96. *Ossiferous Fissure Deposits of Kuzuü, Totigi Prefecture.*

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(Comm. by H. YABE, M.I.A., Nov. 12, 1937.)

The Palaeozoic limestone in the vicinity of the town Kuzuü, Totigi prefecture, on the southern border of the Simotuke mountainland, has many fissures and caverns, and their spelean deposits are varied in nature, some are worthy of special attention on account of their being ossiferous.

The fissures are almost always vertically elongated and open upwards as their exposures show at several quarries. The spelean deposits, which as a whole, constitute the Kuzuü formation of the writer, are divisible into 3 parts, lower, middle and upper. These divisions are not related with the absolute heights of their positions, viz., the middle Kuzuü of one fissure occupies apparently a higher position than the upper Kuzuü of another fissure. Further, the actual stratigraphical contact between the lower and middle Kuzuü was nowhere observed. The middle Kuzuü is built of fluviatile sediments in origin and in this respect, it is similar to the middle sandy layer of Chou-Kou-Tien Loc. 1 (*Sinanthropus* formation), near Peking, China. Most extended in distribution is a residual clay, homogenous and compact in texture; this forms the basal part of the upper Kuzuü on one side and rests unconformably on the middle Kuzuü on the other. The residual clay yields locally different kinds of fossils. The upper Kuzuü, from this residual clay upwards to the very top, seems to represent an open phase of fissures.

The Kuzuü formation is unconformably overlain by superficial deposits of subaerial origin, the Tatikawa beds, a formation which is usually thought to be upper Pleistocene in age. The two formations show the following succession:

Tatikawa beds		Loam	
		Kanumazuti (pumice)	
		Breccia	
Kuzuü formation	Upper	Reddish brown clay (pars. gravel)	<i>Moschus</i> bed
		Gravelly clay	<i>Microtus-Meles</i> bed
		Residual clay (Cave travertine in pars.)	<i>Palaeoloxodon</i> bed (<i>Geoclemys</i> bed) (<i>Amphibia</i> bed)
	Middle	Gravel	
		Sand and clay, in altern.	
		Yellowish brown clay and gravel	
	Lower	Gravelly clay	<i>Stegodon</i> bed
		Cave-travertine	<i>Sus</i> bed

The writer's observation on these ossiferous deposits in the Kuzuü formation is briefly summarized below; details are given in his reports written in Japanese and entitled "On the Kuzuü Formation,"¹⁾ and "Geological Study of the Kuzuü Formation (Fissure Deposits)."²⁾

1. Ôgano Quarries, at the immediate north of the town Kuzuü.

At Ôgano there are four quarries of the Yosizawa Lime Works, on the western side of a limestone hill, which is about 200 m high above the level of the adjacent part of the Kwantô plain. At the time of the writer's visit, six fissures—some rather cavern than fissure—were exposed; these are perhaps formed along small faults or joints.

Here the lower Kuzuü comprises the cave travertine of unknown thickness and the overlying calcareous clay with angular rock fragments, a few meters thick. Numerous remains of *Sus* have been dug out during the past two or three years from the travertine at the base of fissure No. 3 of the quarry No. 3, without association of other fossils. *Sus* bones are rather brittle in their preservation. The deposit is distinguished as the *Sus* bed.

Several *Stegodon* remains were recovered from the breccia-clay overlying the cave travertine in fissure No. 6; the clay contains here numerous chert pebbles, some of which are probably wind-worn. This is now called the *Stegodon* bed. The remains of *Stegodon* belong to *Stegodon orientalis* Owen; some remains of *Cervus* were also found.

The two deposits seem to bear some resemblance to the fissure deposits of Ville du Lang-son, Indo-China in the nature of preservation and kind of fossil content. In the latter, *Sus* and *Stegodon* are important fossils; its geological age is either upper Pliocene or lower Pleistocene, according to Mansuy.

The Middle Kuzuü is not fossiliferous.

The upper Kuzuü of Ôgano is represented by a dark reddish sticky residual clay, more than 10 m thick; this occupies the greater part of fissures Nos. 1, 3, 4, and 5. Where it is interbedded with sandy or pebbly layers, it resembles the *Microtus-Meles* bed, which is typically developed in the Miyata quarry. The residual clay is called the *Palaeoloxodon* bed on its characteristic fossil, *Palaeoloxodon*; besides, *Rhinoceros* remains were found.

2. Izuruhara Quarries, south of the town Kuzuü.

The southern side of the limestone hill of Izuruhara, about 100 m in relative height, is quarried by the Okada Lime Works. A fissure of rather large size exposed at the eastern part still holds a good amount of sediments in many hollows of the wall and in accessory fissures; here the lower Kuzuü does not occur. The middle Kuzuü, well preserved in the hollow No. 8 consists successively of gravels ($1\pm$ m thick), yellowish sandy clay or clay with gravels ($1\pm$ m thick) and white sandy gravels of unknown thickness. The upper Kuzuü to which the greater part of the sediments in the main fissure belongs, is divisible into the following beds in ascending order:

1) Journ. Geol. Soc. Tokyo, XL, 700-722, 11 text-figs., 1933.

2) Contr. Inst. Geol. and Pal., Tôhoku Imp. Univ., Jap. Lang., XXVII, 1-34, 11 text-figs., 18 pls., 1937.

a. Residual clay (thickness unknown): a dark reddish brown clay, without any recognizable content of gravels is highly fossiliferous at hollow No. 3, the fossils comprise small bones of frogs, snakes, moles, rodents, birds, etc. In this Amphibia bed, skeletal parts of individual animals, though dismembered are usually found still retaining their original relative position.

b. Clay with gravels (several meters thick). A brownish earth composed of loamy substance and sand, contains also a great many of angular gravels of chert and quartzite and less of rounded ones or chert, gravels usually $3\pm$ cm in diameter. This clay at the bottom of hollow No. 3 yields many mammalian bones and is especially rich in Carnivora remains (Carnivora bed). A complete skeleton of *Nyctereutes* was once obtained, this is a rare case as usually skeletal parts are dismembered and scattered orderless, though lacking marks of wearing or gnawing. Furthermore, a cast of *Juglans* nut was once found in it. The same clay also occurs in hollow No. 7.

c. Reddish brown clay (several meters thick). At the bottom of hollow No. 2 there is a clay somewhat different in nature from the preceeding one, being yellowish brown, sticky and having sandy bands; it is perhaps fluviatile in origin. The clay bed inclines northwards and abounds in frog- or terrapin remains (*Geoclemys* bed). There is no means to decide the relative age of the *Geoclemys* bed and the Amphibia bed; they are possibly almost contemporaneous.

3. *Moschus* bed and *Microtus-Meles* bed. The upper Kuzuü shows the following succession in the fissure γ of the quarry A at Kadosawa, in descending order:

Dark brown clay (several meters thick)

Dark brown ossiferous clay (*Moschus* bed) (1 meter thick)

Sand with gravels (2 meters thick)

Clay with gravels (several meters thick)

The lowest deposit closely resembles the Carnivora bed of Izuruhara on one side and the *Microtus-Meles* bed of Ôkubo on the other; 2 meters above it lies the *Moschus* bed, a dark brown clay 1 m thick, from which two imperfect skeletons of panther were dug from the middle of the hollow; besides it contains many cervid remains.

The type locality of the *Microtus-Meles* bed is Miyata quarry of Ôkubo: it is a clay with gravels and contains a great many animal remains, which constitute the richest and most varied one of the faunas of the Kuzuü formation. Also it has the most extended distribution in the Kuzuü fissures. The most common element of the fauna is *Microtus montebelli*, (Milne-Edwards), followed by *Cervus* (*Depéretia*) *praeniponicus* Shikama, *Meles anakuma* Tem., *Apodemus speciosus* Tem., *Mogera wogura* (Tem.), and several others.

The gravelly deposit of the upper Kuzuü is characterized by the following features; 1) feeble trace, if any, of stratification, 2) the nature of the matrix like a brown sandy loam, occasionally with sand streaks, but interbedding neither sand and gravel layers nor travertine, 3) distribution of gravels being angular to subangular chert and quartzite, and more rounded chert, besides limestone- and dripstone fragments,

4) relatively small sizes of these exotic gravels, most dominant being those of 1.5-3 cm in diameter, and finally 5) the aggregate occurrence of the majority of animal remains near the base of the deposit, without the association of coprolites. This characteristic sediment seems to the writer to be either one of sudden deposition as mud avalanch or a kind of slope wash suddenly poured into caverns by heavy rain, or an accumulation by slow process of weathering in so far as it concerns its upper part; in this connection the explanation given by Falconer, Ramsay or Geikie on the similar deposits of the Genista Cave of Gibraltar or by Teilhard de Chardin and Young on that of the Chou-Kou-Tien Loc. 1, may be consulted.