Geogr. Fis. Dinam. Quat.,
12 (1989), 47-50, 2 ff.

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GEOMORPHOLOGIC LAND CLASSIFICATION MAP OF LAKE KASUMIGAURA, KITAURA AND THEIR VICINITY, EAST OF TOKYO

Abstract: OYA M., HARUYAMA S. & HIRAI Y., *Geomorphologic land classification map of Lake Kasumigaura, Kitaura and their vicinity, East of Tokyo* (ISSN 0084-8948, 1989).

We have made the geomorphologic land classification map of Lake Kasumigaura, Kitaura and their vicinity near Tokyo. The target area is classified by major geomorphological elements such as diluvial terraces, alluvial terraces, valley plains natural levees, backswamps, former river courses, deltas, sand banks etc., utilizing the aerial photographs and field surveys. In preparing the sublacustrine map of the lakes, the bottom of the lakes are classified by major geomorphological elements such as littoral shelves, sublacustrine valleys, sublacustrine plains etc., utilizing the iso-depth line which was made by the Geographical Survey Institute, Ministry of Construction and measurement with a Fathometer machine.

These lakes are connected with the Pacific Ocean through the Tone River Valley. Therefore the geomorphology of the area is influenced by eustatic movement.

There are Lacustrine Terrace I (4-8 m) and Lacustrine Terrace II (1.8-3 m). The former was formed in the maximum of Holocene Transgression Age i.e. between 6,000 snd 4,000 years B.P.

There are Littoral shelf I (-1.0 to 1.5 m) and II (-2.0 to -3.5 m). About 2,100 or 2,000 years B.P. the sea water level was approximately -3 m.

We can use this map for the integrated development plan of water use and flood control. Furthermore, the map can be used for estimation of the site of soil liquefaction caused by earthquakes and for study of the geomorphologic development of the area.

KEY-WORDS: Geomorphologic land classification, Sea level change. Littoral shelf, Lacustrine terrace, Lake Kasumigaura, Lake Kitaura (Japan).

Riassunto: OYA M., HARUYAMA S. & HIRAY Y., *Carta geomorfologica di classificazione del territorio dei laghi Kasumigaura e Kitaura e zone adiacenti, a oriente di Tokyo* (ISSN 0084-8948, 1989).

È stata eseguita una carta di classificazione del territorio dei Laghi Kasumigaura e Kitaura e zone adiacenti nei pressi di Tokyo. L'area è stata classificata sulla base dei maggiori elementi geomorfologici, quali terrazzi diluviali, terrazzi alluviali, piane vallive, levate naturali, paludi, antichi corsi fluviali, delta, accumuli sabbiosi ecc., utilizzando le fotografie aeree e rilevamenti sul terreno. Anche il fondo dei laghi è stato classificato sulla base dei maggiori elementi geomorfologici, quali piattaforme littorali, valli sublacustri, piane sublacustri, utilizzando le isobate fornite dal *Geographical Survey Institute* (Ministero dei Lavori) e le misure eseguite con uno specifico apparecchio misuratore.

Questi laghi sono connessi con l'Oceano Pacifico per mezzo della valle del fiume Tone. Per altro la geomorfologia della zona è influenzata dai movimenti eustatici del mare.

Si osservano due terrazzi lacustri a 4-8 m e 1,8-3 m s.l.m. Il più antico si è formato durante il massimo della trasgressione olocenica fra 6.000 e 4.000 anni fa. Si osservano poi due piattaforme littorali fra $-1,0$ e 1,5 m e fra $-2,0$ e $-3,5$ m.

Il mare si attestò approssimativamente intorno a -3 m rispetto ad oggi fra i 2.100 e i 2.000 anni fa.

La carta può essere usata per una pianificazione integrata dell'uso delle acque e per il controllo delle inondazioni. Inoltre la carta può servire per una stima della liquefazione del suolo causata dai terremoti e per lo studio geomorfologico dell'area.

TERMINI CHIAVE: Classificazione geomorfologica del territorio, Variazione del livello marino, Piattaforme littorali, Terrazzi lacustri, Laghi Kasumigaura e Kitaura (Giappone).

LAND CLASSIFICATION AND GEOMORPHOLOGIC MAPPING

The foundation for planning any measures for land reclamation or improvement is a through knowledge of the land itself. Information is needed of the physical make-up of the land, its use under existing conditions and its potential use after the establishment of improvement works.

A convenient and readily usable manner of showing basic land data is to make land classification maps. Different types of classification maps can be prepared to highlight the information needed for planning improvement project. The land may be so classified to show the types of flooding that may be anticipated from rivers or storm surges, or to show suitability for specialised crops of general agriculture, possible improvement by irrigation or drainage and urban or industrial development. Under most conditions land classification data are more useful if separate maps can be prepared for each purpose.

Land classification is derived from basic data provided by research in the fields of geomorphology, soil science,

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Let us say our thanks to Prof. Y. Park who kindly looked in English and to Miss S. Kubo who kindly cartographed the maps in this paper.

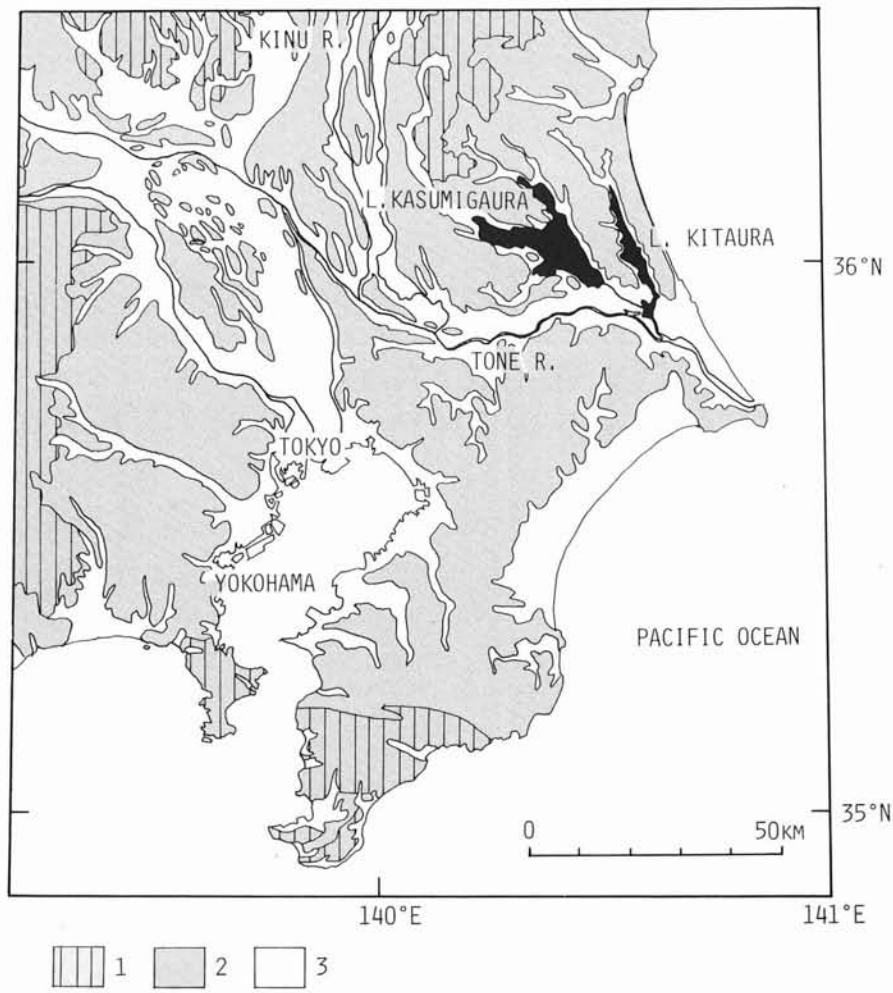

FIG. 1 - Study Area: 1, Mountain, 2 Hill and Upland, 3 Lowland.

hydrology and ecology. Geomorphology is the subject of physical geography which deals with the forms of the earth, the general configuration of its surface, the distribution of land water, and the changes that take place in the evolution of landforms.

A well conceived development plan should be based on a detailed knowlegde of land conditions; a substantial part of such knowledge may be obtained from geomorphologic studies of land followed by preparation of geomorphologic maps.

If the development plan is suitable for the natural development process of topography, geomorphological hazards will not occur, but if it is not, such hazards will happen in the future.

A BRIEF DESCRIPTION OF THE STUDY AREA

The Kasumigaura and Kitaura Lakes are located in the eastern part of the Kanto Plain, eastward of Tokyo (fig. 1). The Kasumigaura Lae, the second largest lake in Japan, is 171 km², and the Kitaura Lake 34 km².

Even the deepest part of the lakes is quite shallow, only 7 m, and their average depth is 4 m. Many small rivers, e.g. the Sakura River, flow into both lakes. The total drainage basin of these rivers is 2,200 km², more than 10 times of the lakes. These lakes are connected with the Pacific Ocean through the Tone River. The water of the lakes was blackish before the construction of a dam in the lower reach of the Tone River.

METHOD FOR PREPARATION OF THIS MAP

The area consist of lands and lakes. The target area is first classified by its major geomorphological elements, such as terraces, valley plains, natural levees, back-swamps, former river courses, deltas, sand banks, sand spits, sand dunes, wave cut benches etc. Aerial photographs are used for this purpose. The map so prepared is put into final form by checking the results of field surveys of the area.

In preparing the sublacustrine map of the lake, the bottom of the lake is first classified by major geomorphological elements, such as littoral shelves, sublacustrine valleys, sublacustrine plains etc., utilizing the iso-depth line which was made by the Geographical Survey Institute Ministry of Construction and the Kasumigaura Field Office, Kanto Regional Construction Bureau, Ministry of Construc-

tion. Secondly, the depth of the lake at some important points was measured with a Fathometer machine. Based on the data from of the above research, this lacustrine geomorphological land classification map was prepared.

FEATURES OF THE AREA JUDGING FROM THE GEOMORPHOLOGIC LAND CLASSIFICATION MAP

a) *Diluvial Terrace*

The area consists of diluvial terraces and alluvial plains (fig. 2). Diluvial terraces are separated into several terraces horizontally by the Kasumigaura Lake, Kitaura Lake and the Tone River. The ground height becomes higher as it nears the Pacific Ocean because of the tectonic ground movement.

The diluvial terraces are divided into two groups vertically, i.e. upper and lower terraces. The former was formed about 120,000-130,000 years B.P. (Last Interglacial Age) and the latter, 10,000-30,000 years B.P. (Last Glacial Age).

These terraces are surrounded by cliffs and dissected by small stream.

b) *Alluvial Terrace*

Alluvial terraces which were formed in Holocene (from 10,000 years B.P. to present) are developed at the foot of the diluvial terraces. These terraces are divided into two groups, i.e. upper alluvial terrace of Lacustrine Terrace I and lower alluvial terrace or Lacustrine Terrace II.

Lacustrine Terrace I is about 4-8 m high and Lacustrine Terrace II, about 1.8-3 m. The former was formed in the maximum of Holocene Transgression («Jomon» Transgression) Age, i.e. between 6,000-4,000 years B.P. and there are sand-spits, ancient tombs, shell mounds and the «Jori» Grid Pattern Systems on it.

c) *Alluvial Plain*

Lacustrine lowlands are developed along the Kasumigaura Lake and other small lakes. Reclaimed lands are developed well between the southern part of the Kasumigaura Lake, the Kitaura Lake nad the Tone River.

The alluvial plain along the Tone River consists of valley

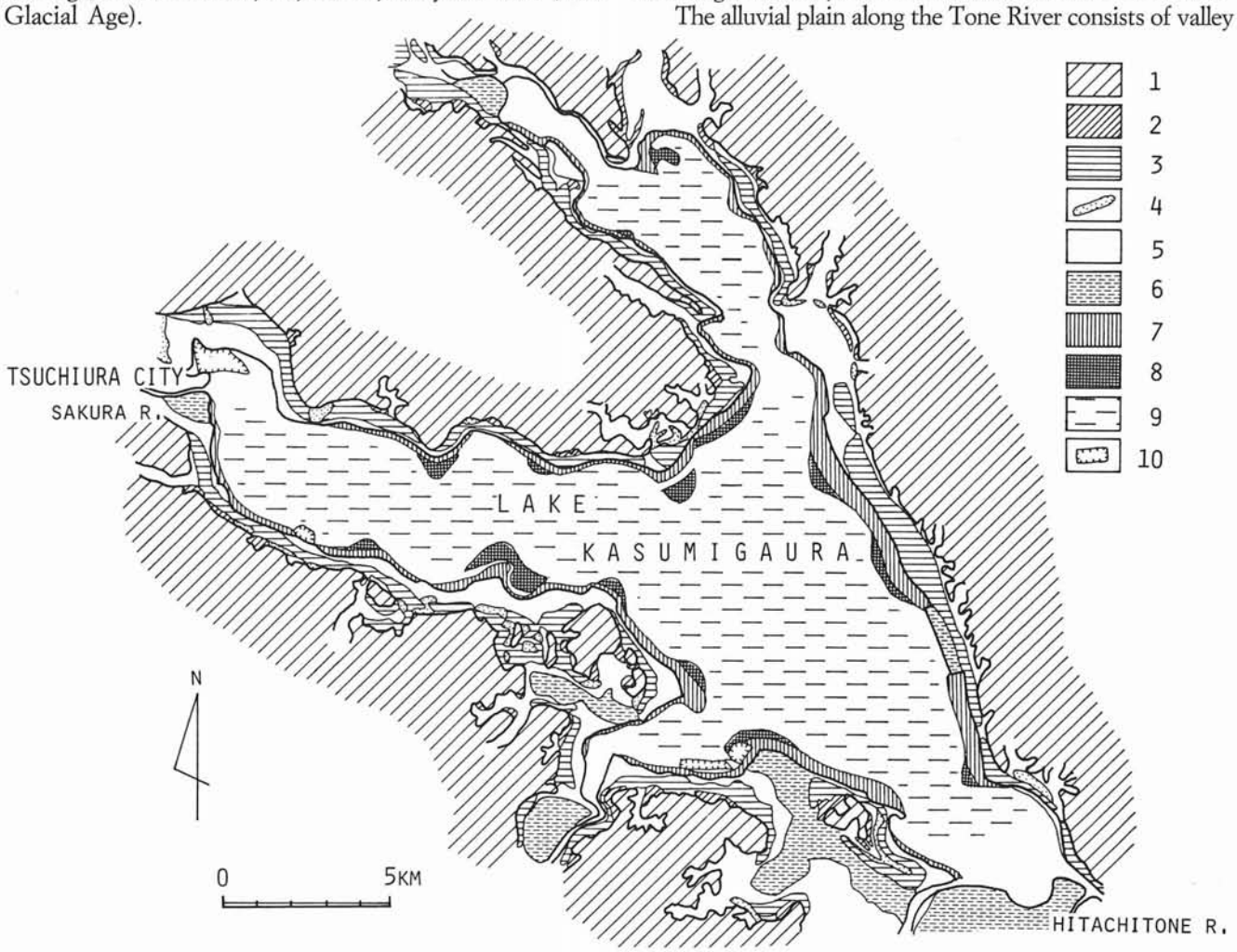

FIG. 2 - Geomorphologic Land Classification Map of the Lake Kasumigaura. 1 Diluvial terrace - 2 Lacustrine terrace I - 3 Lacustrine terrace II - 4 Elevated sand bank or sand spit - 5 Alluvial lowland - 6 Reclaimed land - 7 Littoral shelf I - 8 Littoral shelf II - 9 Sublacustrine plain - 10 Artificial trench.

plains, sand-spits or sand banks, natural levees, back-swamps, deltas, abandoned river cources, reclaimed land etc.

The sand spits or sand banks are developed at the foot of the terraces. These sand-spits or sand banks are devided into several groups: Sand-spits I, II, III and Sand Banks I, II, III. Some Sand-spits I have ancient tombs on it. Sand-spits I and Sand Bank I were formed during the maximum of the Holocene Transgression Age.

The natural levees in the area small. Back swamps or deltas occupy spaces between the terraces and natural levees, sand banks and rivers.

TOPOGRAPHY OF THE BOTTOM OF THE LAKE

Littoral shelves are developed well along the lake side. The width of the shelf is generally 200-500 m. The shelf is divided into two groups, Littoral Shelf I (-1.0 to -1.5 m) and II (-2.0 to -3.5 m). Small cliffs or steep slopes are seen between the two shelves.

Big sublacustrine plains are developed well in the Kasumigaura Lake and the Kitaura Lake. There are steep slopes between the sublacustrine plains and littoral shelves.

Sublacustrine valleys are seen in several places. These valleys are estimated to have been formed by the erosion due o the littral currents.

THE GEOMORPHOLOGIC DEVELOPMENT AROUND THE KASUMIGAURA LAKE, KITAURA LAKE AND THEIR VICINITY

The Kasumigaura Lake and Kitaura Lake are connected with the Pacific Ocean through the Tone River Valley Therefore, the geomorphology of the Kasumigaura Lake, Kitaura Lake and their vicinity is influenced by eustatic movements.

Generally speaking, as compared to the present period, the sea water level was lower, approximately 100 to 140 m, about 18,000 years B.P. in the Würm Ice Age. The sea water level was higher, approximately 4 to 6 m, about 6,000 to 4,000 years B.P. The transgression is called as the «Jomon Transgression» in Japan. About 2,100 to 2,000 years B.P., the sea water level was lower, approximately -3 m. In the Late Heian Period (10-12th century), the sea water level was slightly higher, in the early Edo Period (17-18 century) the sea water level was slightly lower and reached the present level.

In the Würm Ice Age, the Kinu River dissected a large valley under the Kasumigaura Lake the lower reaches of the Tone River. During the Jomon Transgression Age, the Kasumigaura Lake, Kitaura Lake and other lakes and lower reaches of the Tone River were covered by sea water and formed a big inland sea named «Katori Sea». Many people lived along the «Katori Sea» and formed many shell mounds.

Subsequently the «Katori Sea» has gradually changed to land, because of the lowering of the sea water level, the deposition of sand or clay by littoral or fluvial actions, and man made works.

The sand-spits or sand banks which were formed at the foot of the terraces and lacustrine terraces emerged first. People moved from the diluvial terrace to the lacustrine terrace and sand spits or sand banks. The other part of the plain however has remained marshy lands.

In modern times, the marshy lands were reclaimed rapidly. After the Meiji Restoration (1868) the lower reaches of the Tone River have been changed remarkablely by major improvement works for the river.

UTILIZATION OF THIS MAP

The integrated development plan of the lake consists of water use and flood control. In this case, the lake water level will be raised up or lowered a little. Then the distribution of the lacustrine terraces and shelves is important because of the area of inundation or emerged. The area and the distribution of these two topographical elements can be seen on this map.

By utilizing the geomorphologic land classification map, the features of the inundation in the plain along the Kasumigaura Lake, Kitaura Lake and the lower reaches of the Tone River can be predicted.

Flooding of the Kasumigaura Lake occurs under two circumstances: 1) the lake is connected with the Tone River through the Hitachi-tone River, but the capacity of the Hitachi-tone River to hold water is poor. Thus, when the area of the Sakura River has a heavy rainfall, it pours into the Kasumigaura Lake, and its level will go up. 2) when the level of the Tone River is raised by flooding, the water will intrude into the Kasumigaura Lake through the Hitachi-tone River.

The flooding of the former type occurred in 1938, and the latter type in 1941. In the former, the water level reached 3.34 m above sea level. And serious flood damages were done along the lakeside lowland i.e. lower alluvial terraces, lacustrine lowlands etc.

Furthermore, the map can be used for estimation of the side of soil liquefaction caused by earthquakes and for study of the geomorphological development of the area.

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