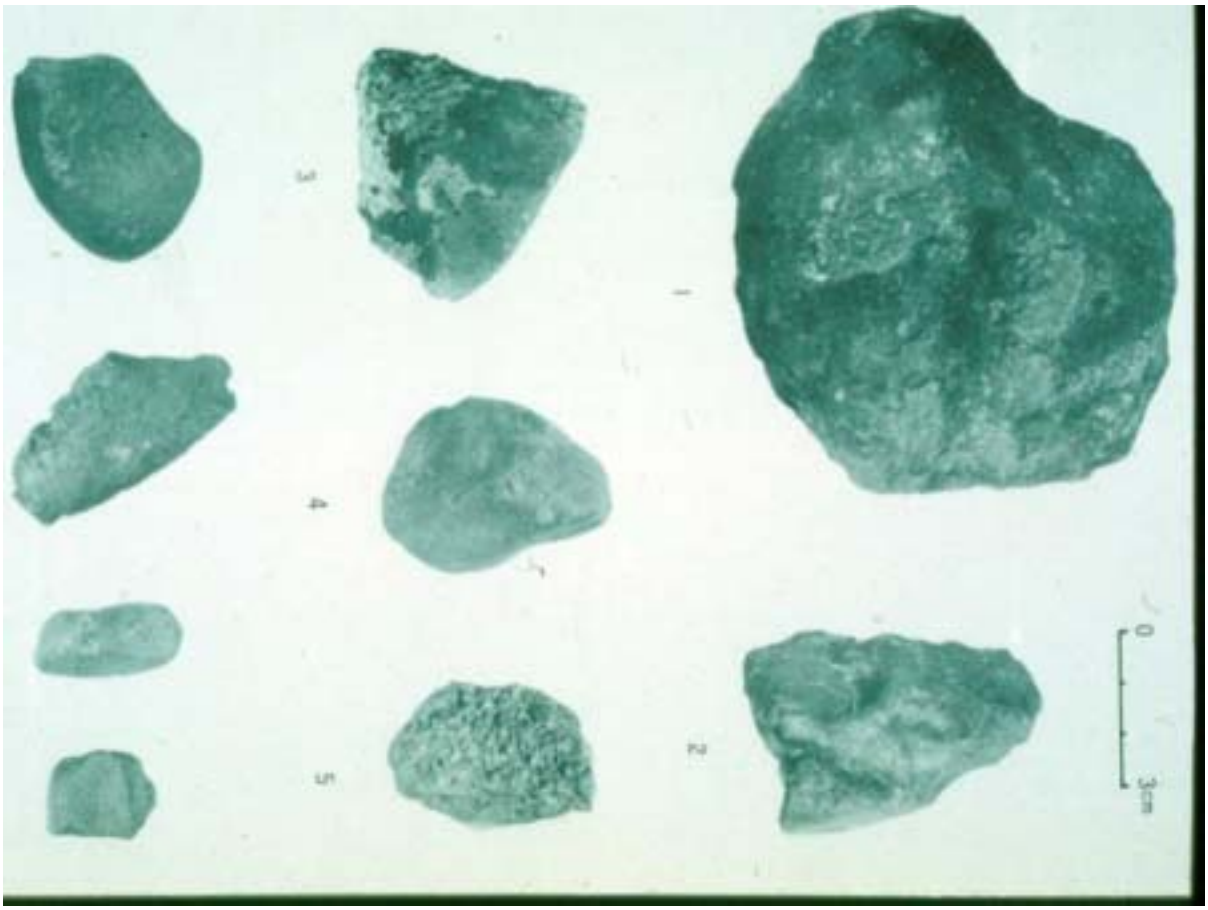
..... **On the way back, at about 500 meters before 10-76, soil is found within ice.** ***The two rocks (above) appeared to be just settled on ice.***



SI-19　上田隊員による最初の隕石発見記事



SI-20 隕石発見・採集位置



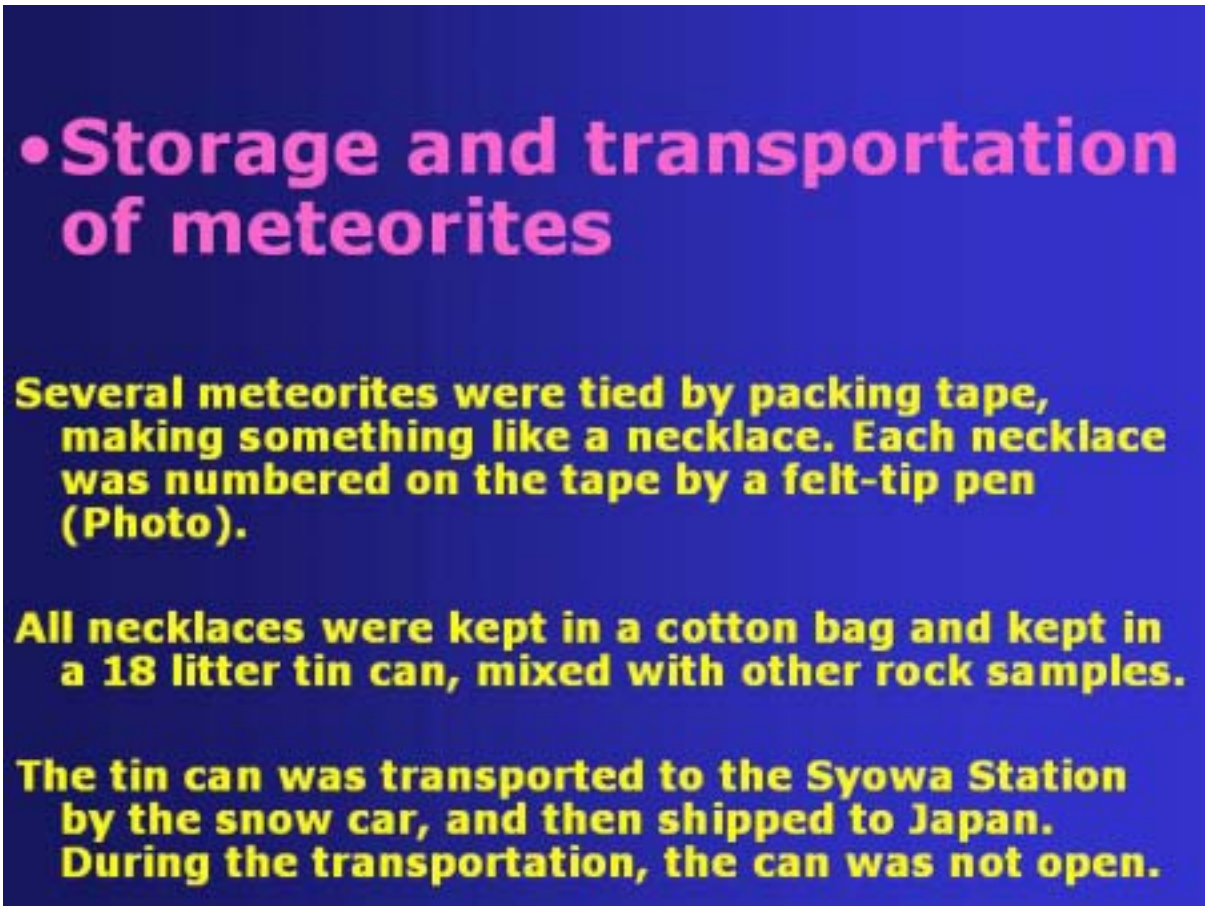
Sl-21　収集された隕石９個　（Yoshida et al., 1971 から）

List of meteorite collection in Dec. 1969

(Partly modified from the list given by Yoshida et al., 1971 and Yoshida, 2003)

Specimen No.	*Reporter to Yoshida*	*Location description in the field (N is magnetic)*	*Field description by the collector. Italic: description by Yoshida.*
1. 69122101	Naruse	300 m from A018 to A016.	*Volcanic breccia-like, with pan-cake-like film.*
2. 69122102	Ageta	800 m from A013 to Totyakuiwa.	Pomeganate-like black rock; *hematite-like, rounded with melted film*
3. 69122103	Ageta	1.4 km from A013 to Totyakuiwa.	Feces-like rock; peridotite-like rock
4. 69122201	Ageta	500 m north from A014	Black rock
5. 69122301	Yoshida, Ageta	6.3k km from A013 toward Motoiwa, and then 1.6 km toward A014. This is 7.4 km	Black rock
6. 69122601	Ageta	Ca 1.5 km northwest of A010.	Black rock
7. 69122602	Ageta	Ca 1.5 km northwest of A010, only 1 m apart from 2601.	Black rock
8. 69122603	Ageta	500 m north from A010	Black rock
9. 69122901	Ageta	3 km northwest of A009 and then turned toward northeast	Black rock

SL-22 隕石採集の野外メモ



SI-23　隕石の保存と運送

SI-24　隕石のナンバリングの再現

Identification of meteorites and related movements in Japan

i) The collected meteorites were handed to Prof., Gorai by Yoshida, both being suspected the possibility that at least some should be meteorite.

ii) Professor Gorai weighed and taken photos of all the rock samples, and then made thin sections and examined under microscope. He realized that all samples are meteorite and further, are of different lithology. Prof. Gorai promptly sent a telegram (*All were found to be meteorites!*), and successively wrote a letter to Yoshida (July 10th) (next slide).

iii) Yoshida responded Gorai through a letter indicating some field details of the occurrence of the meteorites, suggestion to concentration/occurring mechanism, storage and belonging of meteorites, and plan of making a report with a deadline of August 15th (next-next slide) .

S1-25　日本における隕石同定と関連の動き

Dear Yoshida

As telegraphed, the "petrosus" (old material) have been found to be meteorite; all of them! Indeed an astonishing matter. Only one sample (photo No. 1) so called iron meteorite(?) is still questionable and under the examination. Among relatively large rocks you collected (Nos. 2, 3, 4, 5, 8), No. 3 is achondrite and all others are chondrites. The chondrites by each have some differences in lithologies. Remaining smaller rocks now under the thin-section preparation are possibly all meteorite.
It is indeed a surprise. Because according to what you told me, these meteorites were collected from nearly a same area; however, it is impossible to imagine that several meteorites of different lithologies occur together within a small area of ordinary land. Possibly this is due to a concentration by glacial process, that wiped to concentrate meteorites from a very wide area. This is indeed a natural "Meteorite Museum", that made me extremely amazed and shocked.
Now how to precede the research on these meteorites should be considered later. The first importance is to make order and sort out every conditions and data of the meteorite discovery. Further, to collect necessary data and knowledge that may be useful to consider why such a strange phenomenon occurred.
I was suspicious when I dispatched the rocks for making the thin section. I was lucky and now feel on safe because all rocks were weighed and took photos before making thin sections, considering a possibility of being meteorite.
I hope to discuss with you when you come next to Tokyo. Please inform me your schedule.

July 10th, 1970
Gorai

PS.
I think there is a possibility that the belonging of these meteorites may cause a variety of problems. I hope that these may not become private ones and may become useful to many scientists. There are various problems however, and therefore for I will define this meteorite as the gift of "petrosus" that you brought me from Antarctica (this is practically true). Please understand on this point at your side as well.
Please call me to my home phone in the morning time around 7:00 to 8:00.

S1-26　隕石同定直後に吉田にあてた牛来教授の手紙

July 16th, 1970

Dear Respected Professor Gorai,

Thanks for your letter dated July 10th. I also received your telegram about a week back, when I just easily understood that it would be reasonable that one or two may be meteorites. However it is astonishing that all are the homerunsa.
I will contact you tomorrow morning. I just learned from Dr. Oba on literatures and knowledge on meteorites and realized the big meaning of this matter.

Data related to the meteorite discovery include 1. Discovery dates, person and place, 2. Lithology and shape, 3. Numberings. However, I have been bewildered that numbers that I attached were almost all disappeared (it was written on the packing tape by felt-tip pen). Bags in which the meteorites were stocked, tips of packing tape that may be attached on the meteorite may be important data to estimate number of meteorite samples. However, my understanding is that since the localities are within some to ten and some kilometers and to be said as to be not very much different.
Regarding the concentration mechanism, I discussed with other field team members including glaciologists. I have considered the mechanism to be as shown on the figure below, since the area of collection is bared ice area and down slope toward Yamato Mountains.

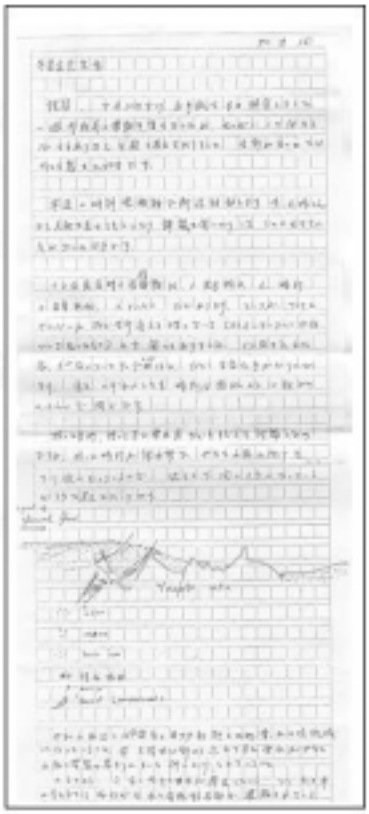
Schematic figure is given here

There are two major points to consider the concentration mechanism of meteorites as follows. The area near by Yamato Mountains is i) the ablation area due to radiation heating effect of bared rocks, and ii) Glacial ice flown from the inland of Antarctic continent is thrusted up due to the threshold effect of the mountain range. Because of the above two effects, i) old ice is exposed, and ii) rocks (meteorites) included in the ice concentrates on the surface of the ice where ice only is ablated.

Regarding the belonging of meteorites .....(several lines skipped)
My sche-dule in July, August and September .....(several lines skipped)

It is felt that the belonging of the meteorites and making reports appear to become topics that is far from my ability. I hope to all time request consult with you.

Masaru Yoshida
Dept. Geol. Min., Hokkaido Univ.



SI-27　牛来レター（Ｓ１－２６）への吉田の返事

- **Early movement and Reports related to the Meteorite Discovery**

- 1969. 12. Discovery of meteorite in the Yamato Mts.
- 1970.3. Return from Antarctica,
- 1970.6. meteorites were passed to Prof. Gorai in June 1970.
- 1970.7. Gorai Telegram "All are Meteorites!".
- 1970.7.← Wintering Report by Ando, "Collection of Meteorites".
- 1970.8. Report in MAGMA by Gorai "Meteorite Museum in Antarctica.
- 1971.1. Polar Report by Yoshida et al. "Discovery of .....
- 1971.1. Newspaper Akahata, "Mystery of Nine Meteorite from Ant.
- 1973. Two EPSL papers by Shima & Shima and Hintenbesger et al.
- 1975.10. Firs Symposium on Yamato Meteorites in Tokyo.

SI-28　やまと隕石初発見後の関連の動き

Meteorite "Museum" in Antarctica

Masao Gorai

Some day in 1968 autumn, Masaru Yoshida of Hokkaido University visited my laboratory telling that he is now departing for Antarctica. I told him that since I have received several rocks surrounding Syowa Station, I would like to receive meteorite *yotemono* as a gift. Of course it should be fairly difficult to collect meteorites, my words to Yoshida above was a kind of joke, and I myself have forgotten what I have told him. Yoshida visited me May or June after completing the wintering in Antarctica. I was absent and he left sample bags with something inside, having requested Mr. Sugiyama of Structure Laboratory to pass to me. Sugiyama brought them to me some days later. However I have completely forgotten that I requested Yoshida to bring meteorite *yotemono* and left them on some desk without opening the bags.

After some time Yoshida visited me, and told me "Sensei, I collected rocks something like meteorites, which you requested me to bring as a gift". Then I recalled that I requested something like that. Then I tried to open the bag and found that they are the *GETEMONOES*. There was color difference such as brownish black, gray, violet, etc., but they were somewhat rounded and covered by thin crust, appearing as if they are meteorites. However it is difficult to understand that such a variety of meteorites occur in a narrow area almost to say at one point (near the Yamato Mountains). I felt therefore, they may be ordinary rocks of a kind of moraine, and blackish crust can be made by a special weathering of Antarctica.

Thus, I thought they maybe or not, or rather to say, should not be meteorite by 95 %. However considering in case of being meteorite, I took photos and weighed all of them and requested the technician to make thin sections. Some days after, thin sections came to me and to my surprise, all were meteorite. Eight rocks are chondrite and one is achondrite. Indeed it was astonishing, and promptly sent a telegram to Yoshida. (Another sample collected by someone said to be iron meteorite appears to be not the meteorite).

As mentioned above, the matters are interesting, and details of collection of meteorites are scheduled to be reported by Yoshida and his colleagues. The reason why such a meteorite museum form will also be examined from glacio- geological point of view. Mineralogical, petrological and space-chemical studies on these samples will be forwarded, after consulting with appropriate people.

(Submitted August 20th, 1970)

南極のイン石"博物館"

SI-29　牛来教授による「南極の隕石博物館」記事　（1970 年、マグマ）

赤旗　第7317号　2版　（6面）　1971年1月21日（木曜日）発行から抜粋

9個のいん石の謎

みんな種類が違う

氷河が一ヵ所に集めた？

変革の立場から

公害研究活動基金を設立

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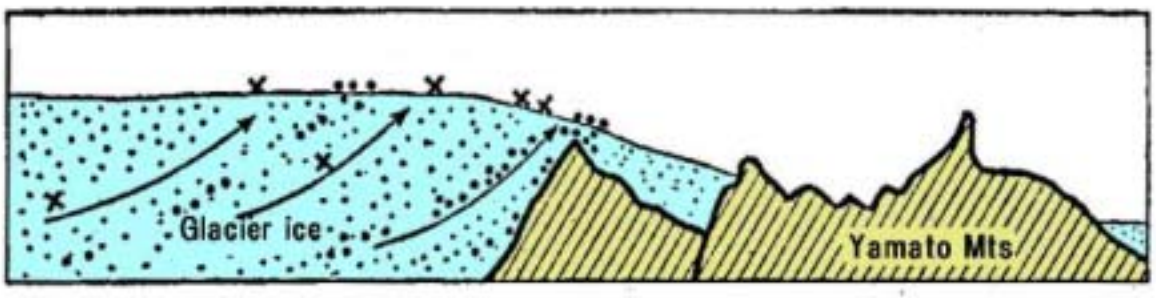
SI-30　やまと隕石初発見に関する赤旗記事（1971 年 1 月）

• Suggestion of Concentration Mechanism Reported in 1971

- The existence of these shear moraine belts suggests that the movement and structure of ice sheet of the area may account for the concentration of the meteorites. High frequency of the distribution of the meteorites may be thus explained in connection with the movement and structure of the ice sheet (Yoshida et al., 1971)
- The glacier is constantly moving and ice coming from inland is thresholdered by the Yamato Mountains, thrusts up, and melts from the surface, remaining meteorites, which fell onto the inland ice field and sank within the ice sheet. As such the meteorites were collected from very wide areas by several thousands of years (Akahata News Paper, 1971).

SI-31　南極における隕石集積機構についての 1971 年段階の発表内容

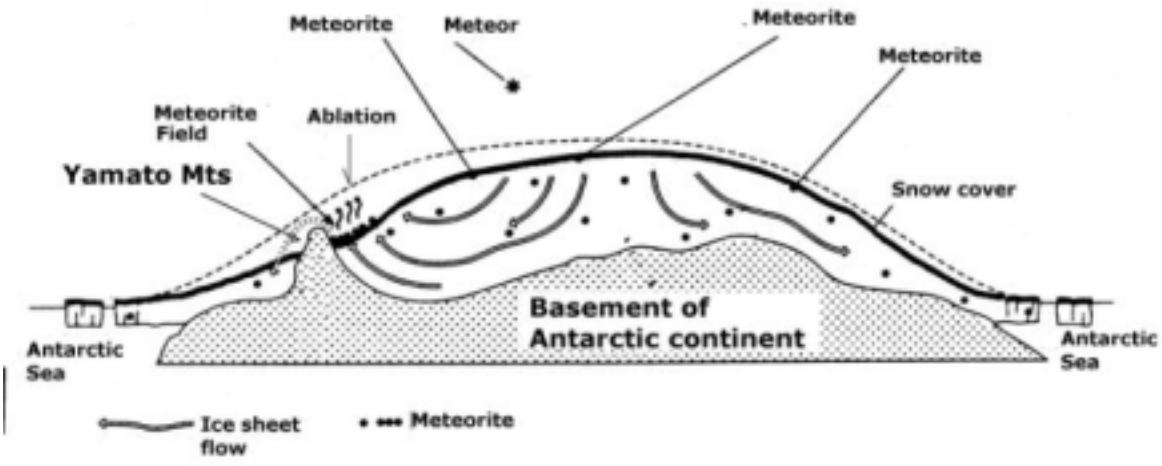


Possible mechanism of meteorite concentration (Yoshida, 1971)

x: Meteorite　●: Morain boulders　•: Glacier ice　▨: Basement rocks

There are two major points to consider the concentration mechanism of meteorites as follows. The area near by Yamato Mts is i) the ablation area due to radiation heating effect of bared rocks, and ii) Glacial ice flown from the inland of Antarctic continent is thrusted up due to the threshold effect of the subglacial basement high. Because of the above two effects, old glacier ice is exposed and rocks (meteorites) included in the ice concentrate on the surface of the ice where ice only is ablated.

SI-32　　隕石集積機構の概念図（1971 年赤旗紙発表）



Concentration Mechanism of Meteorites by Glacial Transportation

(Yanai, 1978)

SI-33　国際的に発表された隕石集積機構のモデル図（矢内桂三,1978）

- **Prediction of Future Collections in 1971**
- **Because of such mechanism of concentration of meteorites, it is possible, that more meteorites may be found in the area of bare ice to the east to southeast of the Yamato Mountains. Even in the present region, more meteorites may remain undiscovered. From this view point, there may be some other areas where the ice structure is the same as the present region, having a possibility of concentration of meteorites (Yoshida et al., 1971, Polar Report).**
- **Because of the concentration mechanism mentioned above, much more meteorites will be collected if we intentionally search them in the area (Akahata News Paper, 1971).**

SI-34　将来の隕石収集予測についての 1971 年の記述

SI-35　南極隕石収集プロジェクトの発足－1975 年