拡散型大規模火砕流の研究
幸屋火砕流での火山地質学的調査研究
VOLCANOLOGY OF THE KOYA ASH FLOW

日米科学協力事業共同研究 (Jan.1,1983-June 30,1984) 成果報告書

A progress report of the U.S.-Japan Cooperative Science Program

研究代表者　Principal investigators

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研究経過

1983年２月、ハワイ大学において両国の研究代表者が、研究計画の打ち合せを行なった。

1983年３～４月、鬼界カルデラ及びその周辺の島々、と九州本土南部において本研究参加者全員により、現地調査が行なわれた。

1983年４月　日本地質学会における研究発表（宇井ほか）

1983年７月　現地地質調査（宇井）

1983年10月　日本火山学会における研究発表（宇井ほか）

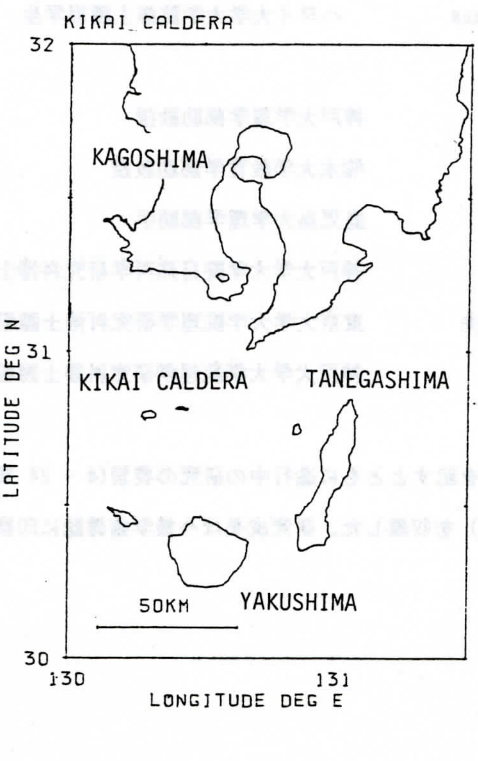
1983年11月　ハワイ大学において本研究参加者の成果発表のため、Products of Explosive Volcanism と題したシンポジウムを公開で行ない意見を交換した。プログラムは３頁参照。

1983年1 月　American Geophysical Union Fall Meeting で研究発表（宇井、鈴木、McBroome、Caress、Knight）

1983年12月　現地地質調査（宇井）

1984年５月　現地地質調査（Walker、小林）

上述の行事の合間に参加者は各自研究室で、種々の室内作業を行ない、公表論文を作成した。



VOLCANOLOGY SYMPOSIUM

Products of Explosive Volcanism

JAPAN – SUMATRA – U.S.A.

Tuesday November 29th, 1983
University of Hawaii at Manoa
Marine Sciences Building Room 114

Morning Sessions

10.30 George Walker (U of H) — INTRODUCTION

10.40 Tadahide Ui (Kobe Univ.) — FLOW LINEATIONS OF KOYA LOW ASPECT RATIO IGNIMBRITE, KYUSYU

11.00 Lisa McBroome (U of H) — GRAIN-SIZE STUDIES OF KOYA LOW ASPECT RATIO IGNIMBRITE

11.20 Tetsuo Kobayashi (Kagoshima Univ.) — GEOLOGY OF KIKAI CALDERA (SOURCE OF THE KOYA IGNIMBRITE), JAPAN

11·40 COFFEE BREAK

12·00 Kazunori Watanabe (Kumamoto Univ.) — AN EXAMPLE OF A LOW ASPECT RATIO IGNIMBRITE FROM ASO CALDERA, JAPAN

12·20 George Walker (U of H) — MOUNT ST HELENS BLAST OF MAY 18 1980 — PYROCLASTIC FLOW OR SURGE?

12·40 LUNCH BREAK: BUFFET LUNCH FOR PARTICIPANTS

Afternoon Sessions

2·00 Yukio Hayakawa (Tokyo Univ.) — TWO EXTENSIVE ASH-FALLS ASSOCIATED WITH LARGE-SCALE PYROCLASTIC FLOWS IN JAPAN

2·20 Mary Caress (U of H) — THE TOBA IGNIMBRITES, SUMATRA

2·40 Keiko Suzuki (Kobe Univ.) — DEPOSITIONAL RAMPS OF THE ATA PYROCLASTIC FLOW DEPOSIT IN SW. JAPAN

3·00 COFFEE BREAK

3.20 Michael Knight (U of H) — THE TOBA CALDERA, SUMATRA

3.40 Yukio Hayakawa (Tokyo Univ.) & Tetsuo Kobayashi (Kagoshima Univ.) — THE 1983 ERUPTION OF MIYAKEJIMA VOLCANO, IZU-MARIANA ARC

4·00 Lisa McBroome (U of H) — CALDERAS AND IGNIMBRITES ON THE EASTERN SNAKE RIVER PLAIN

4·20 Tadahide Ui (Kobe Univ.) — CONCLUDING REMARKS

PRODUCTS OF THE KOYA ERUPTION FROM THE KIKAI CALDERA, JAPAN

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Hawaii Institute of Geophysics, Honolulu, Hawaii 96822. U.S.A.

The Koya eruption from the Kikai caldera generated 8 main pyroclastic layers, found on islands (notably Takeshima) around the caldera and on mainland Kyusyu. Each layer is being restudied in the field and by grain-size analysis, following pioneer studies by Ui (1973), Machida & Arai (1978), and Ono et al (1982). The stratigraphic relationships are shown in fig.1. Features of these layers, and tentative new interpretations, are summarized below in this progress report.

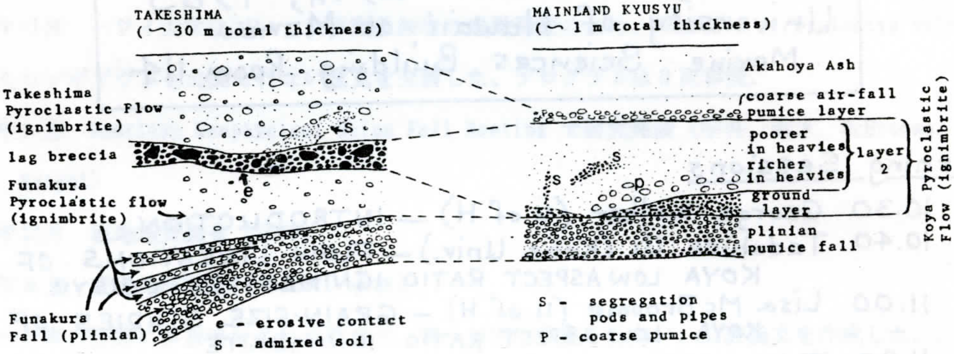

Fig.1 Pyroclastic stratigraphy of products of the Koya eruption.

The lowest layer is a plinian pumice-fall deposit (the Funakura Fall on Takeshima) which, as shown by Machida & Arai (1978), is dispersed N.E. from its source.

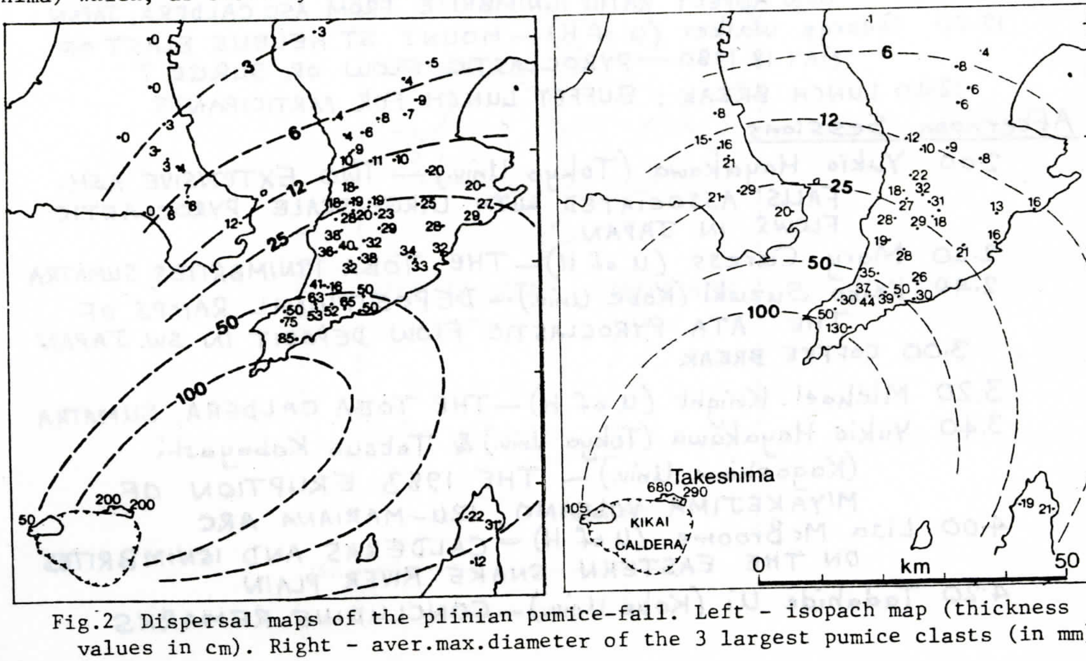

Fig.2 Dispersal maps of the plinian pumice-fall. Left - isopach map (thickness values in cm). Right - aver.max.diameter of the 3 largest pumice clasts (in mm).

The areas enclosed by the maximum pumice size isopleths (e.g. 6000 km^2 for the 20 mm isopleth, fig.2) are large and show that this plinian event was an exceptionally powerful one, only slightly less so than the most powerful currently known (the Taupo ultraplinian).

Next comes an ignimbrite (the Funakura Pyroclastic flow), recognized only on Takeshima. It is a strange deposit since it combines some features of fall deposits (e.g. it has very thin bedding units) with some features of pyroclastic flows (e.g. it thickens into valleys and is poorly sorted). It has a pervasive dark brown thermal coloration, and where thickest is welded. It contains many flow units, some of which are separated by thin plinian layers and are therefore of intraplinian type. The finer particles in it consist of unusually strongly vesiculated pumice and delicate shards, and a relative richness in magmatic gas may be responsible for the unusual field characteristics.

Resting on the plinian pumice in mainland Kyusyu is an extensive but generally thin and dark-colored, sandy or gravelly layer; previously thought to be a fall deposit, it is now (following studies at Taupo: Walker et al, 1981) reinterpreted as the ground layer of the Koya ignimbrite, deposited where fluidization was strongest in the head of the fast-moving Koya pyroclastic flow. It is strongly enriched in heavies (crystals and lithic fragments), fig.3, and on the grain-size plots of fig.4 the samples cluster at the finer end of the field of fines-depleted ignimbrite facies.

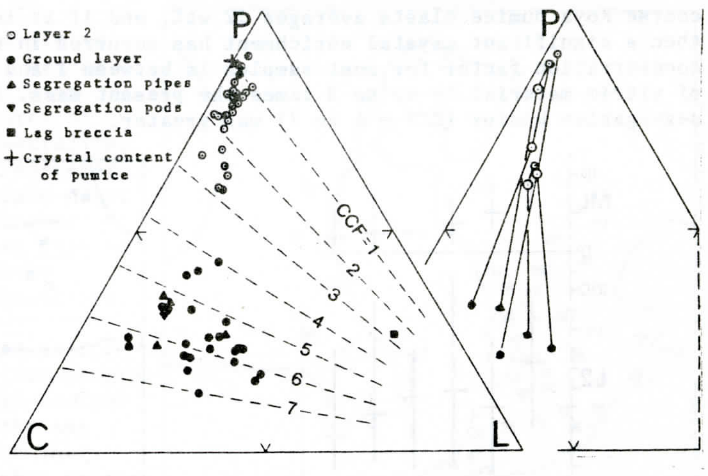

Fig.3 Weight percentages of pumice + shards (P), free crystals (C), and lithic fragments (L) in samples of the Koya ignimbrite. All sub-¼ mm material is included with P. Dotted lines show crystal concentration factors. Plot on right shows tie-lines between upper part of layer 2 (small circles), lower part of layer 2 (larger circles), and ground layer in the same sections.

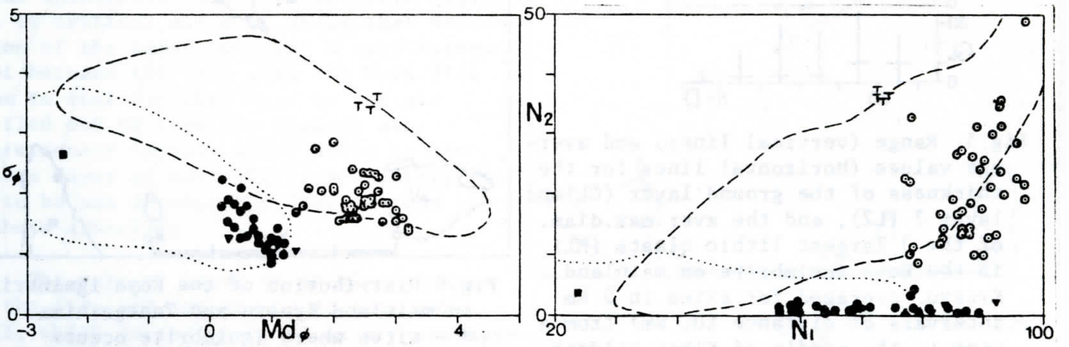

Fig.4 Grain-size plots of the Koya ignimbrite. Left - graphic standard deviation σ_ϕ against median diameter Md_ϕ. Right - N_2 (weight percentage finer than 1/16 mm) against N_1 (weight percentage finer than 1 mm). Dashed lines - the 2% contour for the pyroclastic flow field. Dotted lines - the 2% contour for the field of fines-depleted ignimbrite facies. Symbols as fig.3; T - Takeshima ignimbrite.

The ground layer thickness varies from 0 to 38 cm in response to local factors (e.g. the ground slope, relationship to topographic obstacles, and altitude) as well as decreasing with distance from source, fig.5. The grain-size shows similar trends.

The main part of the Koya ignimbrite (layer 2, after Sparks et al, 1973)rests on its ground layer with a sharp or gradational contact, and is distributed over the area shown in fig.6. The thickness varies from 8 to 140 cm, fig.5. Like the ground layer it mantles the landscape, and it is a veneer deposit. Samples plot mostly within the pyroclastic flow field of fig.4, although they are somewhat fines depleted compared with the average ignimbrite and in consequence are better sorted.

Layer 2 shows a general downward increase in heavies. fig.3, clearly visible in the field as a color darkening. Frequently the lower two-thirds of layer 2 (the part which is darker) contains pipes, pods, and irregular segregation bodies or patches which, like the ground layer, are strongly fines-depleted and enriched in heavies. Wilson (1981) showed that segregation takes place by gas streaming through the moving pyroclastic flow, and continues after the flow has come to rest. The more diffuse and irregular segregation bodies probably formed while movement was still taking place. There is also evidence that some of the streaky sheet-like bodies were formed by erosion of the ground layer, and the deposition of the eroded material along inclined shear planes extending well up into the ignimbrite.

Layer 2 samples contain from 8 to 30% of free crystals. The crystal content of coarse Koya pumice clasts averages 12 wt%, and if it is representative of the magma then a significant crystal enrichment has occurred in the ignimbrite. The crystal concentration factor for most samples is between 1 and 3 (fig.3), and implies a loss of vitric material by up to 3 times the present mass. Loss from the ground layer and segregation bodies (CCF = 4 to 7) was greater.

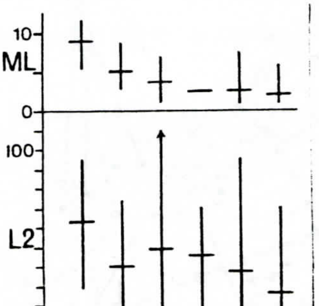

Fig.5 Range (vertical lines) and average values (horizontal lines) for the thickness of the ground layer (GL)and layer 2 (L2), and the aver.max.diam. of the 3 largest lithic clasts (ML) in the Koya ignimbrite on mainland Kyusyu, averaged for sites in 5 km intervals of distance (D, km) from a vent in the middle of Kikai caldera.

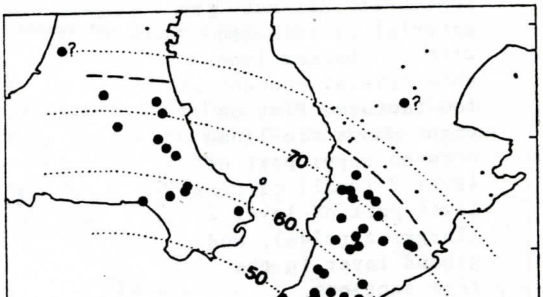

Fig.6 Distribution of the Koya ignimbrite on mainland Kyusyu and Tanegashima.
● - sites where ignimbrite occurs
· - sites where ignimbrite is absent
Dotted arcs show distance in km from a vent (V) in the middle of Kikai caldera

The crystal enrichment, visible downward increase in heavies, and abundance of segregation features indicate that the Koya ash flow was strongly fluidized, and the concentration of coarse pumice clasts towards the bottom implies that it was in a relatively expanded condition; it lacks however the characteristics of a pyroclastic surge deposit. These features, the landscape-mantling habit, and the evident ability to cross 40 to 50 km of open sea to reach mainland Kyusyu from Kikai point to an unusually high flow velocity for the Koya pyroclastic flow.

On Takeshima a coarse lithic deposit, interpreted to be a lag breccia, seems to be the lateral correlative of the Koya ignimbrite. It ranges up to 5 m thick and contains lithic blocks up to 1.5 m across, and strong erosion has occurred at its base. This breccia is thought to have accumulated in the highly turbulent, high-energy, environment around a collapsing eruptive column, before (i.e. closer to vent than)deflation of the pyroclastic material took place to form a pyroclastic flow (Walker, in press).

The next unit is a non-welded ignimbrite (the Takeshima Pyroclastic Flow), that caps Takeshima and is thought to have formed immediately after eruption of the Koya ignimbrite and lag breccia. It ranges up to about 20 m thick. The plots of fig.4 show that it has a higher content of fines and is poorer sorted than the average ignimbrite. Noteworthy features are the abundance of streaky mix-pumice, and locally of irregular masses of soil evidently incorporated from the ground surface.

A coarse but thin pumice-fall deposit rests on the Koya ignimbrite in mainland Kyusyu and extends well beyond the ignimbrite to rest on the plinian pumice or older rocks. Over an area of 60 x 50 km to as far north as Sakurajima, the deposit shows no detectable systematicvariation in thickness or maximum clast size, fig.7. The pumice has a higher content of mafic phenocrysts than that in the Koya ignimbrite, and apparently correlates with the Takeshima ignimbrite.

The best explanation is that this layer contains coarse fall-out from powerful secondary explosions of "fuel-coolant interaction" type occurring in the sea where water was trapped under the Takeshima ignimbrite. Its stratigraphic position is critical,since it shows that deposition of the layer occupied a very narrow slot between the time when the Koya flow came to rest and when dust in the air settled out to form the Akahoya ash. Accretionary lapilli which occur in the coarse layer at many places are interpreted to be ash prematurely flushed from the Akahoya ash-cloud.

The topmost layer on mainland Kyusyu is the fine and homogenous Akahoya ash-fall, which varies up to 40 cm and averages 25 cm thick. It appears to be a co-ignimbrits ash, and may contain the dust that was lost to produce the observed crystal enrichment in the Koya ignimbrite. It is thinner than the ignimbrite, but extends

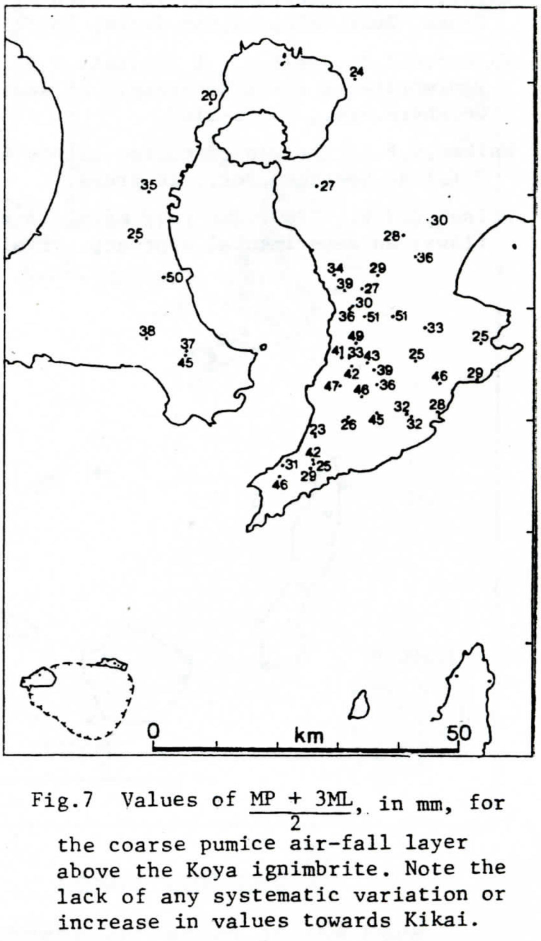

Fig.7 Values of $\frac{MP + 3ML}{2}$, in mm, for the coarse pumice air-fall layer above the Koya ignimbrite. Note the lack of any systematic variation or increase in values towards Kikai.

over a much wider area and has a greater volume. It may also contain ash from the Takeshima ignimbrite and fine fall-out from the explosions that generated the coarse pumice layer. Its exact nature awaits further study.

The deposits from the Koya eruption are very varied and present many unusually interesting and intriguing features. The eruption was an exceptionally violent one - the whole pyroclastic sequence is thought to have accumulated within a very short time, possibly only a day - and though it took place on a relatively far-offshore island it had the capacity to devastate southern Kuysyu. Research to unravel the story of this remarkable eruption continues.

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References cited:

Machida,H. & Arai,F. 1978. Akahoya ash - a widespread tephra erupted from the Kikai caldera, southern Kyusyu, Japan. Quatern.Res.Japan, 17. 143-163.

Ono,K., Soya,T., & Hosono,T., 1982. Geology of the Satsuma-Io-Jima District. Geol.Surv.Japan, 1:50,000 Quad.Ser., Tanegashima (16), No.2

Sparks,R.S.J., Self,S., & Walker,G.P.L., 1973. Products of ignimbrite eruptions. Geology, 1, 115-118.

Ui,T.,,1973. Exceptionally far-reaching, thin pyroclastic flow in southern Kyusyu, Japan. Bull.Volcanol.Soc.Japan, 18, 153-168.

Walker,G.P.L., Self,S., & Froggatt,P.C., 1981. The ground layer of the Taupo ignimbrite: a striking example of sedimentation from a pyroclastic flow. J.Volcan. Geotherm.Res., 10, 1-11.

Walker,G.P.L. Origin of coarse lithic breccias near ignimbrite source vents. J.Volcan.Geotherm.Res., in press.

Wilson,C.J.N., 1980. The role of fluidization in the emplacement of pyroclastic flows: an experimental approach. J.Volcan.Geotherm.Res., 8, 231-249.

Flow lineations of Koya low aspect-ratio ignimbrite, south Kyushu, Japan

Tadahide UI, Hideya METSUGI & Keiko SUZUKI (Department of Earth Sciences, Faculty of Science, Kobe University, Nada, Kobe 657 Japan) and G.P.L.WALKER, L.A.McBroome & M.E.Caress (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii, 96822 U.S.A.)

Koya pyroclastic flow is an example of the low-aspect ratio ignimbrite (Walker et al. 1981) dated as 6,300 Y.B.P. Source of the flow is Kikai caldera, south Kyushu (Ono et al. 1982). The flow easily travelled across the sea (Fig. 1). The Koya pyroclastic flow deposit generally consists of single flow unit traceable up to 110 km away from the source (Ui 1973). The deposit is characterised with dune bedding with ground layer. The flow spreads extensively at the topographically low reliefed area. Valley ponded facies (Walker et al. 1981) are confirmed at several localities due to quick erosion of the deposit. There is no systematic change of thickness in relation to altitude (Fig. 2). Thickness of the deposit decreases monotonously with increasing the distance from the source vent even after the flow travelled across the sea of 40 km wide. There is no major change of pumice diameter after the flow travelled across the sea, but grain size of lithic clast is drastically changed. Lithic clast might be lost during the flow travelled across the sea.

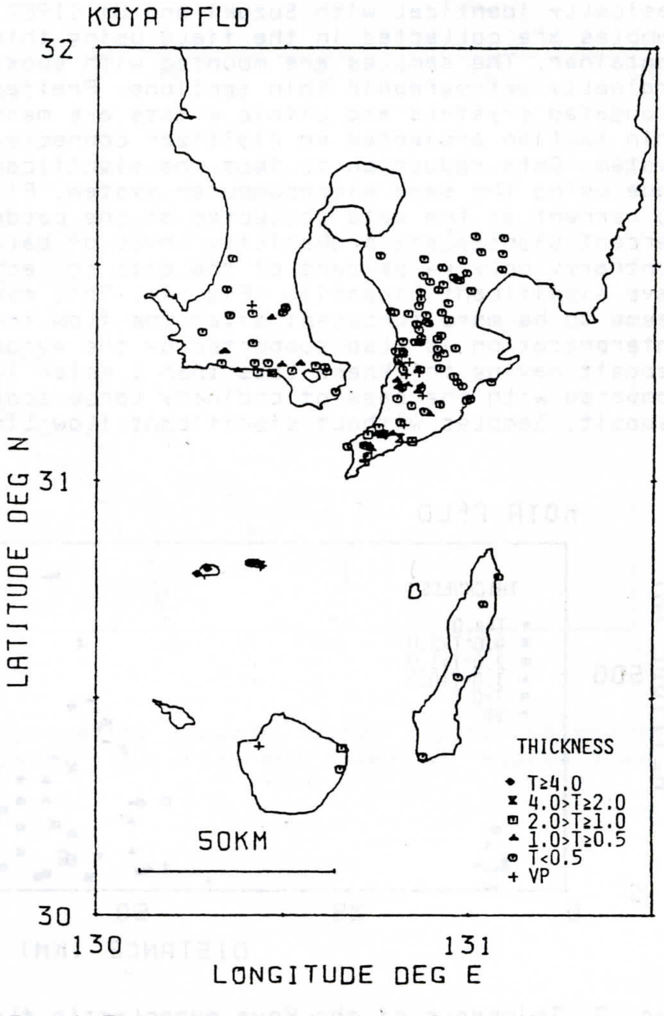

Fig.1 Thickness variation of the Koya pyroclastic flow deposit.

Velocity change of the flow are calculated based on the simplified model, equation of motion for material point. Several basic assumptions are made for this calculation. Energy exchange due to the internal turbulence of the flow and relative reaction of particles are ignored. Effect of tempereture difference from pyroclastic ejecta and air or ground is also ignored. Height of the eruption column is fixed. The flow spread with uniform coefficient of friction against the ground surface within the range of 0.02 and 0.005 after Sparks et al. (1978). The point 1 Km from the center of source caldera is assumed as starting point of the flow. Flow direction is radial from the source. Calculations are made for two routes. One is the route having very flat topography directed to the farthest distribution point passing through Kanoya (Fig.3). The best fit collapse height is around 2100 meters when the coefficient of friction is assumed as 0.02, and 500 meters for 0.005. Another example is the route having very rugged topography towards Uchinoura, eastern coast of Ohsumi peninsula. The best fit value of collapse height is around 2000 meters for 0.02 friction value, and 900 meter for 0.005. Thus the present distribution pattern (Fig. 1) is mainly controlled by the topographic relief.

Flow lineation of the Koya pyroclastic flow is measured. Method is basically identical with Suzuki and Ui (1982). Orientated unwelded samples are collected in the field using thin section size steel container. The samples are mounted with epoxy resin, and prepared ordinally petrographic thin sections. Preffered orientation of elongated crystals and lithic clasts are measured using the image of thin section projected on digitizer connected with microcomputer system. Data reduction to test the significance of flow lineation are made using the same microcomputer system. Fifty samples are measured. 80 percent of the data collected at the caldera rim have more than 90 percent significant probability level of calculated lineation. On the contrary, only 44 percent of the data collected at the Kyushu mainland have significant lineation (Fig. 4). This means that the flow behavier seems to be more turbulent after the flow travelled over the sea. This interpretation is also supported by the evidence that area of the deposit having thickness less than 1 meter is very extensive (Fig. 1) compared with the case of ordinary large-scale pyroclastic flow deposit. Samples without significant flow lineation concentrate the

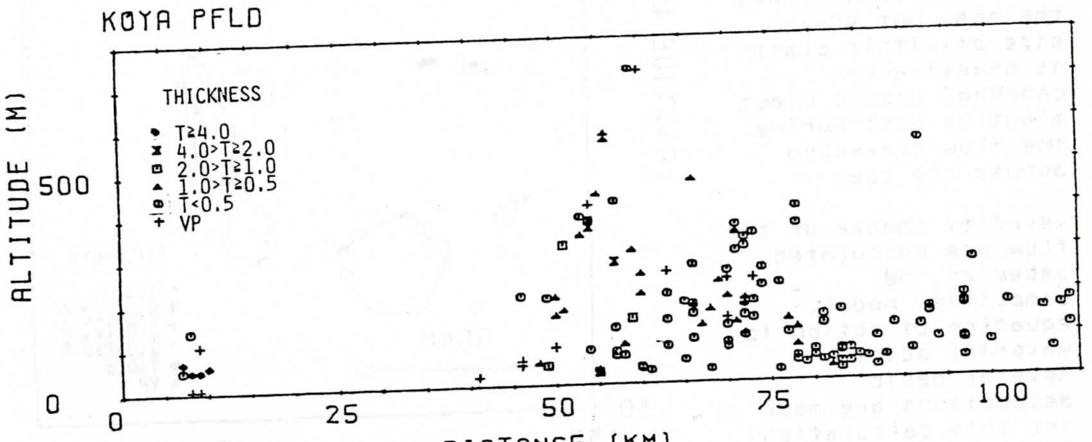

Fig. 2 Thickness of the Koya pyroclastic flow is plotted on a graph distance from the source against altitude of the deposit.

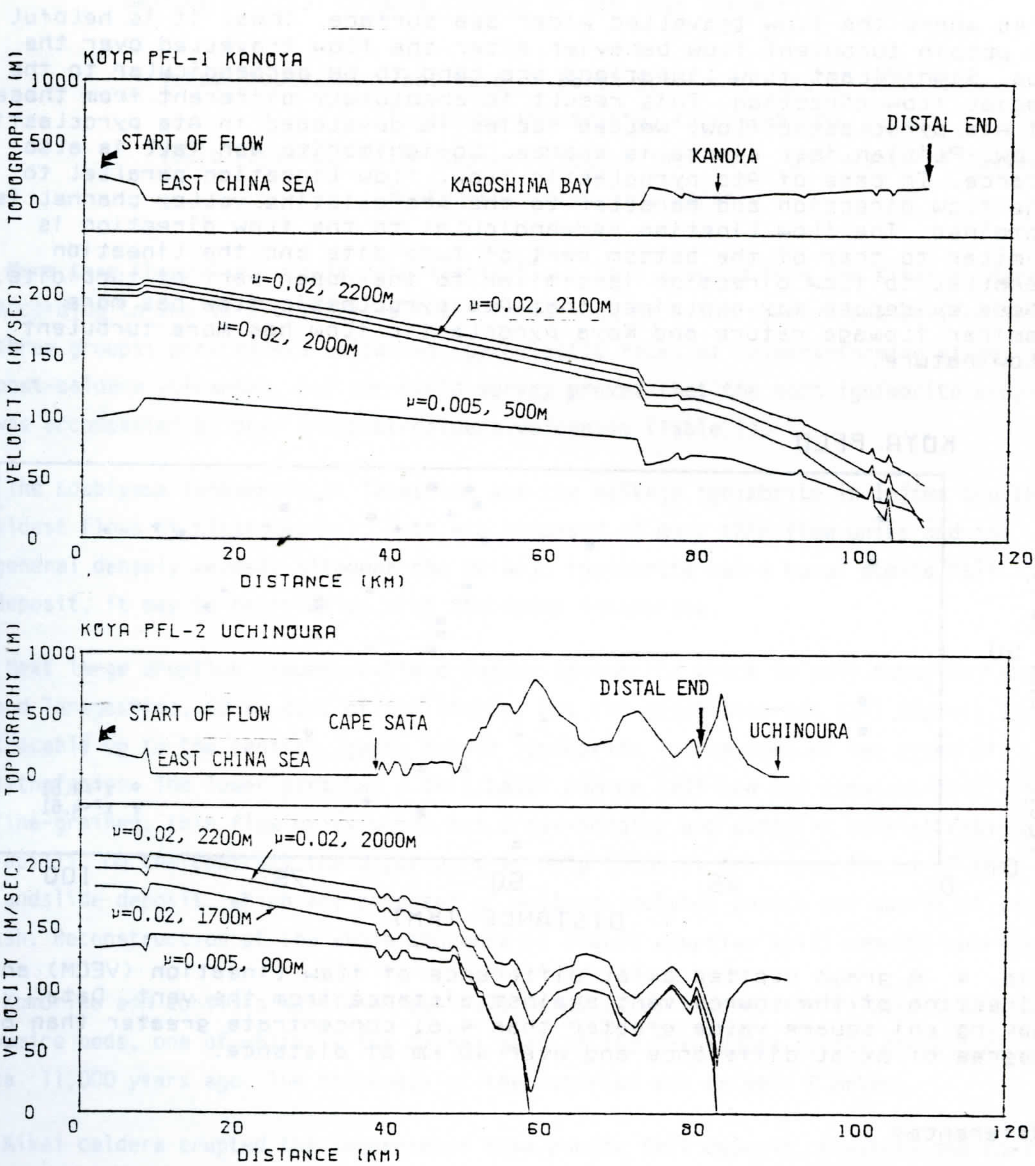

Fig. 3 Velocity change during the flowage. Upper figure represents the curve for topographically flat area, and lower for rugged area.

area where the flow travelled wider sea surface. Thus, it is helpful to obtain turbulent flow behavier after the flow travelled over the sea. Significant flow lineations are tend to be perpendicular to the radial flow direction. This result is absolutely different from those of Ata pyroclastic flow. Welded facies is developed in Ata pyroclastic flow. Plinian fall ejecta is scarce. Co-ignimbrite ash fall is also scarce. In case of Ata pyroclastic flow, flow lineation parallel to the flow direction and parallel to the pre-existing valley channel is obtained. The flow linetion perpendicular to the flow direction is similar to that of the bottom part of turbidite and the lineation parallel to flow direction is similar to the upper part of turbidite. These evidences may explained that Ata pyroclastic flow has more laminar flowage nature and Koya pyroclastic flow has more turbulent flow nature.

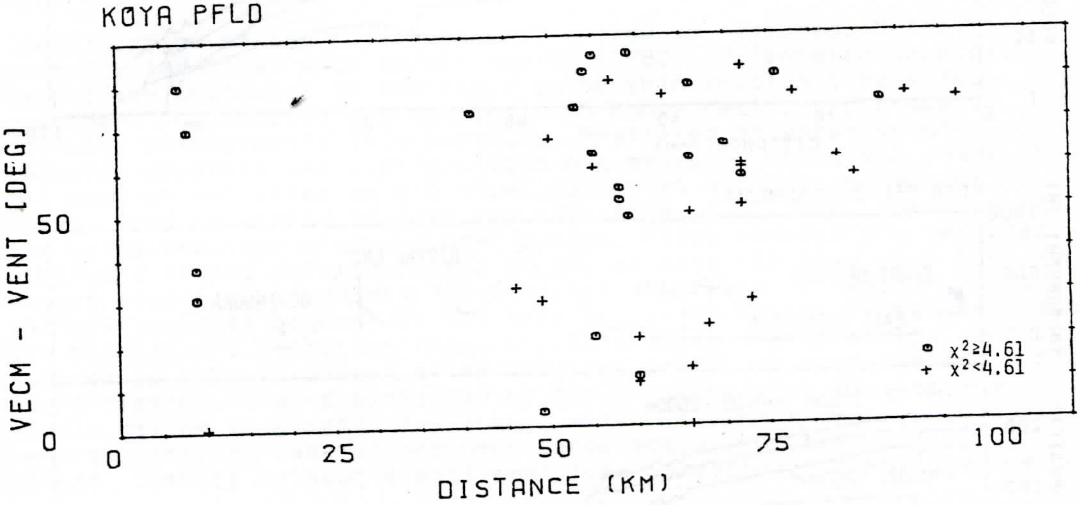

Fig. 4 A graph plotted axial difference of flow lineation (VECM) and direction of the source vent against distance from the vent. Data having chi square value greater than 4.61 concentrate greater than 60 degree of axial difference and over 40 Km of distance.

References

Ono, K., Soya, T. and Hosono, T. (1982) Geology of Satsuma Iwo-jima district. Quardrangle series 1:50,000. Geol.Surv.Japan. (JwE)

Sparks, R.S.J., Wilson, L. and Hulme, G. (1978) Theoretical modelling of the generation, movement, and emplacement of pyroclastic flows by column collapse. Jour.Geophys.Res., 83, 1727-1739.

Suzuki, K and Ui, T. (1982) Grain orientation and depositional ramps as flow direction indicators of a large-scale pyroclastic flow deposit in Japan. Geology, 10, 429-432.

Ui, T. (1973) Exceptionally far-reaching, thin pyroclastic flow in southern Kyushu, Japan. Bull.Volcanol.Soc.Japan 2nd ser., 18, 153 -168. (JwE)

Walker, G.P.L., Wilson, C.J.N. and Froggatt, P.C. (1981) An ignimbrite veneer deposit: The trail marker of a pyroclastic flow. Jour. Volcanol.Geotherm.Res., 9, 409-421.

Geology of Kikai caldera (Source of the Koya Ignimbrite), Japan

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Yukio Hayakawa (Earthquake Research Institute, University of Tokyo, Bunkyo-ku, Tokyo 113, Japan)

More than three large scale pyroclastic flows were erupted from the Kikai caldera. According to Ono et al.(1982), all the formations of Kikai caldera are devided into three groups: pre-caldera volcanoes, pyroclastic rocks of caldera-forming stage, and post-caldera volcanoes. But our field survey proved that the each ignimbrite eruption was accompanied by pre- and post-caldera volcanism (Table 1).

The Koabiyama ignimbrite in Takeshima and the Heikejo ignimbrite in Iojima are the oldest flows of Kikai caldera. Both are composed of many thin flow units and in general densely welded. Although the Heikejo ignimbrite has a basal pumice fall deposit, it may be correlative with Koabiyama ignimbrite.

Next large eruption issued unwelded Nagase ignimbrite which is only found in Takeshima and Tanegashima, 60 km east of the source, but the associated ash fall deposit is tracable up to the central Japan. Nagase ignimbrite is composed of two types of lithofacies. The lower part has a thin basal pumice fall bed and consists mainly of fine-grained, thin flow units which has cross-bedding and contains many accretionary lapilli. On the contrary the upper part is only found as the large blocks of the landslide deposit, which are composed of well-vesiculated pumice and matrix of vitric ash. Reconstruction of the whole sequence of Nagase eruption still remains unsolved.

Komoriko ash consists mainly of ash-fall deposits with some intercalated scoria and pumice beds, one of which is the distal part of the Sakurajima pumice deposit of ca. 11,000 years ago. The thickness of the Komoriko ash exceeds 8 meters.

Kikai caldera erupted the sequence of Koya pumice fall deposit, Funakura and Koya ignimbrites ca. 6,300 years ago. Unwelded or partially welded Funakura flow occurs within the Koya pumice fall section in Takeshima, suggesting that the air-fall pumice and the Funakura flow were almost simultaneously generated. A slight time break is however observed between Funakura and Koya ignimbrites, because the latter frequently contains blocks of the former.

Koya pumice is in general fresh and well-vesiculated. The largest plinian pumice exceeds 50 cm in diameter. Funakura ignimbrite which consists many thin flow units is in general partially or densely welded, which has a wide variety of lithology.

Some units consist mainly of fine vitric ash with variable amount of pumice, and the others of lithics and crystals. Funakura flow usually thickened and more densely welded at the topographic depressions. Although Koya ignimbrite is thickly deposited in Takeshima and Iojima, it shows no-welding.

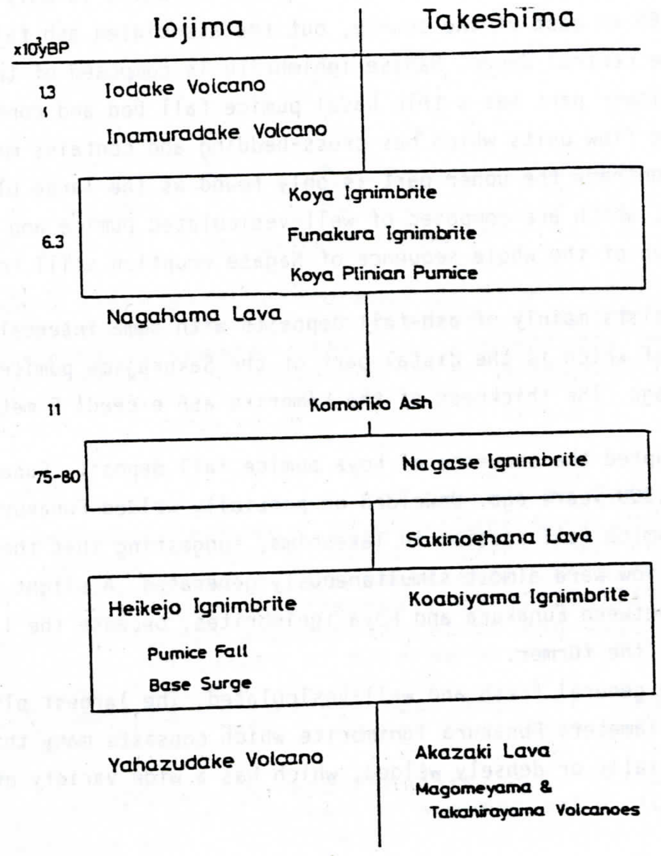
Nagahama lava is just overlain by not the Komoriko ash but the Koya pumice fall deposit. The chemical composition of Nagahama lava is very similar to that of the ejecta of the Koya eruption. These facts suggest that the Nagahama lava is a precursor of the Koya eruption.

References

Machida, H. and Arai, F.(1983) Late Pleistocene widespread tephra from Kikai caldera: new units and revision of age estimations on several large-scale pyroclastic flow deposits in Kyushu. Bull. Volcanol. Soc. Japan, Ser. 2. 28, 206.(Japanese abstract)

Ono, K., Soya, T. and Hosono, T.(1982) Geology of the Satsuma-Io-jima District. Quadrangel Series, Scale 1:50,000 , Geol. Surv. Japan, 80 p.(in Japanese with English abstract)

Table 1 Summary of geology of Kikai caldera



TWO EXTENSIVE ASH-FALLS ASSOCIATED WITH PYROCLASTIC FLOWS IN JAPAN: THICKNESS DISTRIBUTION AND GRAINSIZE CHARACTERISTICS

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The Aira-Tn (AT) ash and Kikai-Akahoya (K-Ah) ash reported by Machida and Arai (1976,1978) are distributed wide area throughout western and central Japan. The ashes are considered air-fall parts of the voluminous pyroclastic flow eruptions occured in southern Kyushu.

The AT ash associated with the Ito ignimbrite (22,000 yr B.P.) is distributed as far as 1,350 km from source, Aira caldera, with thickness of 0.3 cm (Tsuji and Endo, 1978), and is measured 8 cm thickness eastern flank of Fuji Volcano, 870 km from source. At an outcrop 240 km from source, 37 cm thick AT ash rests on the Sukumo ash correlated as the fine distal part of the pre-Ito ignimbrite Osumi plinian pumice. In Kyushu, however, AT ash is hardly identified above the Osumi pumice or Ito ignimbrite.

The K-Ah ash is a extensive ash-fall deposit associated with the Koya ignimbrite (6,300 yr B.P.). It rests on thin deposit of the Koya ignimbrite at many outcrops in southern Kyushu. The thickness is 20-45 cm with a basal coarse layer, which contains pumice fragments (up to 5.0 cm), lithic fragments (up to 1.2 cm), and accretionary lapilli (up to 1.1 cm) within fine vitric matrix. The K-Ah ash is identified more than 1,000 km away from source (Machida and Arai, 1978) with thickness less than 1 cm.

The thickness distribution of AT ash and K-Ah ash is shown in Figs. 1 and 2. Remarkable characteristics of thickness distribution of both ashes are : (1) the thickness does not exceed 50 cm even near-source outcrops. (2) the thickness decreace rate away from source is exceptionally low.

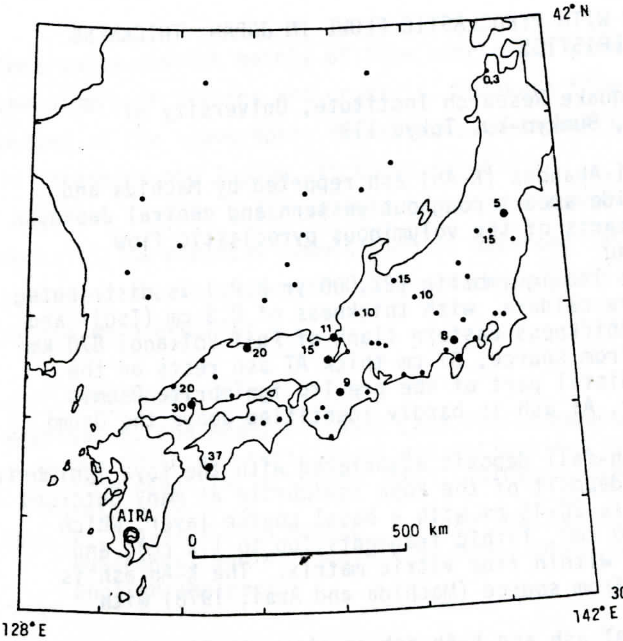
Constituents of both ashes are almost entirely fine vitric materials, bubble-wall glass shards and micro-pumice, and small amounts of crystals and lithics. Glass shards and micro-pumice are colorless, however, some of K-Ah ash are pale brown. Glass shards of K-Ah ash is thinner than those of AT ash.

The grainsize characteristics of both ashes plotted against distance from source are shown in Figs. 3 and 4. For the K-Ah ash there is a definite decrease in all grainsize classes 1ø (500 μm) and coarser, but little significant difference for finer classes. For AT ash there is a little but significant decrease in grainsize classes 3ø (125 μm) and coarser and increase in finer classes, from 240 km to 1160 km away from source. Median diameter of both ashes slightly decrease away from source. Figs. 5 and 6 are section profiles showing grainsize variations of both ashes. At all of the localities sieved both ashes show normal grading profiles : the grainsize population is progressively finer upward in the same section.

The normal grading feature strongly suggests that the eruption duration of both ashes were not longer than the travel time for each ash from source to the nearest outcrops : 240 km for AT ash and 60 km for K-Ah ash. The eruption duration of both ashes may be calculated on some reasonable assumptions. If wind velocity at the time of eruptions is taken at 100 km/h, the durations of the culminating phase of both ashes are less than a few hours.

REFERENCES

MACHIDA, H. and ARAI, F., 1976. Kagaku, 46 : 339-347.
MACHIDA, H. and ARAI, F., 1978. Quat. Res. Japan, 17 : 143-163.
TSUJI, S. and ENDO, K., 1978. Proc. Inst. Natur. Sci., College of Humanities and Science, Nihon Univ., Earth Sci., No. 13 : 69-72.



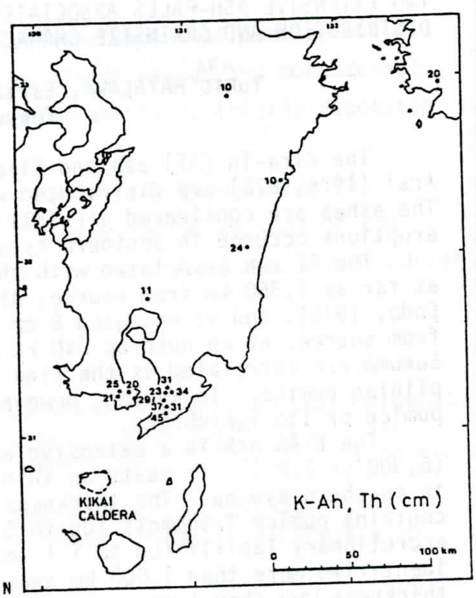
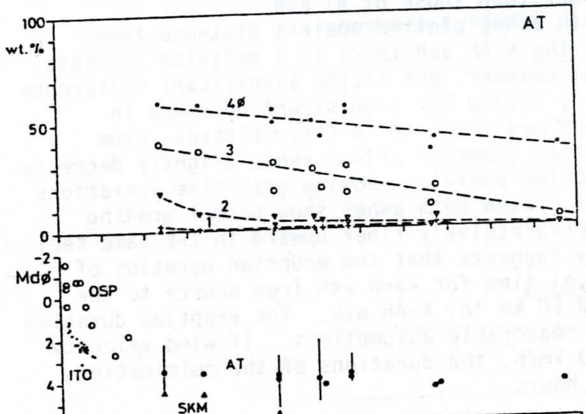


Fig. 1. Map showing the site where AT ash is identified. Numerals are thickness in cm ; modified from Machida and Arai (1981). Large dots : sites from which samples were collected for granulometric analysis.

Fig. 2. Map showing the thickness (cm) of K-Ah ash.



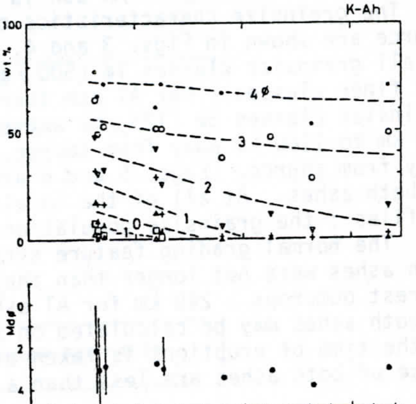


Fig. 3. Above : Cumulative wt % of material finer than the given sieve apertures of AT ash plotted against distance from source. Below : Plot of Mdø of AT ash against distance from source. Where more than 1 sample was sieved from the same locality, average values are given and the ranges are shown by vertical bars. OSP (o) : Osumi plinian pumice, ITO (·) : Ito ignimbrite AT (●) : Aira-Tn ash, SKM (Δ) : Sukumo ash

Fig. 4. As Fig.3 for K-Ah ash.

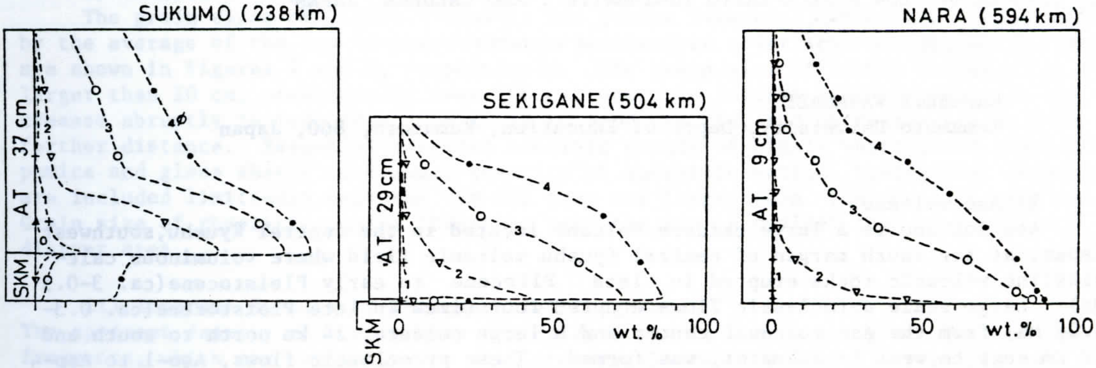


Fig. 5. Section profiles showing grainsize variation of AT ash. Above each plofile are given locality and distance from source. SKM : Sukumo ash.

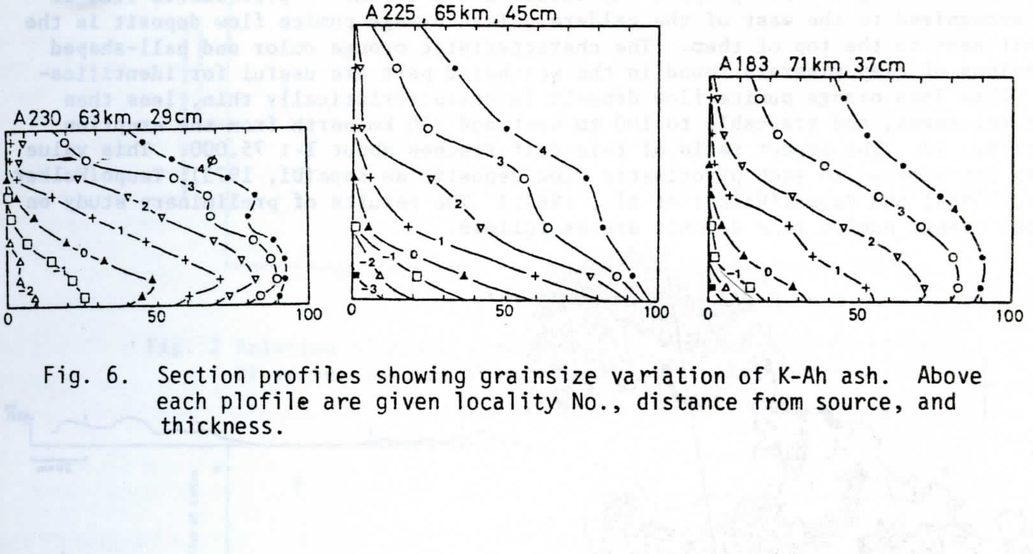


Fig. 6. Section profiles showing grainsize variation of K-Ah ash. Above each plofile are given locality No., distance from source, and thickness.

AN EXAMPLE OF "LOW ASPECT-RATIO IGNIMBRITE", ASO CALDERA, JAPAN

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1) Aso volcano

Aso volcano is a large caldera volcano located in the central Kyushu, southwest Japan, at the south margin of central Kyushu volcanic field where voluminous calc-alkaline volcanic rocks erupted in late Pliocene to early Pleistocene(ca. 3-0.5 Ma). Large scale pyroclastic flows erupted four times in late Pleistocene(ca. 0.3-0.08 Ma) from the Aso volcanic center and a large caldera, 24 km north to south and 18 km east to west in diameter, was formed. These pyroclastic flows, Aso-1 to Aso-4 in ascending order, are collectively called Aso pyroclastic flow. Central cones, more than fifteen in numbers, were formed after the subsidence of the caldera.

2) Tosu orange pumice flow deposit(low aspect-ratio ignimbrite)

The Aso-4 pyroclastic flow, the youngest, is the unit which covers the widest area and reached the furthest distance, about 150 km from the source over mountain areas and sea. Eight stratigraphic sub-units within the Aso-4 pyroclastic flow deposit recognized to the west of the caldera. Tosu orange pumice flow deposit is the sub-unit next to the top of them. The characteristic orange color and ball-shaped concretions of clay minerals found in the weathered part are useful for identification. This Tosu orange pumice flow deposit is characteristically thin, less than 2 m in thickness, and traceable to 100 km west and 150 km north from the eruption center(Fig. 1). The aspect ratio of this unit reaches about 1 : 75,000. This value is very low similar to such pyroclastic flow deposits as Koya(Ui, 1973), Taupo(Walker et al., 1981a) and Rabaul(Walker et al., 1981b) The results of preliminary study on the Tosu orange pumice flow deposit are as follows.

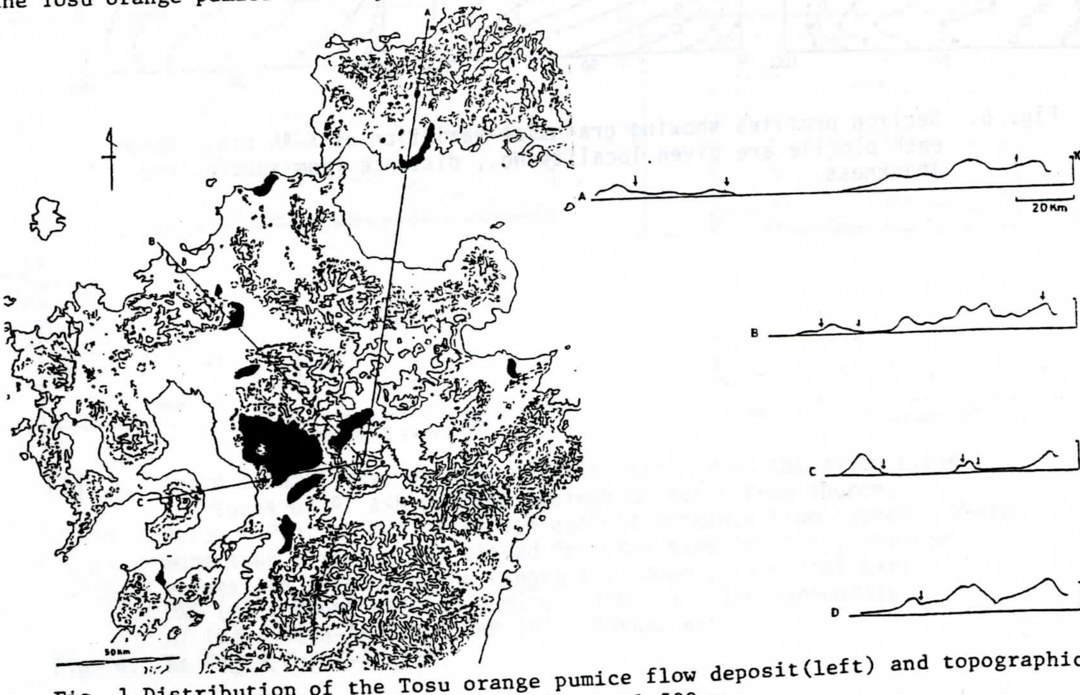

Fig. 1 Distribution of the Tosu orange pumice flow deposit(left) and topographic cross sections(right). Contour interval 500 m.

i) Variation in grain size from the source

The grain sizes of lithic fragments and pumice fragments, which are represented by the average of the ten largest fragments measured in a vertical outcrop of 1 m^2 area, are shown in Figures 2 and 3, respectively. The grain size of lithic fragments shows larger than 10 cm, occasionally over 100 cm, near the caldera rim. However, it decreases abruptly to less than 3 cm in 10 km from the rim, and decreases slightly in further distance. Essential material consists mainly of highly vesiculated rhyolitic pumice and glass shards with small quantity of andesitic scoria, having high density, are included limittedly near the rim and they are larger than the rhyolitic pumice. Grain size of rhyolitic pumice fragments near the rim is smaller than that of the distant area.

ii) Apparent density of the essential fragments

The apparent density of scoria near the caldera rim is 0.8 to 1.1 g/cc. That of pumice fragments, which are recognized in all outcrops, is about 0.3 to 0.4 g/cc(Fig. 4). This pumice desity is very low similar to the Koya pyroclastic flow deposit.

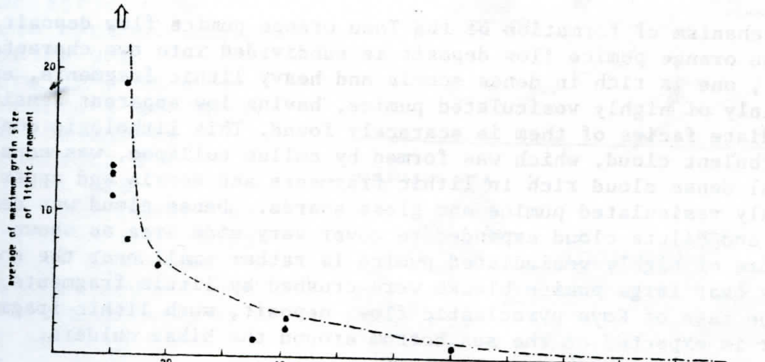

Fig. 2 Relation of grain size of lithic fragments to distance of travel for the Tosu orange pumice flow deposit.

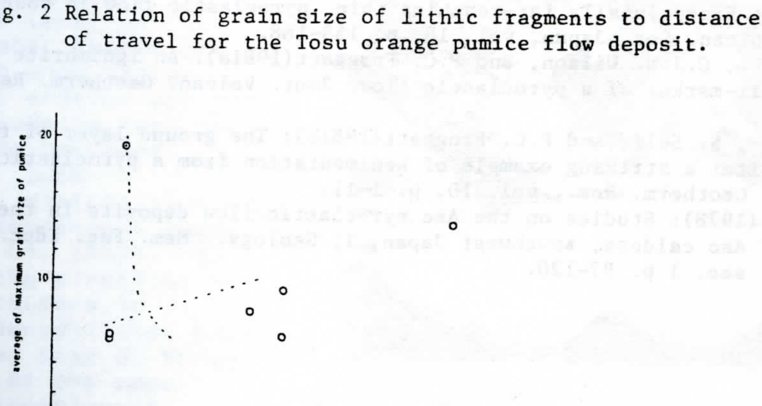

Fig. 3 Relation of grain size of pumice and scoria to dostance of travel for the Tosu orange pumice flow deposit. Open circles; pumice, open circle with central dot; scoria.

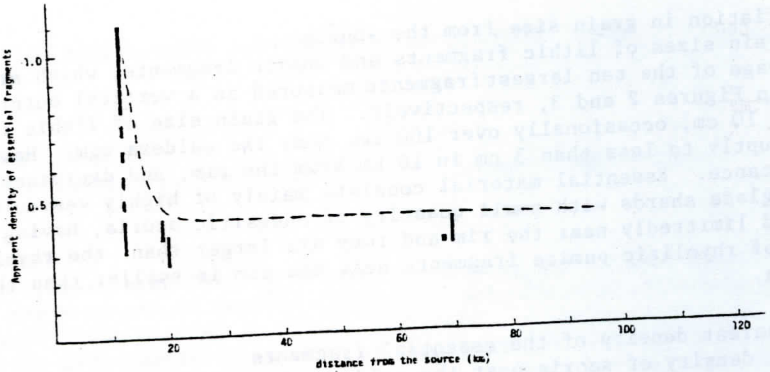

Fig. 4 Apparent density of pumice and scoria versus distance of travel for the Tosu orange pumice flow deposit.

iii) Mechanism of formation of the Tosu orange pumice flow deposit

The Tosu orange pumice flow deposit is subdivided into two characteristic litho-facies, i.e., one is rich in dense scoria and heavy lithic fragments, and the other is composed mainly of highly vesiculated pumice, having low apparent density, and ash. The intermediate facies of them is scarecely found. This lithologic contrast suggests that the turbulent cloud, which was formed by collum collapse, was separated into two layers, basal dense cloud rich in lithic fragments and scoria and upper dilute cloud rich in highly vesiculated pumice and glass shards. Dense cloud was deposited near the source, and dilute cloud expanded to cover very wide area as shown in Fig. 1. The grain size of highly vesiculated pumice is rather small near the source. It is explained by that large pumice blocks were crushed by lithic fragments during emplacement. In the case of Koya pyroclastic flow deposit, such lithic fragments-concentration part is expected on the sea bottom around the Kikai caldera.

References

Ui, T.(1973): Exceptionally far-reaching thin pyroclastic flow in southern Japan. Bull. Volcan. Soc. Japan, vol. 18, p. 153-168.

Walker, G.P.L., C.J.N. Wilson, and P.C. Froggatt(1981a): An ignimbrite veneer deposit; the trail-marker of a pyroclastic flow. Jour. Volcan. Geotherm. Res., vol.9, p. 409-421.

-------------, S. Self, and P.C. Froggatt(1981b): The ground layer of the Taupo ignimbrite: a striking example of sedimentation from a pyroclastic flow. Jour. Volcan. Geotherm. Res., vol. 10, p. 1-11.

Watanabe, K.(1978): Studies on the Aso pyroclastic flow deposits in the region to the west of Aso caldera, southwest Japan, I; Geology. Mem. Fac. Educ. Kumamoto Univ., no. 27, sec. 1 p. 97-120.

Depositional ramps of the Ata pyroclastic flow deposit in southwestern Japan

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Previously, original depositional surface of a large-scale pyroclastic flow deposit prior to the welding compaction was thought to be flat and have no preferred orientation of its dip direction (Ross and Smith, 1961). Asymmetrical distribution of pyroclastic flow deposit within a valley or basin was recognized in the Ata pyroclastic flow deposit, south Kyushu, Japan. Geologic mapping and altimetry were done to make sure this structure at four areas around the source caldera. Generally the deposit is thick and devitrified at the center of a valley, and thin and glassy at the margin of a valley. Fig. 1 shows the contour map of the reconsturcted welded depositional surface at western part of Satsuma Peninsula based on geologic mapping and altimetry. Distribution level is becoming higher toward the west in each wide valley. Differential erosion was not recognized judging from the lithology and basement topography. Such asymmetrical distribution was named as depositional ramps (Suzuki and Ui, 1982). In this area, the direction of the source caldera is eastward. Depositional ramps were analysed also at three other areas of the same deposit. Direction of depositional ramps is almost radially away from the source (Fig. 2). The direction data

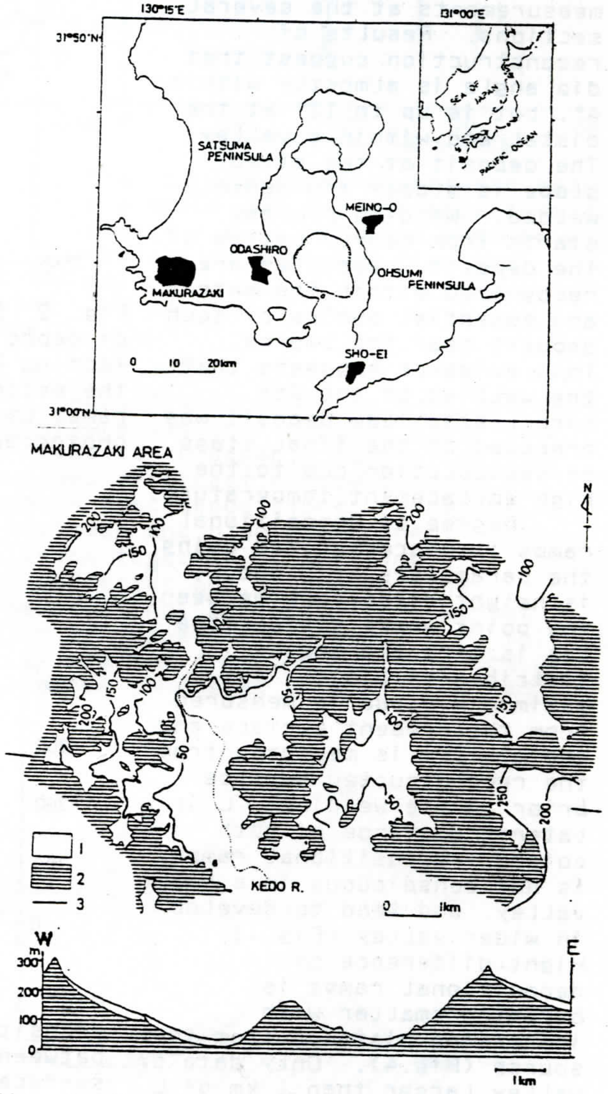

Fig. 1 Counter map of reconstructed depositional surface after welding. Ruled area is not covered with the Ata pyroclstic flow deposit.

suggests the radial flow direction of a large-scale pyroclastic flow.

Depositional surface of the deposit prior to the welding compaction was reconstructed based on the density measurements at the several sections. Results of reconstruction suggest that dip angle is almostly within 4°, but is up to 12° at the distal end within a valley. The deposit at the steep slope is glassy and densely welded. Welding process starts from nearly bottom of the deposit. Vesicles are recognized within the matrix and essential pumice of such deposit near the source. This evidence suggests that the welding of the Ata pyroclastic flow deposit was preceded to the final stage of vesiculation due to the high emplacement temperature.

Degree of depositional ramps is characterized using the parameters of H and L. H is height difference between the point where the surface dip is zero and the distribution limit. The maximum H value is measured from the present surface and the minimum is measured from the reconstructed surface prior to the welding. L is a lateral distance of both points. Depositional ramps is not conspicuous in a small valley, and tend to develop in wider valley (Fig. 3). Hight difference of depositional ramps is becoming smaller with increasing distance from the source (Fig.4). Only data of valley larger than 1 Km of L value are plotted in Figs. 4 and 5. Mean dip angle is also becoming smaller with increasing distance from the source (Fig. 5). These

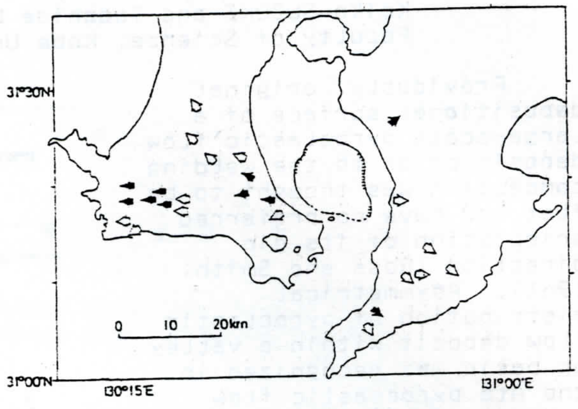

Fig. 2 Solid arrow shows the direction of depositional ramps confirmed by field mapping and altimetry. Open arrow shows the estimated direction of depositional ramps based on topographic map and aerial photographs.

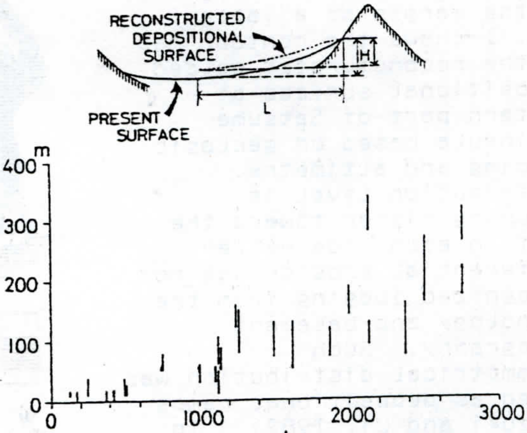

Fig. 3 Length(L)-Height(H) relation of depositional ramps. L is the distance between distal end and the site of zero surface dip. H shows the relative height. Vertical bar expresses the height difference between the height of present surface and the height of reconstructed depositional surface at the same points.

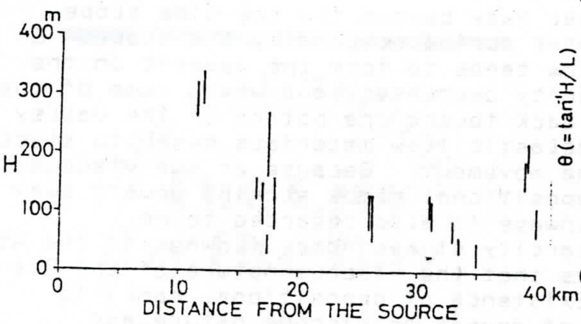

Fig. 4 The relation between relative height (H) and the distance from the source for depositional ramps. Only data, which length (L) is more than 1 Km, is plotted. H is becoming smaller with increasing distance from the source.

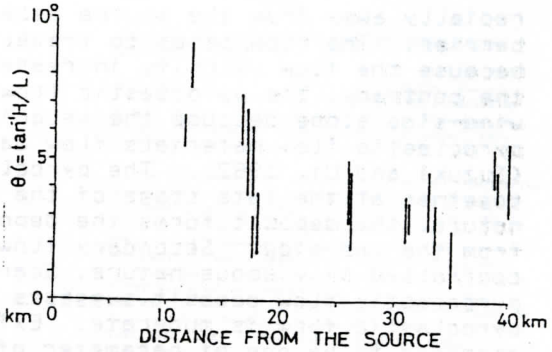

Fig. 5 The relation between mean dip angle and the distance from the source. θ is becoming smaller with increasing distance from the source.

results suggest that structure of depositional ramps is more abundant at the Depositional ramps structure was confirmed in other two densely welded pyroclastic flow deposits in Japan. Such structure could not be recognized in non-welded pyroclastic flow deposit. Evidence of densely welding suggests that depositional ramps are formed by the low level column collapse and high emplacement temperature. Glassy matrix may stick together at the time of deposition to obtain the viscous character and to prevent the formation of nearly horizontal depositional surface. The current model of emplacement and formation of depositional ramps is as follows (Fig. 6): the Ata pyroclastic flow started from the low level column collapse and formed the thin and dense fluidized layer, travelled

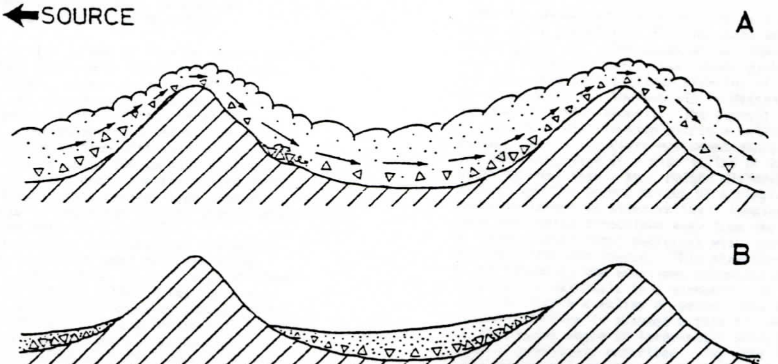

Fig. 6 Schematic cartoon of the emplacement and formation of depositional ramps. Length of arrow is proportional to the flow velocity.

radially away from the source ascending and descending the topographic barrier. The flow tends to travel away beyond the lee-side slope because the flow velocity increases during descending the slope. On the contrary, the pyroclastic flow tends to form the deposit on the wind-side slope because the velocity decreases, and where some of the pyroclastic flow materials flow back toward the bottom of the valley (Suzuki and Ui, 1982). The pyroclastic flow materials began to stick together at the late stage of the movement. Because of the viscous nature, the deposit forms the depositional ramps sloping upward away from the lee-side. Secondary flowage is also regarded to be controlled by viscous nature. Scarcity of secondary flowage in the Ata pyroclastic flow deposit suggests that the viscous nature of the Ata pyroclastic flow is moderate. Existence of depositional ramps is regarded to be one of parameter of degree of viscous nature and lateral change of mobility of pyroclastic flow.

References

Ross, C.S. and Smith, R.L., 1961, Ash-flow tuffs: Their origin, geologic relations, and identification: U.S.Geol.Surv., Prof. Paper 366, 81p.

Suzuki, K. and Ui, T., 1982, Grain orientation and depositional ramps as flow direction indicators of a large-scale pyroclastic flow deposit in Japan: Geology, v. 10, p. 429-432.

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AGU FALL MEETING
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V12A-06

Flow lineations of Koya low aspect-ratio ignimbrite, south Kyushu, Japan

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Koya pyroclastic flow is one of the low aspect ratio ignimbrites erupted 6000 years ago at Kikai Caldera, south of Kyushu Island, Japan. More than 30 km distance of open sea separates between two islands at the caldera rim and area of distribution at main island of Kyushu or neighbouring islands. The deposit generally consists single flow unit with ground layer. The deposit is tracable up to 100 km away from the source. The deposit after cross the sea losted dense clasts and formed ignimbrite venieer type deposit having dune structure. Thickness is less than 1 meter. Aspect ratio of the deposit is 1/4400.

Orientated thin sections were made for non-welded deposits and flow lineations were measured using elongated crystals and lithics. Significance of flow lineation data were checked based on the Tukey chi-square test. Only 40 % of the measured samples have significant probability levels greater than 90 %. This is much lower than that of "normal" aspect ratio ignimbrites. Distributions of flow lineation data shows bimodal. Major mode concentrates nearly normal to the source direction, and secondary mode is parallel to the source. Flow lineation parallel to the valley is also obtained. Flow lineation normal to the source direction seems to be incompatible with the results obtained from the other large scale pyroclastic flow deposits. This evidence is similar to the grain orientation obtained from the bottom part of turbidite. Koya pyroclastic flow deposit after cross the sea is very thin and sparse. Elongated crystals and lithics in the Koya flow might have rolled on the ground.

V42A-20 POSTER

Granulometric study of the Koya low-aspect ratio ignimbrite, Japan

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The 6000 year B.P. low-aspect ratio Koya ignimbrite is spread widely over southern Kyushu and islands to the south, and is mostly <1 m thick. It rests on a plinian deposit, has a basal ground layer, and is overlain by a coarse pumice bed (containing accretionary lapilli) and a capping ash-cloud fall deposit.

The ground layer is characteristically strongly fines-depleted and enriched in crystals and lithics, and varies from 4 m in proximal outcrops on Takeshima to 0 to 50 cm in distal outcrops on Kyushu. The contact with layer 2 (the main body of the ignimbrite) is sharp to gradational. Layer 2 itself shows a downward enrichment in crystals and lithics, and commonly possesses segregation pipes, pods, and sheets similar in character to the ground layer. These features, the high crystal enrichment factor found throughout the deposit, and the concentration of large pumice towards the bottom of layer 2, indicates that the flow was strongly fluidized and emplaced in a relatively expanded condition.

The distribution of the ignimbrite and plinian pumice indicate a source vent in the now-submerged Kikai caldera, and imply that the pyroclastic flow traversed 40 to 50 km of open sea to reach Kyushu, Yakeshima, and Tanegashima. On Kyushu, the ignimbrite mantles the mountainous landscape with a thickness on ridge crests similar to that on valley bottoms, and after crossing the sea, the flow still possessed enough momentum to surmount obstacles >800 m high. The thickness and grainsize of the overlying pumice bed appear to be unrelated to the primary vent, suggesting an origin by great secondary explosions where the pyroclastic flow entered the sea in Kagoshima Bay.

V12A-14A

Depositional ramps of the Ata pyroclastic flow deposit in southwestern Japan

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The Ata pyroclastic flow deposit is one of large-scale pyroclastic flow deposits erupted 30,000 - 60,000 years ago. The eruption was started with small-scale plinian air fall, local minor pyroclastic flow and succeeded by the climax eruption of the Ata pyroclastic flow. The deposit is densely welded, even in case of a thin deposit. The deposit shows a asymmetrical distribution within a valley channel or a basin. Such a structure was named depositional ramps (1) and recognized in a wide valley or basin whose width is more than 1 km. Height difference between the highest and the lowest points of a single depositional ramps is larger in wider valley. Ramping directions show the radial directions away from the source. Scale of depositional ramps decreases with increase of distance from the source. This structure is regarded to be formed by the excellent accumulation of pyroclastic materials in a windward-side rather than a lee-side within a valley or basin. Dip angle of the original surface is assumed within 4°, which is similar to the repose angle of large-scale pyroclastic flow deposit previously described. The same structures were also recognized in other two densely welded pyroclastic flow deposits based on published geologic map and topographic map. But this structure is difficult to find in a non-welded pyroclastic flow deposit. This suggests that high emplacement temperature is helpful to form depositional ramps.

(1) Suzuki, K. and Ui, T. (1982) Geology, 10, 429-432.

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V11A-07

The most recent volcanic history of the Toba depression, Sumatra

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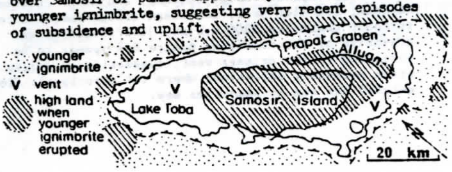
The 100 by 30-40 km depression of Lake Toba is widely quoted as the world's largest caldera, and Samosir Island with its cap of lacustrine sediments is identified as a resurgent dome. There are however anomalies which suggest that this is an over-simplified picture. The younger of the two 1000 km^3 rhyolitic ignimbrites associated with the depression was erupted from vents in the northern and southern parts of the lake, and these parts of the lake are possibly two calderas which formed synchronously. At the time of the eruption it seems that Samosir must have formed ground too high to be surmounted by the younger ignimbrite. The Prapat graben which lies within the Toba depression was already in existence at this time and became infilled with ignimbrite. Asymmetric subsidence of the western part of Samosir since took place along a major NW-trending fault bounding Lake Toba on the west, renewed faulting took place along the east of the Prapat graben, and a new graben developed between Samosir and Alluan. Subsequent volcanism produced rhyolite lava domes along several of these faults. A puzzling feature is the presence in the lacustrine sediments over Samosir of pumice apparently derived from the younger ignimbrite, suggesting very recent episodes of subsidence and uplift.



V11A-08

The Toba ignimbrites, Sumatra

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Two Quaternary crystal-rich rhyolitic ignimbrites, each of about 1000 km^3, occur in and around the Lake Toba depression in northern Sumatra and are separated by an erosional and weathering break. The younger ignimbrite covers 20,000 km^2 and extends nearly 100 km from the lake. It is commonly 30 to 60 m thick and in most exposures is totally non-welded. The older ignimbrite locally exceeds 300 m thick, is mostly welded, is of multiple type, and except near the lake is largely concealed by the younger ignimbrite. The distribution of maximum pumice and lithic clast sizes and median grain size in the younger ignimbrite point to at least two source vents, one (or more) in the north part of Lake Toba and one in the south part. Coarse proximal lithic breccias occur near both. Lateral variations in grainsize and composition are well documented, and include a general outward decrease in grainsize and content of dense constituents (crystals and lithics). The rate of change in grainsize and constitution, and the presence of a ground layer in some areas, indicate that the pyroclastic flow was moderately well fluidized; it travelled a long distance because of its large volume rather than its velocity. The crystal concentration factor averages 1.8 indicating a major loss of vitric ash, and the large-volume associated Toba ash-fall is interpreted to be of co-ignimbrite type.

日本火山学会1983年秋季大会講演要旨

55. 鬼界カルデラ幸屋火砕流の噴火過程

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T. Ui, H. Metsugi, K. Suzuki, G. P. L. Walker, L. A. McBroome, M. E. Caress, Y. Hayakawa, T. Kobayashi and K. Watanabe: Eruption process on Koya pyroclastic flow, Kikai Caldera.

鬼界カルデラ起源の幸屋火砕流堆積物について low-aspect ratio ignimbrite の一例として，その噴火と火砕流としての流走過程を調べる研究を開始した．本火砕流堆積物の現在の分布はカルデラ縁上の竹島・硫黄島のほか 30 km 以上海をへだてた九州本土南部や種子島・屋久島などカルデラ中心から最大 110 km の地点まで追跡できる．噴火年代は約6000 年前であり（宇井・福山，1973），火砕流堆積物のマグマ換算体積は 10～20 km^3 程度である．堆積物の全厚は給源から遠いほど次第に薄くなり，給源からみて地形起伏の少ない方位で遠くまで分布する．本質岩片の直径は南九州本土南端部でもカルデラ縁と変らないが，外来岩片の直径は流走距離により低下する．流走体内部の粒子の相互作用や温度の効果を無視し，column collapse 後は地表と火砕流との間に摩擦抵抗が働らいて運動エネルギーを失なうモデルで，噴煙柱高度 h と動摩擦係数 μ の関係を調べると，$\mu=0.02$ では $h=1900\sim2100$ m，$\mu=0.005$ では $h=500\sim900$ m 程度となり，方位による到達距離の差は地形起伏に支配されているとみなせる．

非溶結の定方位試料を樹脂で固め薄片にして，結晶配列を測定し流動方向を求めた．統計上有意な結晶配列の指向性をもつものは，カルデラ縁の谷埋め堆積物で谷方向に沿う流動方向が認められる．その他の試料ではカルデラ中心方向におおよそ直角の指向性をもった結晶配列をもつ場合があるが，有意な指向性をもつものは全試料の 40% にすぎない．このような指向性の低さはより運動エネルギーの大きい遠くまで拡がって堆積した火砕流であったため乱流的性質が強いと解釈される．

日本地質学会第90年学術大会講演要旨

233　拡散型大規模火砕流堆積物の流動堆積機構――――幸屋火砕流での研究計画

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幸屋火砕流堆積物（宇井　１９７３）は広域テフラ――アカホヤ火山灰（町田・新井　１９７８），船倉降下軽石・船倉火砕流堆積物・竹島火砕流堆積物（小野・曽屋・細野　１９８２）と共に約６０００年前（宇井・福山　１９７２）の鬼界カルデラ最末期の大規模火砕流を放出する噴火による堆積物である。九州本土南端では，幸屋火砕流堆積物は下位の阿多・入戸両火砕流堆積物の侵食された台地地形を覆ってうすく広く分布する特徴がある。また台地間の谷を厚く埋めた部分もある。Walkerらは同様の性質を示す火砕流堆積物を New Zealand の Taupo ignimbrite の一部や，New Britain 島 Rabaul カルデラ周辺の火砕流堆積物の一部などに見出した（Walker, Heming and Wilson １９８０, Walker, Wilson and Frogatt １９８１）。Walkerらはこのような分布特性をもつ火砕流をLow-aspect ratio ignimbrite（拡散型大規模火砕流堆積物）と名付けて，台地を覆ったうすく拡がった岩相（IVD: Ignimbrite veneer deposit）のほか台地間の谷を埋める岩相（VP: Valley pond ignimbrite）があること，ＩＶＤにみられるラミナ構造などの特徴により普通の大規模火砕流堆積物と識別した。

Low-aspect ratio ignimbrite は火砕流としての流動時の運動エネルギーが大きく，普通の大規模火砕流とは噴火・流動・堆積機構が異なる可能性がある。演者らを研究代表者とするグループでは，Low-aspect ratio ignimbriteの噴火・流動・堆積機構を考察するために幸屋火砕流堆積物の調査を進めている。

文　献

町田洋・新井房夫（１９７８）　第四紀研究　１７，１４３－１６３．

小野晃司・曽屋龍典・細野武男（１９８２）　地域地質研究報告　薩摩硫黄島地域の地質，地質調査所．

宇井忠英（１９７３）　火山　第2集，１８，１５３－１６８．

宇井忠英・福山博之（１９７２）　地質雑，７８，６３１－６３２．

Walker, G.P.L., Heming, R.F. and Wilson, C.J.N. (1980) Nature, 283, 286-287.

Walker, G.P.L., Wilson, C.J.N. and Frogatt, P.C. (1981) Jour. Volc. Geotherm. Res., 9, 409-421.