Geomorphology of Narugo and its Vicinities, North Japan - Chronological View Based on Radiocarbon

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Geomorphology of Narugo and its Vicinities, North Japan

— Chronological View Based on Radiocarbon Dates —

Kunio OMOTO

1 Introduction

The present author reported on geomorphic development of Onikōbe, Narugo Nakayamadaira and Mukaimachi Basins crossing the Ohu backbone range (Omoto 1964, 1966, 1967 and 1968), in which he described and clarified geomorphological characteristics related with Pleistocene lake deposits in the tectonic basins of Onikōbe, Narugo, Nakayamadaira and Mukaimachi. But the absolute chronology on geomorphic surfaces and lake deposits remained unsolved.

Recently the author dated the samples taken from the above basins by means of radiocarbon measurements (Nishimura *et al.* 1972, Omoto *et al.* 1974). The absolute ages of other Pleistocene lake deposits at Kutchan, Togatta and Shiobara were reported (Omoto 1971, Imaizumi 1974, and Kobayashi *et al.* 1971). It is interesting for the author as to their situations and origins that the absolute ages of the lake deposits are all included in Würm Ice Age. In addition, the above mentioned basins have volcanoes and volcanic deposits (some are welded tuff and pyroclastics) in and surrounding.

In this paper, the author correlated the geomorphic surfaces of Narugo Basin and its vicinities based on the radiocarbon dates, and discussed the synchronization of Pleistocene lake deposits in the northern Japan.

2 Outline of Geomorphology and Geology

The Mukaimachi, Nakayamadaira, Narugo and Onikōbe Basins are continuous in a transverse valley across the Ohu backbone range. The margins of basins are clearly defined by steep mountain flanks, except west and east margins of Nakayamadaira Basin. The Oguni River flows westward (the Sea of Japan drainage) and the Eai River eastward (the Pacific Ocean drainage). The water divide between both drainages forms a divide in valley near Sakaida Railway Station, at about 340 m a.s.l., the lowest divide in the Ohu backbone range. Along these rivers develop several levels of river terraces. At the foot of mountain flanks, there are hill-lands with the elevation of 560 m to 280 m, not so much dissected, still keeping original flat surfaces. The mountains north of each basin rise about 1000 m to 1350 m a.s.l., while the mountains south 700 m to 900 m a.s.l.

Based on Ikeda (1946), Kato and Shimada (1953), Shimada (1955), Nakamura and Maeda (1959), Oide and Ōnuma (1960), Taguchi (1961), Ōsawa (1964), and the present author (1964, 1966, 1967 and 1968), the geology is outlined as following: The surrounding mountains consist of granite, diorite, green tuff and Tertiary volcanic rocks. The hill-lands consist of Yamaya formation and Mitsusawa dacite overlaid with Akakura formation in Mukaimachi, green tuff and dacitic tuff in Nakayamadaira, Miyazawa formation, Uwahara dacite and Onikōbe formation in Onikōbe, green tuff, Onoda formation, and Uwahara dacite in Narugo. The fanglomerate and terrace deposits are younger deposits than above mentioned.

In these basins, there develop well laminated siltstone beds including plant

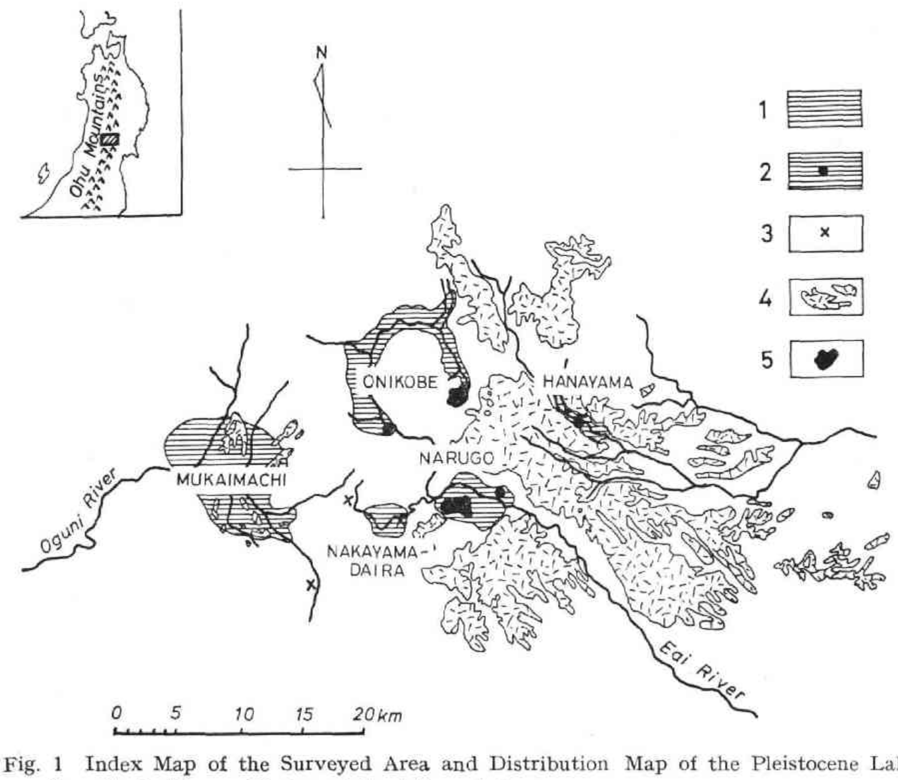

Fig. 1 Index Map of the Surveyed Area and Distribution Map of the Pleistocene Lake Deposits in Narugo Basin and its Adjacent Area.

1: Pleistocene Lake Deposits
2: Sampling site of the Lake Deposits for ^{14}C-Age dating
3: Sampling site of the Terrace Deposits (or Fan) for ^{14}C-Age dating
4: Pleistocene Pyroclastic Deposits
5: Dacite Lava and Pumice Tuff of Takahinata and Narugo Volcanoes

fossils, drift woods, and sometimes vivianite (Shimada *et al.* 1974). The facies change ascendingly from siltstone into sand or sand and gravel gradually. These sediments are Pleistocene lake deposits (Kato and Shimada 1953, Shimada 1955, Oide and Ōnuma 1960, Nakamura and Maeda 1959, Nakamura 1962, Omoto 1964, 1966, 1967 and 1968), whose distribution is shown in Figure 1.

3 Previous Correlations of Geomorphic surfaces

In the former studies (Omoto 1964, 1966, 1967 and 1968), the author correlated geomorphic surfaces based on the geomorphic and geologic evidences. Interdrainage correlation was done by the continuity of Makinohara surface in Mukaimachi Basin to Shokubutsuen surface in Nakayamadaira Basin. The author suggested on the possible correlation of Sugenodai surface and Nishihara surface, both of which include drift woods and peaty clay beds, by radiocarbon dates.

Between Nakayamadaira Basin and Narugo Basin, the geomorphic surfaces were correlated based on tephrochronological method and surface geology. The east part of Nakayamadaira Basin and whole Narugo Basin are covered with four layers of aeolian volcanic ash from Narugo Volcano, which cover the terrace deposits higher than Nishihara surface and Daigakunōjō surface. It is obvious that the terrace surfaces covered with aeolian volcanic ash layers were formed before the volcanic activity of Narugo Volcano.

Between Narugo Basin and Onikōbe Basin, the geomorphic surfaces are discontinuous at the east of Mt. Hanabuchi, and they were correlated with the relative height above the present river floor, dissection and sedimentary environment.

4 Absolute Correlations by Radiocarbon Dates

Radiocarbon data quoted in this paper are listed in Table 1. The author infers the age of formation of geomorphic surfaces in Narugo and its vicinities as follows; 1) Sugenodai surface ca. $23{,}005^{-1100}_{+1285}$ yrs. B.P. (TH-015), 2) Nishihara surface ca. 18,595±705 yrs. B.P. (TH-033), 3) Daigakunojo surface before 11,950±285 yrs. B.P. (TH-007), 4) Makinohara surface ca. 15,925±445 yrs. B.P. (TH-005), and presents the correlations based on radiocarbon dates, together with continuity of geomorphic surfaces and surface geology in Table 2.

Direct correlation of geomorphic surfaces far away is possible only by radiocarbon dates. For example, IVb surface near Sakunami Railway Station, upstream of the Hirose River, is correlative with Nakamachi Terrace (Tayama 1933) in Sendai (Ouchi 1973). The date of wood sample from the IVb surface was 19,215±760 yrs. B.P. (TH-031). The sample was taken from organic clay bed overlaid by terrace gravels, about 4 m in thickness, near Sakunami Railway

Table 1 Radiocarbon Dates quoted in this Paper

Sample	Code	yrs. B.P.
Onikōbe Lake Deposits (Wood)	TH-032	$27,100^{-1745}_{+2270}$
Narugo Lake Deposits (Wood)	TH-034	$28,495^{-2035}_{+2785}$
Hanayama Lake Deposits (Wood)	Gak-314	27,900±1700
Shiobara Lake Deposits (Wood)	TK-66	33,400±1200
Zaō Lake Deposits (Peat)	Gak-4853	34,400±1000
Kutchan (1) (Peat)	N-927	37,300±2200
Narugo (2) (Peat)	TH-005	15,925±445
Narugo (3) (Wood)	TH-007	11,950±285
Mukaimachi (1) (Wood)	TH-015	$23,005^{-1100}_{+1285}$
Nakayamadaira (1) (Wood)	TH-033	18,595±705

Table 2 Correlations of Geomorphic Surfaces

Mukaimachi Basin	Nakayamadaira Basin	Narugo Basin	^{14}C-Age
Sugenodai surface*	Higashizawa surface	Sanjō surface	*23,005
	Nishihara surface*	Daigakunōjō surface	*18,595
Makinohara surface*	Shokubutsuen surface	Myōsade surface	*15,925
Akakura surface	Nakayamadaira surface Hebinoyu surface	Takehara surface	
Mukaimachi surface	Yakeishihata surface	Kamigawara surface	

Station by Tamura and Ōkubo in 1967. Hence, Nishihara surface is correlative with the IVb surface in Sendai. Some humic soil layers of Tachikawa surface in Kantō were dated by Kigoshi *et al.* (1969). The first layer, 150 to 180 cm in depth was dated 17,000±400 yrs. B.P. (Gak–1129) with total organic carbon in soil, 16,000±300 yrs. B.P. (Gak–1014) with humic acid separated, and 19,800±500 yrs. B.P. (Gak–1015) with humin sample separated. The second layer, 200 to 290 cm in depth was dated 24,900±900 yrs. B.P. (Gak–1130) with total organic carbon, 22,300±900 yrs. B.P. (Gak–1016) with humic acid separated, and 21,400±600 yrs. B.P. (Gak–1017) with humin sample separated. These dates suggest that the Tachikawa surface (terrace) was formed at 24,900±900 yrs. B.P., and is correlative with Sugenodai surface in Mukaimachi Basin.

5 Paleo-lakes during Würm Ice Age, in north Japan

It is clarified from the above mentioned radiocarbon dates that there were several late Pleistocene paleo-lake basins in north Japan, although whole of late Pleistocene lake deposits are not listed in Table 1. The author would like to emphasize that it should be noteworthy that late Pleistocene lake deposits were aged within the Main Würm Ice Age. Most of these paleo-lake basins were tectonic in origin under the influence of uplifting backbone range since Miocene. Each lake deposit does not have the same level in altitude, which means that each seems to have kept isolated level.

Eustatic sea-level fall in the Ice Age brought active downcutting along the coast, but it could not reach so fast inland. The above inland basins could maintain the isolated levels till the downcutting arrived. Climatic changes related to the Ice Age brought a lot of lake sediments. Abundant plant fossils in the lake sediments and pollen diagrams indicate cool and moist climate. The author confirmed the close relationships between paleo-lake basins and lacustrine sediments derived of volcanic activity, and between geomorphic situations fixed by geotectonic structure and geomorphic developments of paleo-lake basin regions. But more accurate discussion needs more data both of radiocarbon dates on late Pleistocene lacustrine deposits and of geomorphic developments on late Pleistocene paleo-lake basins.

The terrace surface was eroded deeply between Nakayamadaira and Narugo Basins, showing ravine topography. The author supposed that the ravine had been formed after the sea-level fall in the last glaciation (Omoto 1968), which was proved by the radiocarbon age of 18,595±705 yrs. B.P. (TH–033). Judging from the erosion depth of Narugo-kyo (ravine), or the lowering of the Daiya River floor since Nishihara surface, the downcutting has continued at least 70 meters since 18,595 yrs. B.P. at the eastern margin of the Ohu Mountains. Strictly speaking, the upheaval amount of the region should be reduced, but it should be noticed that the downcutting caused by the sea-level fall in the Ice Age arrived inland with such a time lag as shown by radiocarbon age. Another ravine, where the Narugo Dam is situated, might be cut at the same age with the Narugo-kyo (ravine).

The Onikōbe lake deposits seem to be aged younger than the author expected. If the age is correct, the lake deposits of Narugo, Onikōbe, and Hanayama are correlative in age and those of Nakayamadaira and Mukaimachi seem to be aged contemporaneously. The river terraces and fans in the basin are expected younger than the lake deposits. The above geomorphic development is not definite because of the lack of radiocarbon dates.

6 Conclusions

Followings are main results of the present study.

1) Geomorphic surfaces of Narugo and its vicinities were correlated with radiocarbon dates as Table 2.

2) The lake deposits of the surreyed area are aged between $27,100^{-1745}_{+2270}$ yrs. B.P. (TH–032) and $28,495^{-2035}_{+2785}$ yrs. B.P. (TH–034). Other late Pleistocene lake deposits in north Japan are expected to be aged between $37,300 \pm 2200$ yrs. B.P. (N–927) and $33,400 \pm 1200$ yrs. B.P. (TK–66).

3) Narugo-kyo (ravine) was cut after the sea-level lowering of the Würm Ice Age.

4) Downcutting caused by the sea-level lowering of last glaciation arrived at the eastern margin of Ohu Mountains in retard of several thousands years, and eroded the terrace surface more than 70 meters deep.

5) The river terraces and fans in Onikōbe Basin were formed during or after the Würm Ice Age. More radiocarbon dates are necessary to compile the geomorphic development in the Onikōbe Basin in detail.

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