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ON THE PALYNOFLORA IN THE PALEOGENE IN THE ISHIKARI COAL FIELD, HOKKAIDO, JAPAN.

by

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(with 6 text figures)

Abstract

To clarify the composition and change of the palynoflora in the Paleogene in Central Hokkaido, the samples taken from three representative localities are investigated: the northern and southern parts of the Ishikari coal field and the plain and offshore areas near Yufutsu, south ~southwest of the coal field. The palynofloras in the Ishikari coal field do not indicate so warm climate as has generally been supposed. This discrepancy may be interpreted as follows: a montane area existed near the coal field (may be east of it) and much pollen (montane elements) from the flora in the area were supplied to the sedimentary basin in the coal field when the Ishikari Group was formed there. The palynoflora in the coal field, therefore, was composed of the mixture of pollens from very warm lowland floras and these from cool temperate montane floras. On the other hand, the palynofloras in the plain and offshore areas near Yufutsu were accumulated in so remote site from the montane area that the pollens transported to the site are very few and they are mainly composed of the elements of very warm lowland floras.

In the successions of the palynofloras from the lowest part to the top of the Paleogene, a noteworthy lowering in temperature, " Terminal Eocene Event ", is recognized in between the Ishikari and Poronai stages.

Introduction

The Ishikari coal field is one of the type areas of the Paleogene System in Japan. The system is divided here into two parts: the lower part (Ishikari Group, Eocene) and the upper part (Poronai Group, Late Eocene~Oligocene). The Ishikari Group is mainly composed of non-marine sediments with many coal seams and rich plant fossils, and the Poronai Group is composed of marine sediments being rich in molluscan (Poronai fauna) and foraminifera fossils but scarce in macro plant fossils. Consequently, it is defficult to get a complete floral succession based on the macrofossils throughout the Paleogene. However, as rich pollen fossils are reported to be found not only in the Ishikari Group but in the Poronai Group (Sato, 1972), we can expect to get the floral succession by using the pollen fossils. The Ishikari coal field is also divided into two parts: the northern part (Sorachi coal field) and the southern part (Yubari coal field). In the former, the Ishikari Group is much thicker and the Poronai Group thinner than in the latter; and inversely in the latter, the Ishiakari Group is thinner and the Poronai Group is thicker than in the former.

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A noteworthy lowering in temperature in the Tertiary period was reported all over the Northern hemishpere, which is called " Terminal Eocene Event " (Wolfe, 1978). This event is also expected to be recognized in the Paleogene in the Ishikari region. One of the purposes of the present study is to clarify the floral succession throughout the Paleogene time by using pollen fossils and to recognize the event in the floral succession.

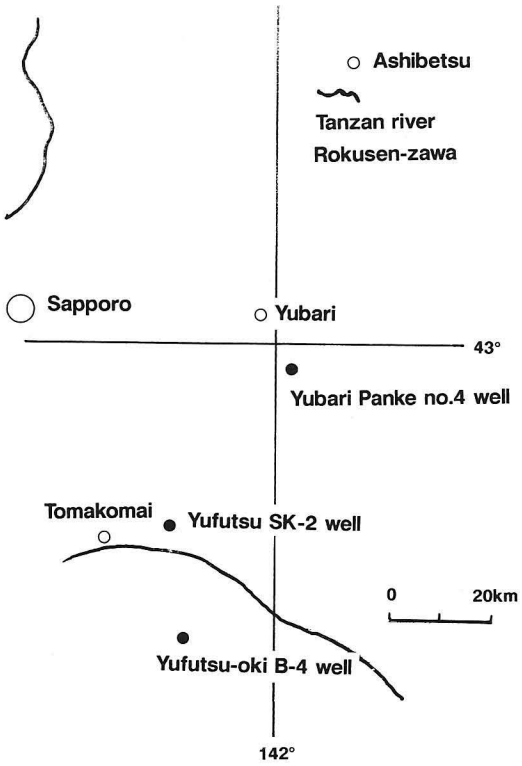
Samples and treatments to take out fossil pollen grains from the samples in the present study.

Samples for the present study were collected at four localities. Two of them are in the Ishikari coal field: one (Tanzan river~Rokusenzawa river area) in the Sorachi coal field and the other (Penke No. 4 well in the Shimizusawa area) in the Yubari coal field. The other two are in the plain and offshore areas near Yufutsu, south~southwest of the coal fields (Yufutsu SK-2 and Yufutsu-oki B-4 wells), where we find the Paleogene only in wells (Text-fig. 1).

The samples are treated with the following treatments.

(1) About 20~30 g crushed sample (40~60 mesh) is soaked in Schultz solusion for 4~6 hours.

(2) Washing by water



Text-fig. 1 Locality map for the present study.

(3) Heating in 10% KOH solution at 60～70℃ for 40～60 minutes.

(4) Washing by water

(5) Soaking in hydrofluoric acid for more than 4 hours.

(6) Washing by water

(7) Heating in the solution of mixture of nitric acid, hydrochloric acid and water (1 : 1 : 1) at 60℃ for 5 minutes.

(8) Washing by water

Repeat the treatments (5)～(8) several times.

The material thus obtained is mounted with glycerin jelly and examined under the microscope. Count total 150-200 pollen grains except microplanktons and spores under the microscope and the frequencies of each pollen type are shown as relative per cent of the total pollen grains. Microplanktons and spores are shown as percentage abundance relative to pollen; thus the percentage can exceed 100.

Results and discussion

The present pollen analysis shown in Text-figs. 3～6 tells that the frequencies of montane or temperate elements such as Pinaceae, *Tsuga* or *Alnus* in the Ishikari Group are higher than expected on the basis of the results before and that the climatic condition inferred from the pollen assemblage (palynoflora) is not so warm as is generally supposed. Some plant fossils indicate very warm or subtropical climate such as palm. *Musophyllum* or other evergreen hardwoods are recognized so far in the Ishikari Group, and the climate during the Ishikari stage, therefore, is assumed to be very warm temperate or subtropical and wamer than any other periods in the Neogene time. But the palynofloras found in the present study can not be said to indicate a far warmer climatic condition than those found in the warm periods in the Neogene age in Hokkaido.

As Text-figs. 3～6 show a noteworthy change in composition of the palynofloras is recognized at the boundary between the Ishikari and Pronai Groups, but not in the Ishikari Group. That is, *Tsuga* and Pinaceae, cool element, abruptly increase and *Quercus*, Tricolpate pollen and *Liquidambar*, warm element, decrease in frequency upwards from the boundary between the Ishikari and Pronai Grous, but not in the Ishikari Group.

In Text-fig. 4, the Wakkanabe Formation, a member of the Ishikari Group, is similar to the Poronai Group in the frequency of Pinaceae. This similarity may be due to that the both formations are similar in facies (marine). There are many reports on the abundant occurrence of Pinaceae pollen in marine sediments (for examples, Traverse and Ginsburg, 1966; Cross et al, 1966: Sato, 1972 and Yamanoi, 1986). At the boundary between the Wakkanabe Formation and the Poronai Group, however, the occurrences of *Tsuga*, *Quercus*, Tricolpate pollen and *Liquidambar* are similar to the occurrences of the other cases: Text-figs. 3b, 5 and 6. Any evidence indicating Terminal Eocene Event is not found in the Ishikari Group. Tanai (1991) reports that a change in floral composition occurred in the

late stage of the Ishikari Group (Ikushunbetsu stage), where the flora which is dominated by the warm~subtropical elements changed to the one dominated by temperate deciduous broad leaf trees. He considers that this change corresponds to " Terminal Eocene Event ". The conclusion based on the macrofossil differs from that based on the palynoflora. The change in the composition of palynoflora at the boundary of the Ishikari and Poronai Groups is supposed to be caused not by the climatic change but by the difference in the facies of the both groups, that is, the Ishikari Group is non-marine and the Poronai Group is marine. The palynoflora in marine sediments is richer in montane elements than that in non-marine sediments (for example, Traverse 1988, p. 412-416). However, some marine sediments with few montane elements contain a palynoflora indicating warm climate, when they were formed in a warm environment, for examples, the Sankebetsu Formation (Sato, 1970, 1972) or the Takinoue Formation (Sato, 1987). These facts suggest that a palynoflora in marine sediments also reflects the climate at the time when the sediments formed, though some restrictions must be taken into consideration. Consequently the change of the palynoflora from the warm temperate palynoflora to the montane elements dominant flora at the beginning of the Poronai stage is considered to show a lowering in temperature that corresponds to " Terminal Eocene Event ". The lowering in temperature began at the late stage of the Ishikari stage as Tanai noted, but the temperature lowered significantly at the boundary between the Ishikari and Poronai stage.

Text-figs. 5 and 6 show the composition of the palynofloras in the Ishikari Group in the Yufutsu SK-2 and Yufutsu-oki B-4 wells. Comparing these palynofloras in the same group in the Ishikari coal field noted above, the frequencies of montane elements like Pinaceae or *Tsuga* are remarkably lower in the former than in the latter. According to Traverse (1988), the ratio of montane elements in a palynoflora in marine sediments is higher than in non-marine sediments. This means that the remoter from the montane area the site where the sediments were formed, the higher the ratio of montane elements in the sediments. However, this can be applied only to the case where the site is in a marine environment. In the case discussed in the present paper the palynofloras for comparison accumulated in the non-marine and coal-bearing environment. Presumably a montane area existed near the Ishikari coal field at the Ishikari stage, and the compositions of palynofloras in the Ishikari Group in the coal field (lowland) are considerably influenced by the pollens (montane element) transported from the area. On th other hand, the palynofloras in the Ishikari Group found in the Yufutsu SK-2 and Yufutsu-oki B-4 wells represent a real feature of the flora in the lowland at the Ishikari stage, because the sites of the two wells were so remote from the montane area that the pollens from the montane area are too scarce to have influence on the compositions of the palynofloras there.

(1) A noteworthy lowering in temperature at the end of the Eocene time, the Terminal Event, is recognized at the boundary between the Ishikari and Poronai

stages in Hokkaido.

(2) The composition of the palynofloras in the Ishikari Group in the Ishikari coal field, does not indicate a very warm climate. This is due to the montane elements which derived from the montane area existed near. The real feature of the flora in the lowland at that time will be recognized in the palynofloras in the Ishikari Group in the area far south-westward from the Ishikari coal field, as in the Yufutsu SK-2 and Yufutsu-oki B-4 wells.

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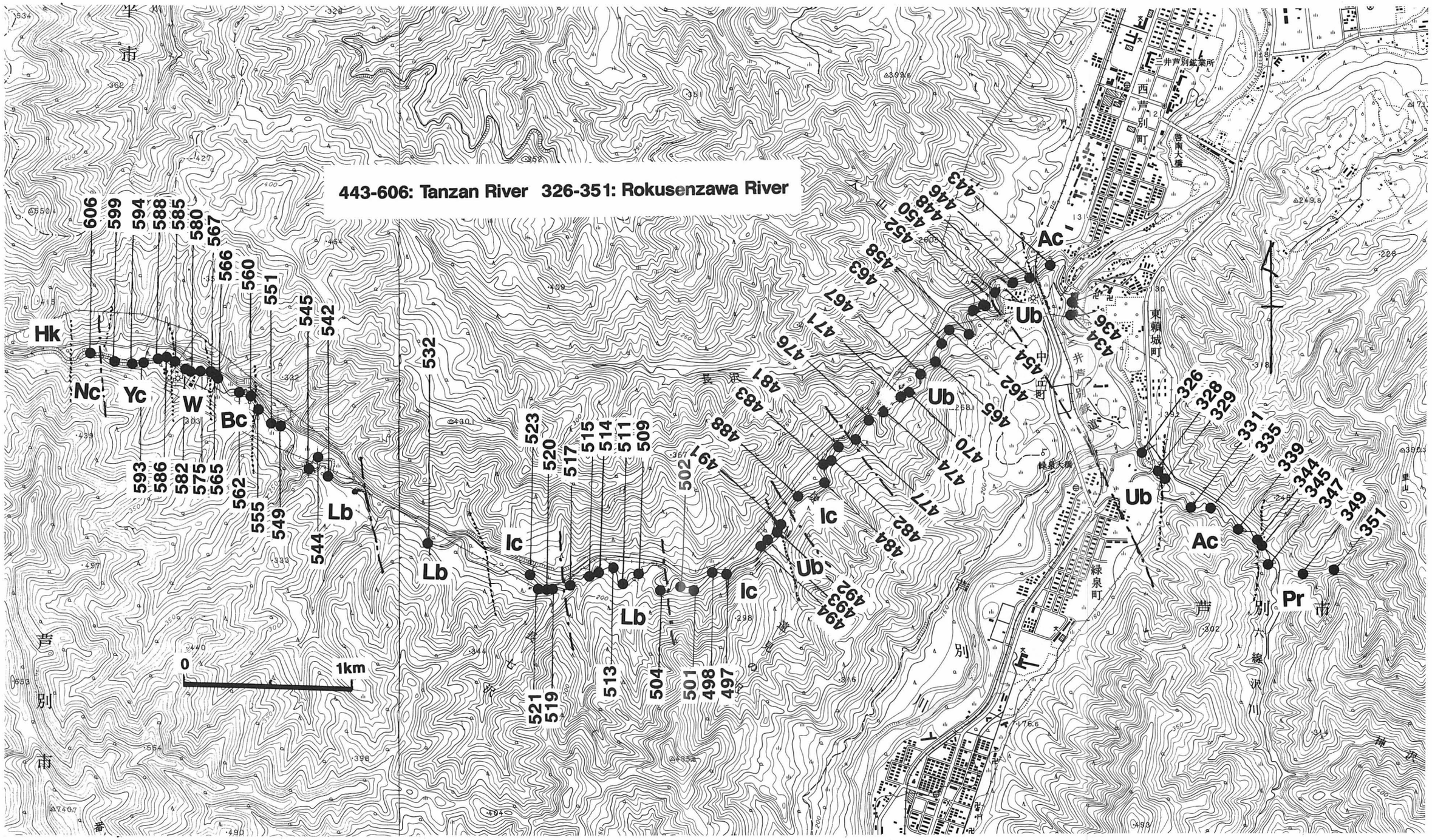
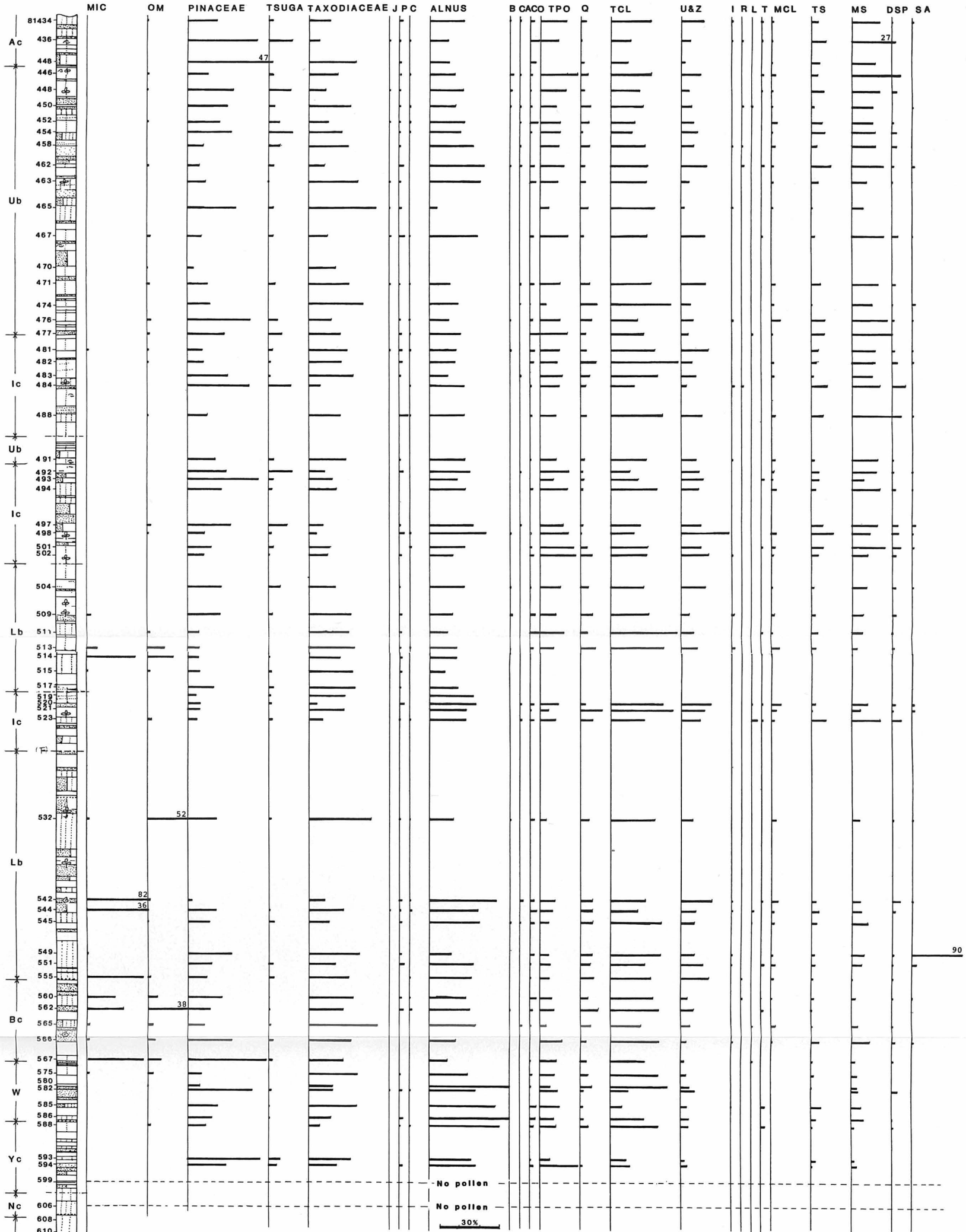


Text-fig. 2 Detailed sampling localities in the Tanzan river and Rokusenzawa river areas.

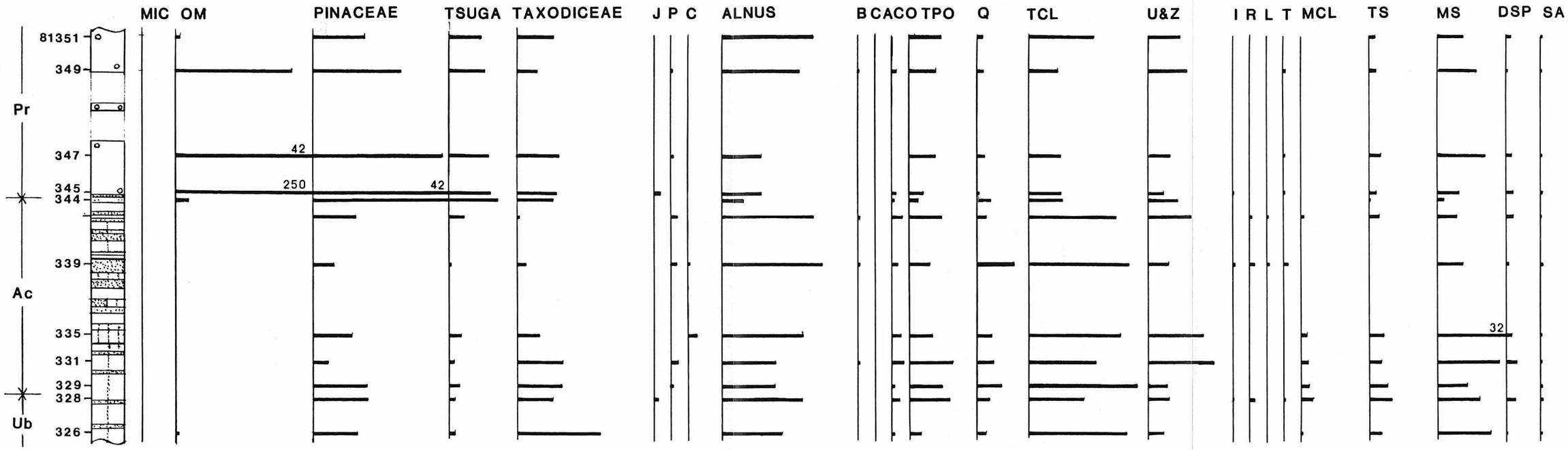


MIC: *Micrhystridium*, OM: Other Microplanktons, J: cf. *Juglans*, P: cf. *Pterocarya*, C: *Carya*, B: *Betula*, CA: cf. *Carpinus*, CO: cf. *Corylus*, TPO: Triporate pollen gen. indet., Q: cf. *Quercus*, TCL: Tricolpate pollen gen. indet., U&Z: cf. Ulmaceae, I: *Ilex*, R: cf. *Rhus* or *Nyssa*, L: *Liquidambar*, T: *Tilia*, MCL: Monocolpate pollen gen. indet., TS: Trilete spores, MS: Monolete spores, DSP: Spores and pollen clearly judged to be derived from Cretaceous rocks,based on their characteristic shapes, SA: Sporomorph A, spherical, less than 10 μ in diameter, surface smooth, biological affinity unknown, not found in terrestrial sediments.

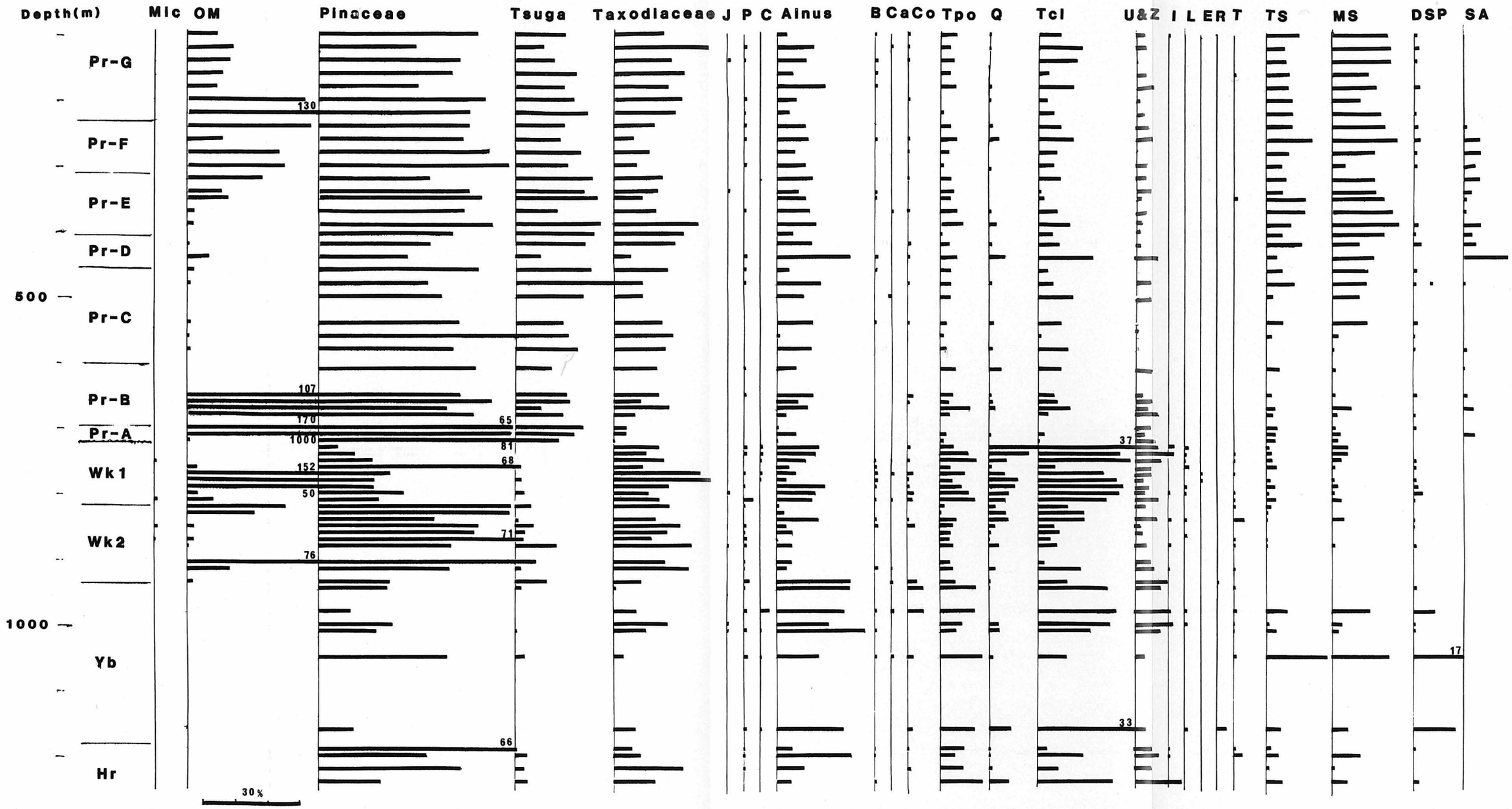
Ac: Ashibetsu Formation, Ub: Hiragishi Formation, Ic: Ikushunbetsu Formation, (Takane Formation), Lb: Akabira Formation, Bc: Bibai Formation, W: Wakkanabe Formation, Yc: Yubari Formation, Hm: Horokabetsu Formation, Nc: Noborikawa Formation, Hk: Hakobuchi Formation. Pr: Poronai Formation

Text-fig. 3a Pollen diagram of the Paleogene formations in the Tanzan river area.

Pollen diagram of the Hiragishi – Poronai formations along the Rokusenzawa river



Text-fig. 3b Pollen diagram of the Paleogene formations in the Rokusenzawa river area.

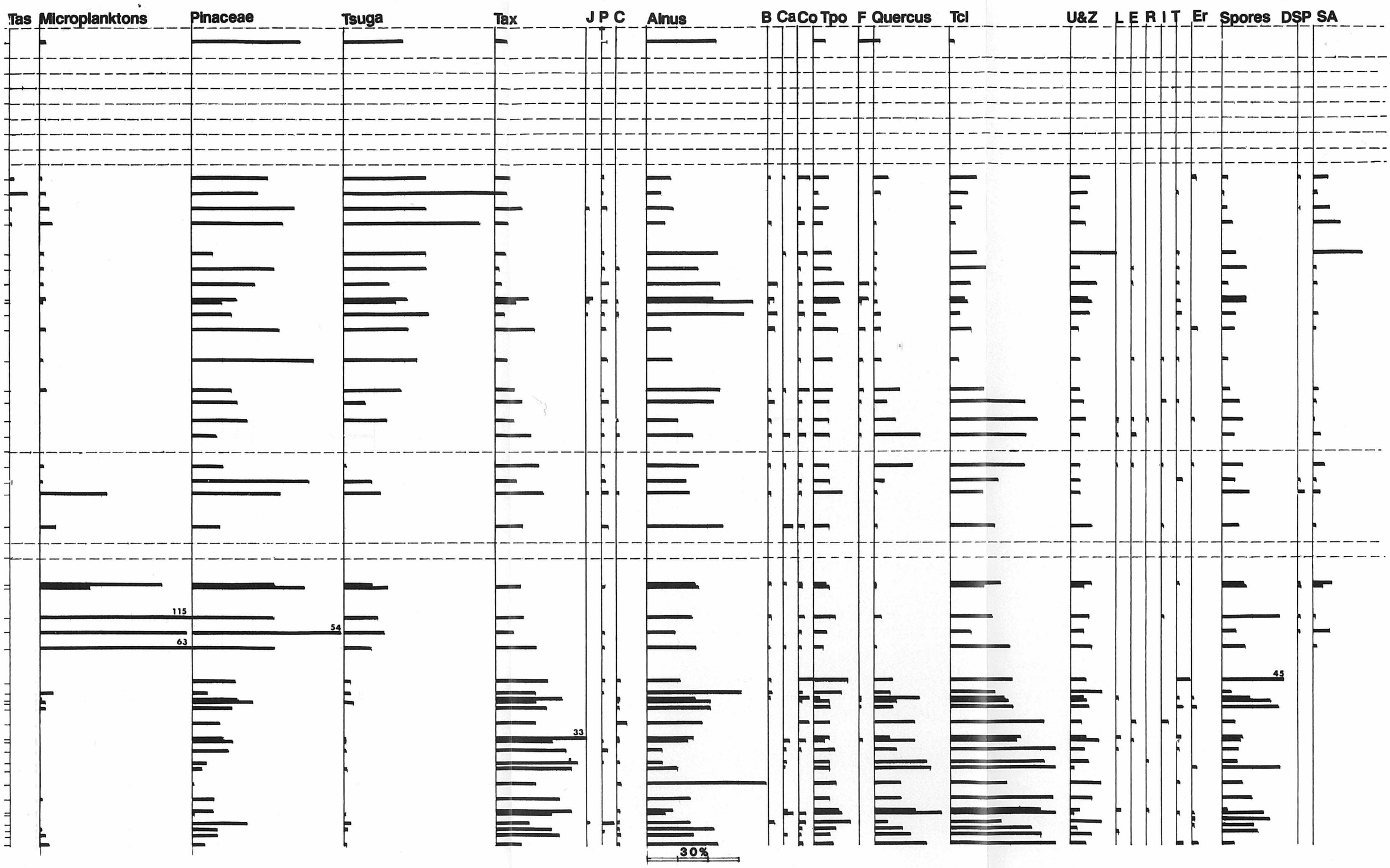


Text-fig. 4 Pollen diagram for the Penke No. 4 well.

Tas: *Tasmanites*, OM: other microplanktons, J: *Juglans*, P: *Pterocarya*, C: *Carya*, B: *Betula*, Ca: *Carpinus*, Co: *Corylus*, Tpo: Triporate pollen gen. indet., F: *Fagus*, U&Z: *Ulmus* and *Zelkova*, L: *Liquidambar*, E: *Engelhardtia*, R: *Rhus*, I: *Ilex*, T: *Tilia*, Er: Ericaceae, Ch: Chenopodiaceae, TS: Trilete spores, MS: Monolete spores, DSP: spores and pollen clearly judged to be derived from Cretaceous rocks based on their characteristic shapes, Sporomorph A: spherical in shape, less than 10 μ in diameter, surface smooth, bological affinity unknown, not found in terrestrial sediments.

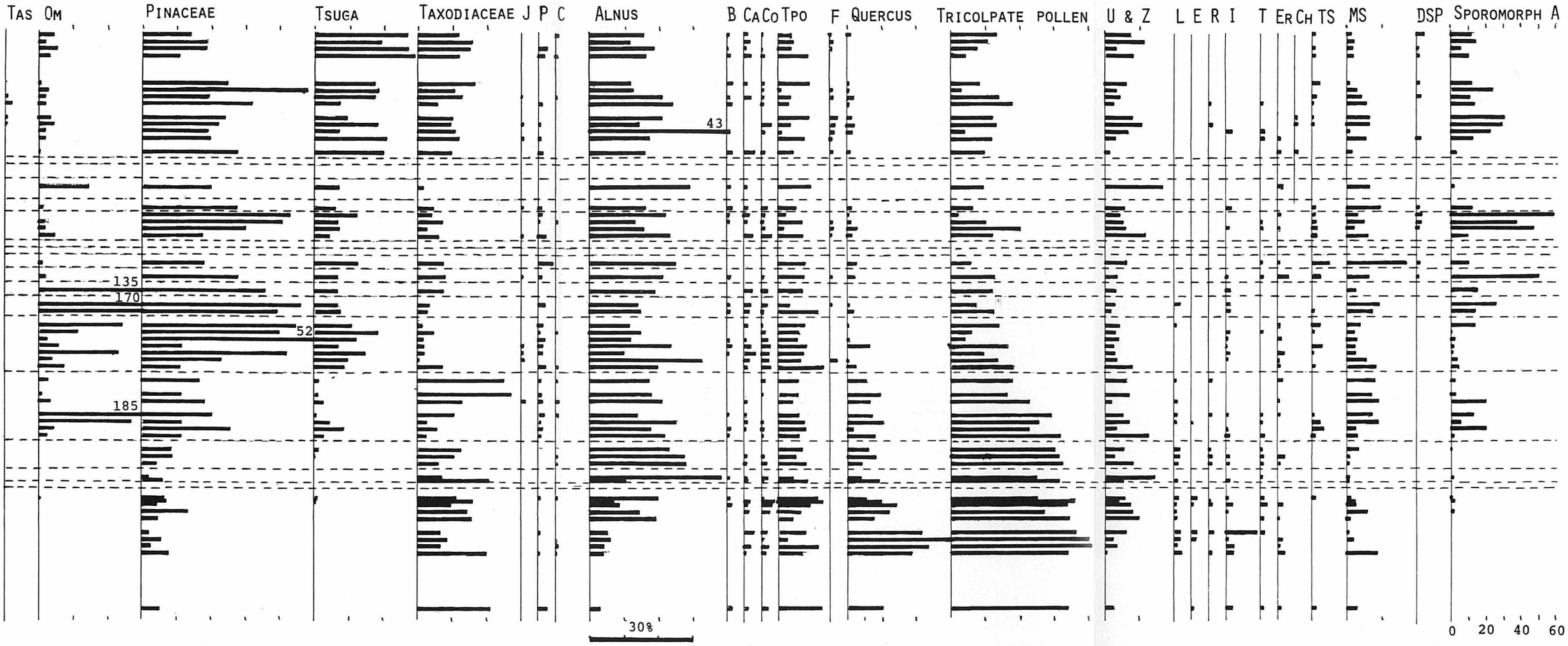
Ne: Neogene sediments, Pr: Poronai Group, Is: Ishikari Group.

------: Horizon containing very few or no pollen and spore.



TAX: Taxodiaceae, J: *Juglans*, P: *Pterocarya*, C: *Carya*, B: *Betula*, CA: *Carpinus*, CO: *Corylus*, TPO: Triporate pollen, F: *Fagus*, TCL: Tricolpate pollen, U&Z: *Ulmus* and *Zelkova*, L: *Liquidambar*, E: *Engelhardtia*, R: *Rhus*, I: *Ilex*, T: ae, DSP: Pollen and spores judged to be derived from the Cretaceous rocks, SA: Sporomorph A. ------ Horizon containing very few or no pollen and spore. Tk: Takinoue Formation, Pr: Poronai Group, Is: Ishikari Group.

Text-fig. 5 Pollen diagram for the Yufutsu SK-2 well.



Text-fig. 6 Pollen diagram for the Yufutsu-oki B-4 well.