

Some Considerations of Recent Faulting in the Western Fringe of the Fukushima Basin

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Kenzō FUJIWARA

Preface

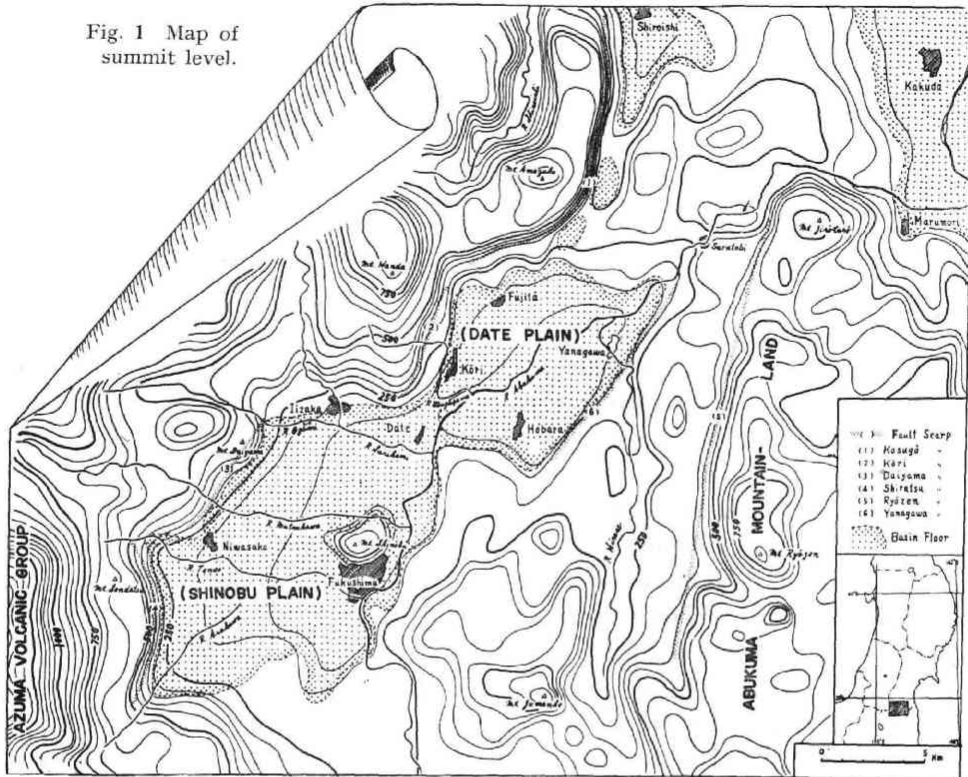
The Fukushima Basin has been regarded as one of the basins whose tectonic character is the most obvious of the basins lying in a row in the eastern half of the Tohoku region. However, it is along its side of the Backbone Range that the fault scarps can be clearly recognized, while along its eastern fringe of the Abukuma Mountainlands there can scarcely be traced the fault topography so clearly as the other side.* The basin floor is composed of two parts connected with each other just like a twin; one is a southern part named "Shinobu Plain" (13km by 10 km) and the other a north-eastern one "Date Plain" (10 km by 8km) (Fig. 1). The Abukuma, the trunk river in this area, only erodes the fringe of the eastern hills slightly in the Shinobu Plain, but it erodes the basin floor wide and deep in the Date Plain, having formed a large flood plain on its both sides.

Along the western fringe of the basin there are 3 fault scarps, — Kori, Daiyama fault scarps and that (Shiratsu fault scarp) along the eastern fringe of Azuma Volcanic Group, and they do not connect directly with one another, nor are related with and are quite different in form, and structure. Corresponding to the difference, they cause varied landforms to the basin floor at the foot of the respective scarps. For example, some steps of river terraces are seen well developing in the vicinity of Iizaka and Kōri Towns, while in the south-western part of the basin alluvial fans are conspicuous.

The formation of the topography of basin floors is caused chiefly by the complicated circumstances of their surrounding mountains which have provided the materials to bury the basins, to say nothing of the modes of their subsidence. This suggests that many sided considerations are necessary to study basin topography. In this paper, the author tries to mention some topographical data obtained in the western fringe of the Fukushima Basin and to consider its topographical formation, giving some explanations to them.

* On the side of the Abukuma Mountainlands, there is the Yanagawa fault, facing the basin, but obscure topographically, and the Ryōzen fault with a long-scale scarp (Fig. 1). Bordered by these and those on the side of the Backbone Range on its both sides, the Fukushima Basin is surely defined as a "Graben". The faults on the eastern side seem to have taken no part in the formation of the basin floor, because the one is too small in scale and the other too far from the basin. Therefore, they are not referred to in the present paper.

Fig. 1 Map of summit level.



Acknowledgment

The author chose the area as his field at the suggestion of Professor Yoshirō Tomita under whom he has always carried out his works. The present survey made good progress under kind conveniences and helpful discussions of the members of the Geographical Institute, Fukushima University and of the Fukushima branch of the Construction Ministry. Well logs were kindly furnished to the author by many persons. The author wishes to express his hearty thanks to them.

Physiographical Settings

1. Kōri and Kosugō fault scarps.

These two are the most outstanding from the view point of topography; the Kōri fault scarp dominates to the west of Kōri Town and the Kosugō fault scarp reaches northwards to Kosugō and Shiroishi from the north of Fujita town. They are not connected with each other as is seen to the north-west of Fujita Town, but



Photo. 1 The southern end of the Kosugo fault scarp north of Fujita Town.

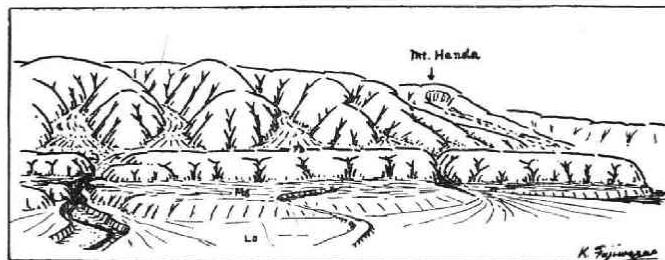


Fig. 2 Sketch of the Kori fault scarp.
Fb: fault bench, Ms: middle surface, Ls: lower surface.

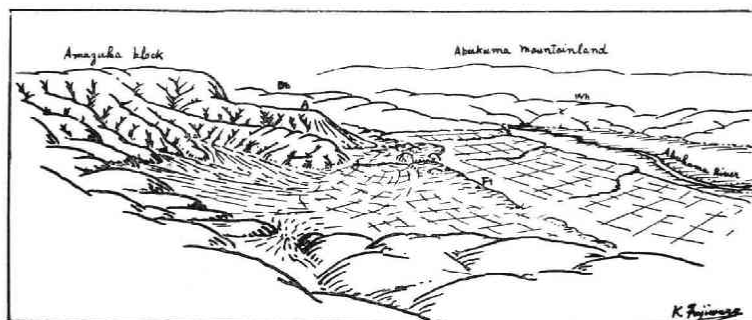


Fig. 3 The southern part of the Kori fault scarp viewed from Mt. Handa. Its fault bench is correlated with the eastern hill-lands (Dh, Wh) in height.
A: Mt. Atsukashi, Dh: Dōyama hill-land, Wh: Wada hill-land (the fallen side of the Ryozen fault), Ft: Fujita Town.

can be thought to belong to the same fault line for the following reason.* (a). Characteristics in form: The very steep main scarp, about 300m in height, and the fault benches as its foot are observed in common between them (Fig. 2, 3). (b). Character of the fault plane: They are both thrust faults which displace the Miocene formations of sandstone, sandy shale and sandy tuff, because the fault plane dips 60–70° westward (Photo. 2).



Photo. 2 The fault plane of the Kori fault at the Ubugasawa valley bottom. This fault is a thrust one fracturing agglomerate & having N15°E in direction, 67°W in dip.

As Fig. 1 shows, a summit-level accordance can be noticed both on the fault block of Mt. Amazuka and on the hills to the east with the main part of the Kosugō fault scarp running between the above areas. Because of its flat tops and thickness of soils, there were once some who classified them into two topographical planes, old and new, formed in different periods, regarding them as old erosion surfaces⁽¹⁾. However it seems more correct that the upper and lower flat planes recognizable in the summit-level belong to the same topographical plane which was displaced by the Kosugō fault. Because the lower flat plane (about 300m) is similar in height to the fault bench of the Kōri fault (Fig. 3). The fault benches are about 300 m in height in the Kosugō fault scarp, but about 200 m to the west of Kōri Town, lowering down to about 140m at its southernmost end.

One more characteristic of the Kosugō fault is its narrow troughs, which can be observed at Saikawa, Kosugō and Kaida. And it is quite obvious that they are not dissected valleys, but faults troughs often developed at the foot of fault scarps because of the characteristics of their forms. In the basin the existence of such troughs is not to be traced, but there are some note-worthy landforms which suggest the same mechanism of depression, as is often seen at the foot of a fault scarp, although different in form

* At a point in the mountains north-west of Fujita Town, a shattered zone can be observed. The rocks are broken into pieces too disorderly for us to find any system in it. Therefore, it is a matter of interest how the Kori and Kosugō faults are related with each other in this part in point of structure.

from the so-called trough. They will be mentioned in detail in next chapter.

2. Geological structure of the mountains in the north-western part of the basin.

In the mountains in the north-western part of the basin through the Tertiary formations some pointed tops composed of liparite. According to the report²⁾ by Mr. Shoji Ijiri who surveyed the geology throughout this area, the geological structure of the Tertiary formations constitutes one syncline with N-S synclinal axis parallel with the Surigami River, and the strata is almost horizontal in the neighbourhood of the same river, but at its limbs dip about 20° respectively. On the other hand, the summit heights, disregarding the pointed tops, are the lowest in the vicinity of the Surigami, gradually increasing in the east and west. And the eastern limb is the Kori thrust block already mentioned, 550–600 m in height except Mt. Handa, which is composed of liparite, the block being similar to the Amazuka thrust block in height. The westward dip, which increases towards the eastern part of this area, changes its dip eastwards near the fault scarp, and shows 32°E right on the scarp. Judging from this fact along with the fault plane of the Kori fault scarp showing 70°W , it can be easily surmised that this block was thrust up eastward.

In the western limb of this area, there is a fault structure observed closely by Mr. Ijiri. He says in his report that the above-mentioned Tertiary formations are displaced by a normal fault with its east side fallen, which extends northward from the outlet of the Mtsukawa Valley, and that granodiorite, the foundation rock of the Tertiary sediments is distributed on the west side of this fault line.* In addition to this fault line, there are almost some fault lines in parallel with it. They are clearly expressed by the river system, but their vertical features can not be grasped. However, the easternmost of them reveals its scarp clearly, facing the basin, the fault displacing the eastern flank of Mt. Daiyama composed of liparite. A group of small hills dotted to its east are buried hills caused by the depression. Generally speaking, these fault lines become dim northward, and even the Daiyama fault can not be traced in topography from the Ogawa River northward. On the contrary, they draw nearer southward until at last they converge into the foot of the mountain west of Niwasaka Town.

3. Topography of the eastern slope of Azuma Volcanic Group.

Azuma Volcanic Group, which dominates over the south-western part of the basin, consists of volcanic cones, 1800–2000 m in height, which are known not to be covered with thick volcanic materials because their basal rocks are exposed nearly as high as 1200 m.⁽³⁾ Mr. Kakuage made a pedological study of the com-

* As the western flank of the granodiorite is displaced by another normal fault of NWN-SES with its west side fallen down, according to the report, the mass of the granodiorite can be regarded as a kind of horst-block-structure with a pointed plane just like a wedge in its south, the end of the point existing at the outlet of the Matsukawa Valley and being nearly 3 km in width there (Fig. 13).

plicated structure of these volcanic cones, examining their periods of activity and types of eruption. According to his results, there seems to have been a transition in the points of lava eruption and its types.

On the eastern slope of this volcanic group, no lava-flow reached farther down than 700m in height, and under its end rise in a row frontal mounts, about 600m in height (Fm in Fig. 4). Along the eastern foot of these frontal mounts are attached flat surfaces (300m in height) covered with thick volcanic detrital materials (Vs in Fig. 4). These flat surfaces form sharp-cut cliffs on the east side,



Fig. 4 The eastern slope of the Azuma Volcanic Group and the alluvial fans under it.

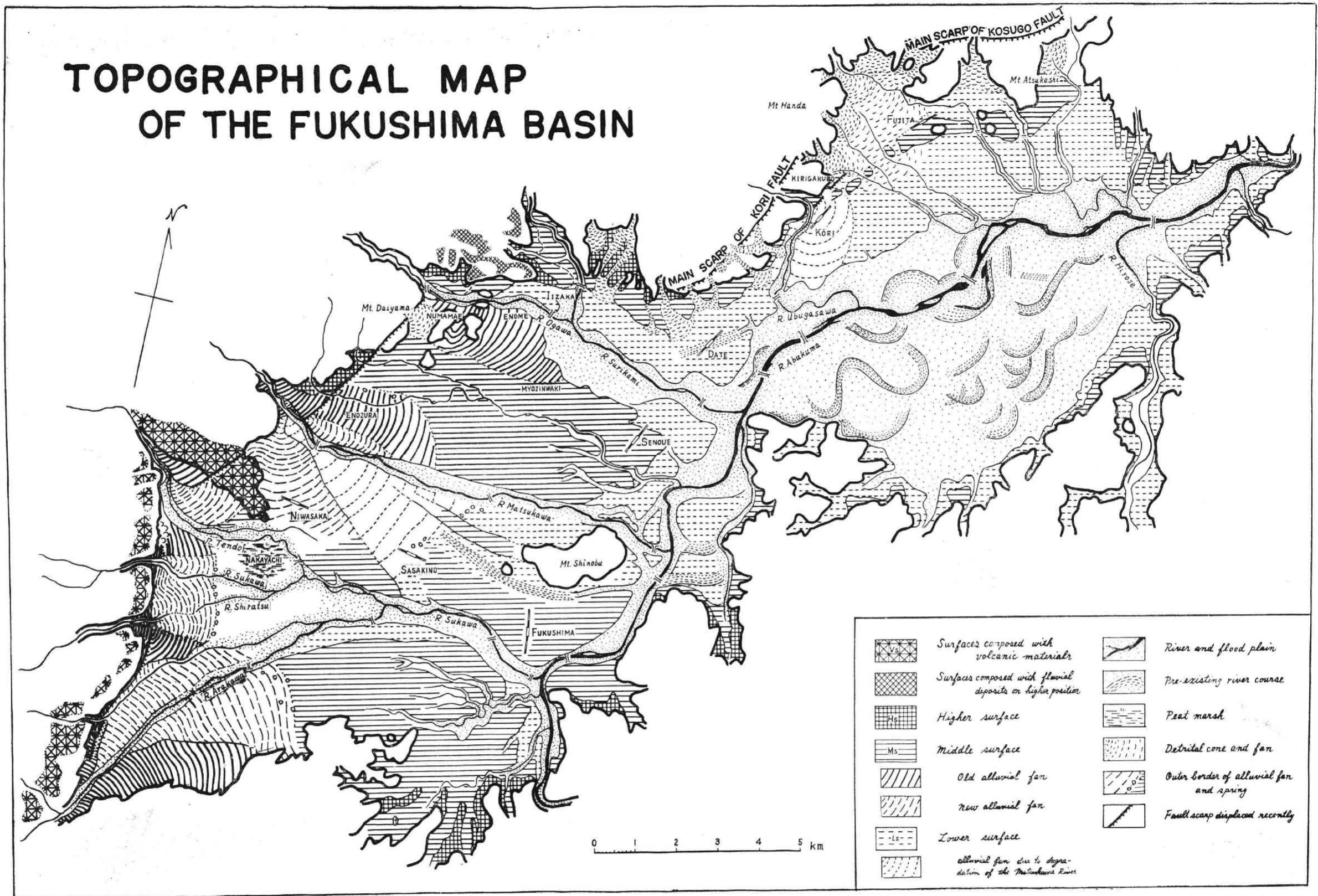
Iv: Mt. Issaikyo, Av: Adatarara Volcanic Group, Fm: frontal mount, Vs: surface composed with volcanic detritus, Sf: Sukawa fan, Shf: Shiratsu fan, Suf: Sukawa fan, Tf: Tendo fan.

but no positive data could be found to determine the character of the scarp. However, from its feature in form and the character of the fault plane observed at the valley bottoms of the Shiratsu and Sukawa Rivers dissecting the scarp, it follows that this is also a scarp by faulting.* Therefore, this steep scarp under the eastern foot of Azuma Volcanic Group is tentatively named "Shiratsu fault scarp" for convenience of author's description.

As above, in this volcanic mountain there were recent faulting along its eastern foot, and volcanic activity different in time and place. And it can easily be imagined that exercised considerable influence upon the quantity of materials transported

* According to the geological map published by the Fukushima Prefectural authorities, this fault line detaches from the mountain foot in the part north of the Sukawa River, running toward the north-west in the direction of the upper course of the Matsukawa River from the outlet of the Tendo River. Consequently, it seems that this fault do not connect directly with the Daiyama fault (Fig. 13).

Fig. 5 Topographical map of the Fukushima Basin.



by the Arakawa River and others flowing out of the mountain. Consequently, the forming of the alluvial fans along the mountain foot must be fully studied from these two angles.

Some Observations and Their Interpretation

1. The active fault under the Kōri fault scarp.

There are some landforms worthy of note under the Kōri fault scarp dominating over the north-western part of the Date Plain. Along the national road through Fujita Town, there are flat-topped low hills lying in a row (Ms. in Fig. 5, 6). They are composed of decomposed subangular gravels mingled with clay, and contains in it more detritus from the mountain behind than what was transported by the main stream of Abukuma. They are respectively bordered on the lower surface under it with the steep cliff about 10m in height. There are some points

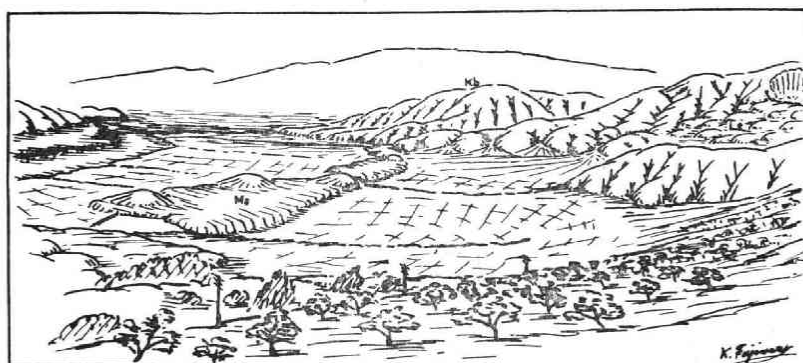


Fig. 6 View of the Kori fault scarp from Mt. Atsukashi.
Kt: Kori block, Ls: landslide on the eastern slope
of Mt. Handa, Ms: flat-topped hill (middle surface).

left to be examined to clarify and determine the character of this cliff.* Small domes observed on the flat tops of the hills north of Fujita Town are composed of tuff breccia of which the mountains behind are also composed. They are probably

* This cliff, just like a smooth are in shape, looks like a terrace scarp along the Abukuma River. However, the author has obtained some data by which it can be defined as a small fault scarp. They are as follows: (1) there is no former course of the river which seems to have formed this scarp. (2) The uppermost layer of the lower surface is a thick bed of silty clay assumed a deposition in still water, under it there is the subangular gravel bed suggested the same materials of which middle surface is composed. (3) The tuff breccia near the cliff shows some fault planes with $N 80^{\circ} E$ direction and $65-80^{\circ} S$ dip. They are not necessarily connected with the fault plane in question, but from their position and direction it may probably follow that there is some relation between them.

buried hills by the above-mentioned sediments. There is also a hollow on the north side of these hills, — that is, between the hills and the Kosugo fault scarps. By the electrical method of prospecting the author could succeed in clarifying that it is a hollow caused not by depression but by the erosion by two streams flowing there. In this case, there arises a problem, “Why could these streams not but flow along the foot of the fault scarp where the talus developed?”

From Fujita Town southward, the landslide from Mt. Handa covers not only the backs of these hills but also the parts between them, and further pushes itself out on the lower surface, so that the landform observed above can not be recognized.

The Ubugasawa River originated from the Kori block turns abruptly to the right at its valley mouth, and flows southward along the foot of the mountain. The outer border of the Kori fan (Fig. 5) also extends excessively southward. This suggests that the river more frequently flowed in the same direction at the time when the fan was being made. And a shallow trough can be noticed near Date Town. It runs on the north side of the station in the direction of the north-east. This is an old river bed of the Surigami River or its branch stream in or after the period of the lower surface. That is to say, it follows that the Surigami River flowed at that time quite nearer to the mountain foot in the direction of north-east. This phenomenon along with that of the Ubugasawa River is worthy of note.

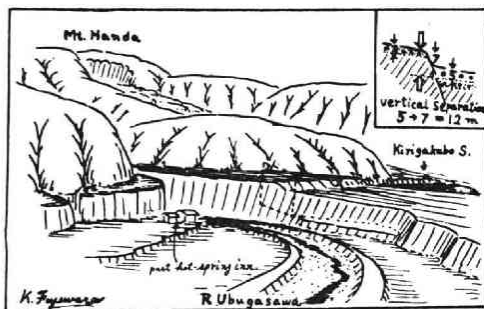


Fig. 7 Fan scarp at the outlet of the Ubugasawa River. X-mark is the point of Photo. 3.

At the outlet of the Ubugasawa River, there is a steep cliff, 8 m in height, crossing the valley. The author had an opportunity of observing the newly exposed part (Fig. 7) by a slide which happened to take place near the cliff. The observation revealed that this was a recent fault scarp with the displacement of 10–12 m, and that the Kori fan was brought into being by the displacement

(Photo. 3). Low cliffs regarded as the prolongation of this fault scarp exist along the mountain foot on its north and south. The scarp is about 10 m high near Kirigakubo to the north, and upper side strata of the fault there dip 25°–30° to the east, while the lower do rather westward. These facts along the scarp indicates that the lower side dropped down in the opposite direction at the time of the recent faulting.

It is a generally recognized fact that the most recent faulting often brought



Photo. 3 Fan scarp west of the Kori Station (see Fig. 7).

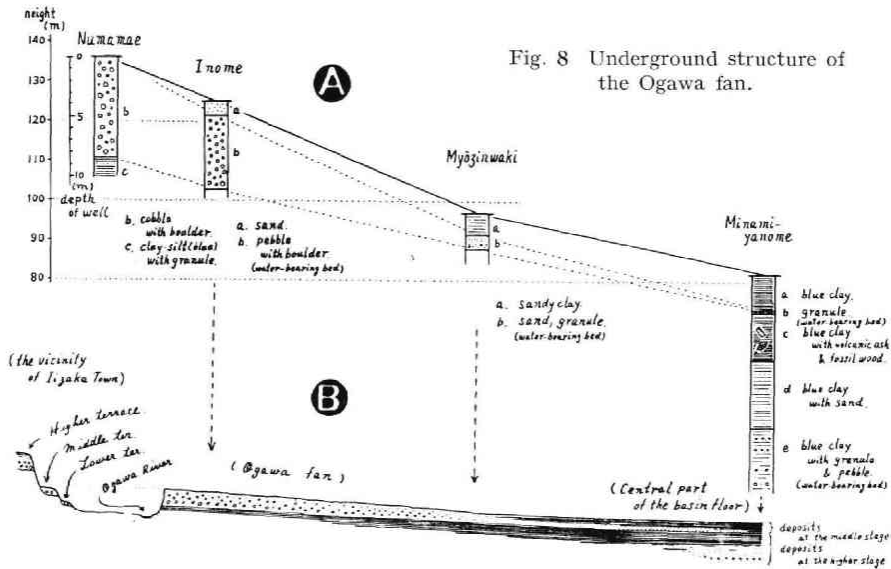
reverse dipping and small-scale hollows to the surface of a fan under a fault scarp.⁽⁵⁾ In this case, the river flowing on it is apt to shift its course—for example, under the Mahiru fault scarp along the eastern fringe of the Yokote Basin, Akita Pref., the present river is flowing along its foot, having left not a few troughs on the surface of the old fan showing reverse gradient.⁽⁶⁾ And along the base of the Kori fault bench also, was caused the reverse dipping of the fallen side by the most recent faulting as is clearly indicated by the displacement of the stratum at Kirigakubo Settlement. The faulting in the present area is thought to have taken place at or after the period of the diposition of the lower surface, because the materials of the Kōri fan overlay a bed of silt-clay of which the lower surface are composed. And the hollow under the Kosugō fault scarps were formed by the streams at this period as was already mentioned above. Judging from these facts, it is certain that the old river courses, irregular in direction, resulted from the reverse dipping of the fallen side which frequently occurs under the scarp at the period of the most recent fault movement.

2. River-terraces in the vicinity of Iizaka Town

The environs of Iizaka, a famous hot-spring town, is most amply provided with river terraces in the Fukushima Basin. In this area, they can be classified into 3 surfaces of terraces (Fig. 5). The middle terraces are the largest in area of them, and on it there are a greater part of the town and orchards. In the neighbourhood of the town, moreover, they can be subdivided into two kinds—that is, upper and lower ones. The former, where public offices and residential quarters are, is thickly covered with a layer of sand and gravels almost as large as men's heads, while the latter with hotels and shops on it, has a thin layer of sediments, and may rather be defined as an erosion terrace. On the contrary, the middle ones (the Ogawa fan) along the Ogawa River are covered with a layer

(8 m in thickness) of sand and gravels of boulder size at Numamae Settlement at the mouth. The great quantity of sand and gravels was transported and deposited here owing to the revival of the Daiyama fault crossing the outlet of the valley. This fan, however, failed in developing its normal form, hindered by the buried hills dotted on the south side of the river course. As a general rule, the outer border of a fan ought to be traced by springs and other indicators. In the case of this fan, however, the border is obscure. This is, as is shown in Fig. 8, because the part is covered with fine materials such as silt and clay, which prevent water from percolating through them. Such instances can often be observed in the depressed basins — Yokote and Yamagata basins, etc. in Tohoku Region.⁽⁷⁾ In those areas the distribution of settlements is delicately influenced by that of ground-water.

The upper ones can be distinguished from the others by the facts that they are mainly composed of greatly decomposed gravel beds and that one-third of the beds is thinly covered with the alternation of laminated sand and silt beds. They are about 140m near Iizaka, and 160m at the valley mouth of the Ogawa River. On the south side of the Ogawa River, the author observed at Numamae Settlement a fairly thick bed of fine materials lying under the gravel bed of the Ogawa fan. There is a little difference of height between the uppermost part of the fine materials on the south bank and the upper terraces on the north side of the river course, but



both of them seem to be correlated with each other because these two beds on both sides are composed of quite similar materials. On the south bank area of the lower course they change into silts, seem surely to be lacustrine deposits, with volcanic ash, increasing its thickness (Fig. 8). From above a geomorphological development of the area can be drawn as follows. In the period when the upper surface was brought into being, there extended a fairly large lake in this basin, and then the fans were developed on the basin floor by the revival of the Daiyama faulting. But because they spread into the lake, in direct, their fore-set beds was apt to be covered with the sediments of the lake. In the vicinity of Iizaka this crustal movement, on the other hand, expressed itself by a tilting towards the basin floor, so that the higher surface was denudated, resulting in the making of the middle terraces there.

At the height of about 200-300m on the hills between the Ogawa and Akagawa Rivers there are fluvial deposits of gravels on their flat ridges or gentle slopes. And they are decomposed as greatly as if they were the Aobayama gravel beds near Sendai. What is worthy of note as to the deposits is that thin beds of clay intercalated in them, in general, dip southward. This dip is thought neither to be a local and partial one nor to show the value which it did at the time of their deposition. Probably it took place after they had been deposited.

As was referred to in the 2nd item of the previous section, the Iizaka area is a part where the Kōri and Daiyama faults cross each other. The up-thrust of the Kōri faults and the depression of the fallen side (basin floor) of the Daiyama fault must have made this area dip toward the basin more or less. If the landform in the Iizaka area is considered as the results of such an upward crustal movement, some of the characteristics will be understood with ease.

3. Form of Matsukawa fan and its structure.

The Matsukawa fan is noted as an excellently managed orchard zone, and also from the view point of geomorphology, it raises not a few interesting problems. This is a fan not simple but compound (Fig. 5).

A fan (old one), where lies Anyōji Settlement at the valley mouth of the Matsukawa, is generally composed of andesite gravels, dark red, greatly decomposed and about 20cm in diameter, the largest rock mass measuring 50cm. This old fan is cut down at its height of about 170m by a steep cliff 15m crossing the same river at right-angle. Its form, position and direction clearly show that it is not an eroded cliff. Moreover, it runs on the Daiyama fault line. These facts convince the author of a recent fault scarp which displaced the apex of the old fan (Fig. 9). Next to the surface of this fan, there is, to the north of it, a topographical surface, which can be correlated with the upper surface in the

vicinity of Iizaka. This higher surface borders on the basin floor with a steep scarp, about 40 m in height, and its gravel bed is observed to be cut to a great

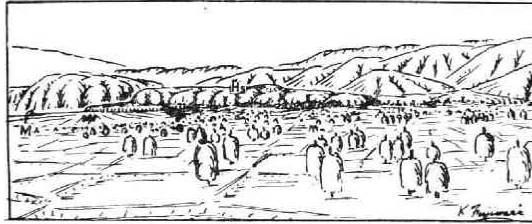


Fig. 9 Sketch of the fan scarp near the mouth of the Matsukawa River.

M: Matsukawa River, Hs: higher surface, Mf: Matsukawa fan, X: the point of Photo. 4.



Photo. 4 The gravel bed, cut off by recent faulting, of higher surface (see Fig. 9).

extent (Photo. 4). On the other hand, the mud-flow hills are displaced by 30–40m along the mountain foot west of Niwasaka Town. The facts indicate that the Daiyama fault displaced the higher surface and the old fan at least twice after the Diluvium.

The author found two beds of gravels piling the one with the other in an eroded cliff on the left bank of the Matsukawa River, 100m below the recent fault scarp which displaces the old fan mentioned above. The upper 11m in thickness is composed of gravels, 10–50cm in diameter, deposited very disorderly, and not decomposed. In the lower, on the contrary, the gravels are generally 20cm and rarely 50cm in diameter and the latter is so much like that of the old fan in the point that the matrix is greatly decomposed. These two kinds of gravel beds are also recognized in the profiles of the wells at Aragoya Settlement and near Niwasaka Town (Fig. 10).

The wells in this area are 40–50 feet in depth, and sometimes as deep as 65 feet. On the left side fan, however, the upper gravel bed is missing near Inozura Settlement. Dug out a gravel (lower one), brick red color, comparatively decomposed, is exposed just under the ground, ground water level existing about 10–15 feet below. And what attracts an surveyer's attention is a shallow trough extending toward ENE, and dissecting this part of the fan surface. Above observations reveal its structure as follows. The Matsukawa fan can be divided into two parts—the south bank one distributed with deep wells and the north bank one with shallow wells. The latter is the surface of the old fan itself which was dropped down by the recent fault, and the former is another surface (new fan) newly deposited on the old fan.

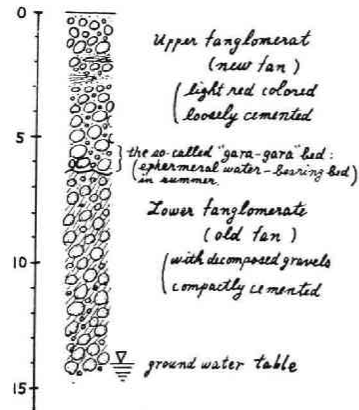


Fig. 10 Sketch of a typical well section in the vicinity of Niwasaka Town (on the new fan of Matsukawa).

A note-worthy phenomenon to be mentioned here is the excessive extension of the new fan toward the south-east. However, it seems that this is not a special one observed as to the new fan. That is to say, the same fact is noticeable in the case of the old fan when the outer border of the north side bank of the old fan is traced and when a comparison is made between the gravel bed there and the lower gravel one on the south side (both being the gravel beds of the old fan). Theoretically, this kind of development of a fan takes place when it is formed on a sloping plane—for example just like a fan formed by a branch stream flowing into its main valley⁸⁾. However, a flat basin floor such as the Fukushima Basin ought not to slope so much as intermont basins and valleys do. Therefore, the subsidence of the basin floor having brought about the unusual development of the fan toward ESS is probably due to the displacement caused by the recent rival of the Daiyama fault. That is to say, it seems that the value of the displacement became more southward with the result that the basin floor sloped also toward the south.*

* A marsh named "Kakayachi" exists on the south of Niwasaka Town. This is thought to have been free from the filled-up by Matsukawa River because it is at the back of the mud-flow hills. However the silt-like, deposits can be traced also on the north side of the hills, overlaying the outer end of the matsukawa fan. This fact prevents the author from agreeing at only this explanation.

The geological characteristics already referred to in the previous section might probably be due to the explanation of the mechanism as to the subsidence of the basin floor. Another reference will be given in the following item.

4. Fans along the eastern foot of Azuma Volcanic Group.

The rivers flowing into the basin from Azuma Volcanic Group are the Tendo, Sukawa, Shiratsu and Arakawa Rivers (Fig. 4). On detouching from the mountain foot they draw nearer to one another until they become one river in a short distance, and their confluence is near the Nakayachi marsh referred to in the foot-note of the previous item.

The Shiratsu River forms the most typical fan along the eastern mountain foot, though it is the shortest of the others in length. This is a noteworthy fact.

That is to say, it is obvious that the formation of the fans in this area including this fan is explained only by the recent faulting having taken place along the mountain foot. Then, is there any other cause of the formation?

Fig. 11 indicates the profile of the wall of a well on the mid-fan of the Shiratsu fan.

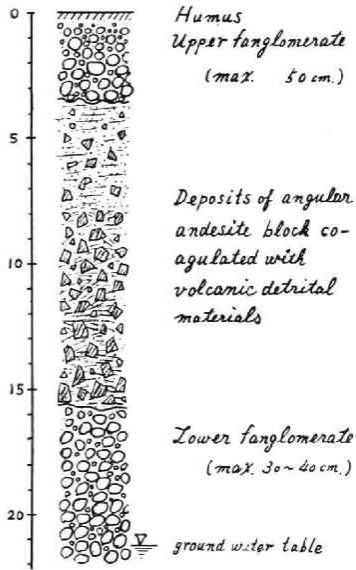


Fig. 11 Sketch of the well section of the Aoba-gakuen on the mid-fan of Shiratsu fan.

As is shown in it, the body of the Shiratsu fan appear to be thickly constructed with a volcanic mud flow overlying a bed of boulders of great size in this part of the fan. And it is also true that the valley of the Shiratsu is filled with the matters at its outlet (Photo. 5).



Photo. 5 Outcrop of volcanic detritus, thickly constructing the fan-body of the Shiratsu fan.

As was mentioned before, the eruption in Azuma Volcanic Group took place at different points from the view-point of the period of its making. The most recent eruption began by breaking the pre-existing volcano near the peak of Issaikyo. The farthest end of the lava having flowed down at the time buries only the valley head of the Shiratsu River. The aerial photo clearly shows the above fact. In other words, the volcanic detritus was brought about by the most recent eruption of Azuma Volcanic Group, and formed a greater part of the Shiratsu fan, providing abundant mud and stone flow to the river. This is because the Shiratsu, shortest as it is, formed a fan on an unproportionally large scale. The fans formed in the same process ought to be observed along the foot of a volcano, the instances being the gentle gradients similar to fans in form found along the Biwazawa at the eastern foot of Bandai Volcano, Fukushima Pref., and along the Torie River at the northern foot of Iizuna Volcano, Nagano Pref..

Landslip, large in area and on a large scale, now taking place are known in the Azuma Volcano area and they are caused by the hydro-thermal alteration there.⁹⁾ They have frequently and excessively taken place especially along the upper courses of the Arakawa and Matsukawa Rivers, and have been supplying an enormous quantity of mud and stone flow to these two rivers. Consequently, the fact that the fans being formed by them are mostly composed of andesite gravels of great size* makes the author try to give another consideration as to how the fans was formed, taking into account such a volcanic activity in the upstream area without attributing its cause only to faulting.

The fan-like surface (old fan) composed of the volcanic detritus along the Shiratsu River was displaced by the recent fault scarp (about 15m) at the outlet of the valley (Fig. 12 & Photo. 6). Owing to this faulting under the Shiratsu fault scarp the volcanic detritus on the old fan upward this scarp was removed by the river and scattered out over the fallen part under this scarp (upper gravel bed in Fig. 11). The deposition of gravels laid down by the river—the formation of a new fan—was brought about only over the left side of the fan. In the case of the fan of the Sukawa River, however, a new fan is formed only on the right side.

The Tendo and Arakawa Rivers flowing outside the aforementioned rivers also show some interesting topography along them (Fig. 5). The Daiyama fault displaced the surface of the old fan of the Tendo river about 17m, developing

* The old and new fans of the Matsukawa River area are chiefly composed of gravels of andesite. However, it is worthy of note that gravels of grandoioite and shale are mingled with those of andesite to a considerable degree in the gravel bed of the fan surface newly formed by dissecting and in the river bed itself.

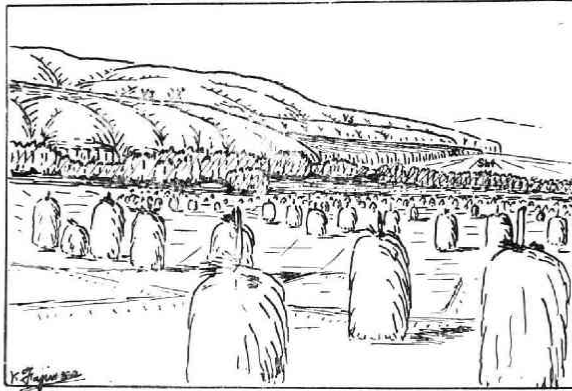


Fig. 12 The Shiratsu fan and the fan scarp cutting down its apex.
 Vs: surface composed with volcanic detritus,
 Shf: Shiratsu fan, X: the fan scarp showing by Photo. 6.

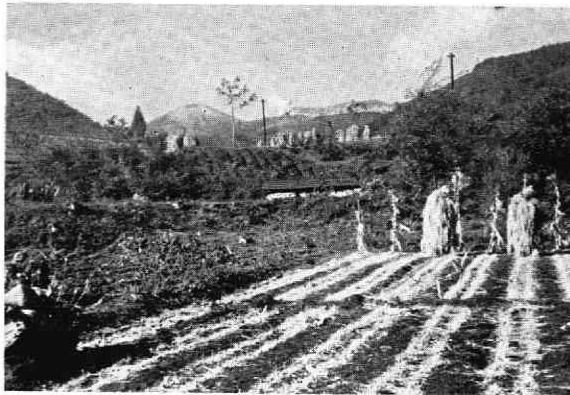


Photo. 6 Fan scarp (about 15 m) at the apex of the Shiratsu fan (see Fig. 12). Mt. Ko-Fuji and Mt. Issaikyo (the most recent eruption area in the Azuma V.G.) are seen far away.

its new fan in the south of the left side of its old one. Having shifted to the south, the present river erodes the south fringe of the old fan of the Sukawa River. The formation of the new fan of the Arakawa River, on the other hand, seems to have been caused by its destruction of the right side fringe of the old Shiratsu fan. And its old fan, composed of andesite gravels of great size and whose surface is uneven and comparatively gradient, is left only on its right bank. What made the same river erode the old fan and form its new one was the recent displacement, under the Shiratsu fault scarp, which can be clearly observed at the outlet of the valley of the Shiratsu, and the faulting occurred at the same period of the most recent displace-

ment of the Daiyama fault.

It has been explained hitherto that the Daiyama and Shiratsu faults are united together from the topographical point of view, but the latest geological survey has revealed that they are not connected in a simple form as was already referred to. The structural relation between them, as is shown in Fig. 13, is considerably complicated. The Daiyama fault and its westward tectonic lines converge in the Nakayachi area, which, in addition, belongs to the fallen side of the Shiratsu fault having displaced the eastern foot of Azuma Volcanic Group, along with the

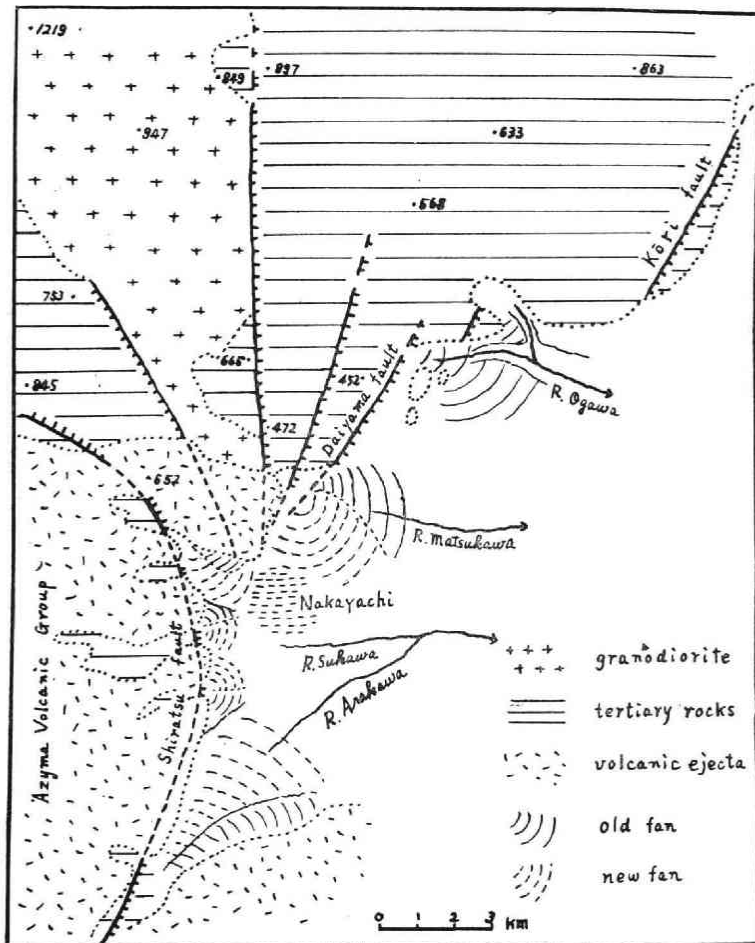


Fig. 13 Schematic map showing the relation between the arrangement of fans in the basin floor and the geological structure in the mountains in the western fringe of the Fukushima Basin.

above faulted structure. That is to say, viewed from this geological structure, quite interesting is a conclusion that the subsidence of the western part of the Shinobu Plain may be the severest in and around the Nakayachi marsh. From such a view-point, it follows that the noticeable feature under the Shiratsu fault scarp mentioned above, the development of the new fans caused by the mode of the subsidence of the basin floor at the most recent time such as under the Daiyama fault scarp. However, the definite solution for its mechanism can not be found in the present stage, because volcanic ejecta covering the mountain foot area present any further knowledge of the fault plane and other structural facts.

Summary

The afore-mentioned observations and their explanations will be summarized as follows :

1. Three faults can be recognized along the western fringe of the Fukushima Basin, and under all of them there are fault scarps displaced in and after the Diluvium.

2. The Kōri fault is a thrust one. At the period of the most recent displacement, narrow troughs caused by depression, or shallow hollows as a result of reverse dipping were formed under the fault bench.

3. The Kōri and Daiyama faults cross each other in the Iizaka area. For this reason, each activity of these faults, that is, the up-thrust of the Kori fault block and the subsidence of the fallen side of the Daiyama fault made the area dip toward the basin with the result that the river terraces were formed there.

4. The arrangement and forms of the new alluvial fans under the western mountain foot were decided by the modes of faulting. That is to say, under the northern half of the Daiyama fault scarp the fans developed to the south-east, and at the eastern foot of Azuma Volcanic Group, that is, under its southern half,—they shifted to the north. These phenomena were due to the mode of the subsidence of this basin. Although the decisive conclusion must be avoided because the concrete data have not yet been obtained, the geological structure is likely to give a powerful suggestion to the mode of the subsidence.

5. At the eastern foot of Azuma Volcanic Group, the form and the materials of the fans did not necessarily depend upon only the displacement of the fault there. In this area they were more sensitive to the volcanic activity in the drainage area of each rivers constructing the fans.

6. In the central part of the basin there was a large lake during the period from the higher surface to the middle (the old fan), and was deposited the thick bed of not only lake deposits but also the volcanic ash from the western

volcanoes. For this reason ground-water is prevented from percolating down in this part of the basin, where drinking water is provided with by the artesian water contained in the basal gravel bed of the higher surface. The lake gradually decreased in size, and at the period when the new fans were formed, it was retained only in the Nakayachi area.

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