

SEDIMENTARY FACIES OF THE MIOCENE IN THE SAMBURU HILLS, NORTHERN KENYA

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INTRODUCTION

Constituting of volcanic, volcanoclastic and clastic sedimentary rocks, the Tertiary in the Samburu Hills west of Baragoi, northern Kenya, is divided into the Nachola, Aka Aiteputh, Namurungule, Nanyangaten, Kongia, Nagubarat and Tir Tir Formation, in ascending order (Sawada *et al.*, 1987 ; Makinouchi *et al.*, 1984). By the 1982 and 1984 Japan — Kenya Expedition, a number of Miocene hominoid and mammal fossils was collected from the sediments of the Nachola, Aka Aiteputh and Namurungule Formations. It is important to make clear the environmental background at the depositional stage of their formation. The paleoenvironment has been investigated geologically and paleontologically. Very little, however, has been stated about the sedimentary environment. Baker (1963) briefly described it only the lacustrine sediments.

Taking part in a fieldwork of the 1984 expedition, the author observed and described the sedimentary facies of the three formations at some localities. This paper shows the sedimentary columns of these formations, and briefly presents the tentative interpretation of depositional environment.

NACHOLA FORMATION

The Nachola Formation, unconformably covering the Precambrian basement complex, is the lowest formation of the Miocene in the Samburu Hills. It consists of clastic sediments, pyroclastic sediments and lava flows of volcanic rocks. The clastic sediments composed the lower part of the formation. Although they interbed with the thick lava flows of basalt and trachybasalt in the south, the intercalations of lava flow thin northward (Sawada *et al.*, 1987 — Fig. 6). Along the westside of the Nanyangaten River, the intercalation is not observed.

Three columnar sections (Fig. 3-Locs. 1, 2 & B5) present the sedimentary facies and succession of the Nachola Formation (Fig. 2). Loc. B5 is located in the southern part (Sawada *et al.*, 1987 — Fig. 6), and Locs. 1 and 2 are west of Nachola (Fig. 1). Sediments are mainly composed of thick-bedded, ill-sorted and massive sand. They are thicker-bedded and coarser in the south than them in the north. Although cross lamination and crude grading are observed in a few sand beds at Locs. 1 and 2, the massive texture is the characteristic of most of sand beds. Illsorted sands contain frequently granule-sized, rarely pebblesized, grains. At Loc. B5, thick-bedded and distinct

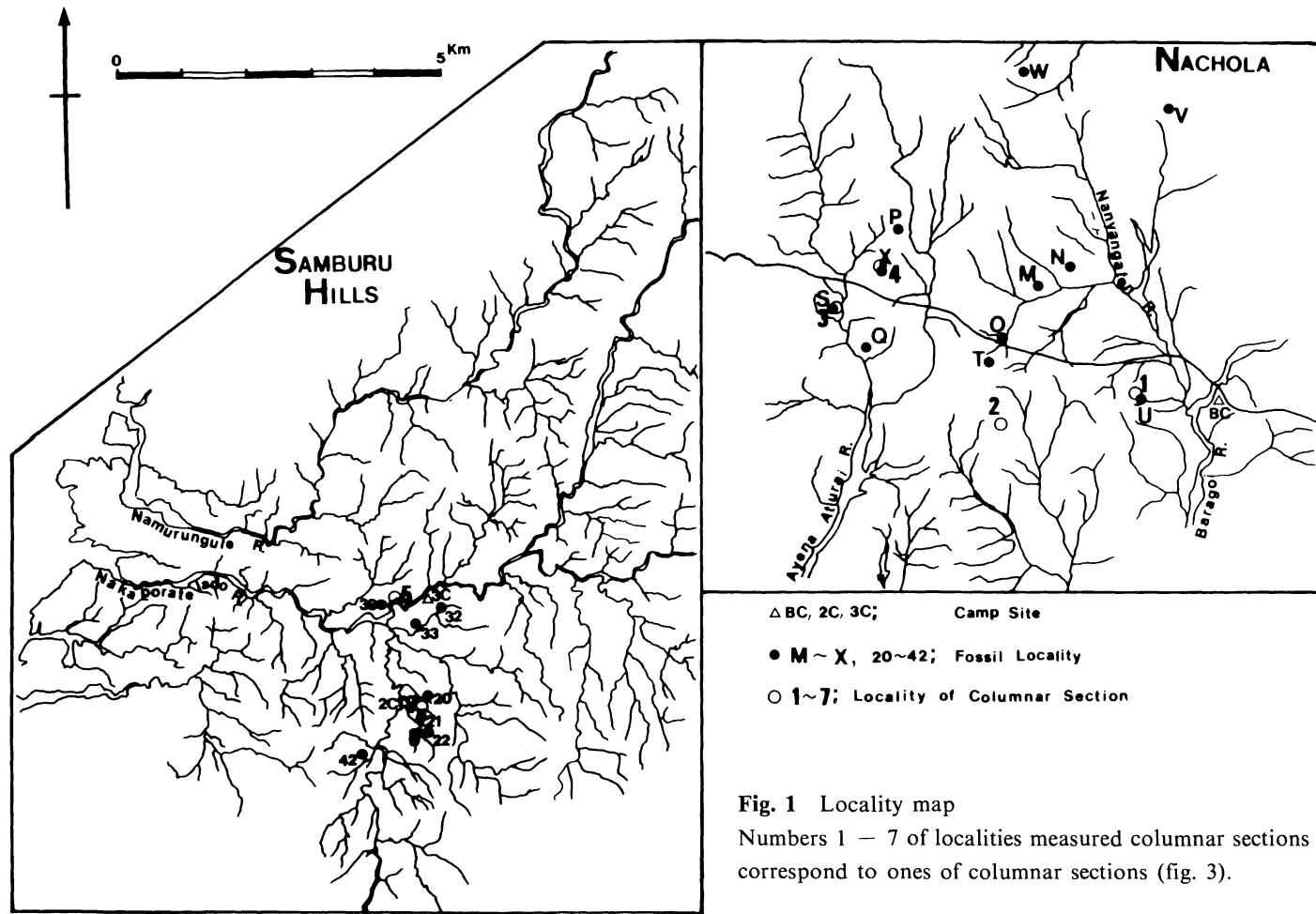


Fig. 1 Locality map
Numbers 1 — 7 of localities measured columnar sections correspond to ones of columnar sections (fig. 3).

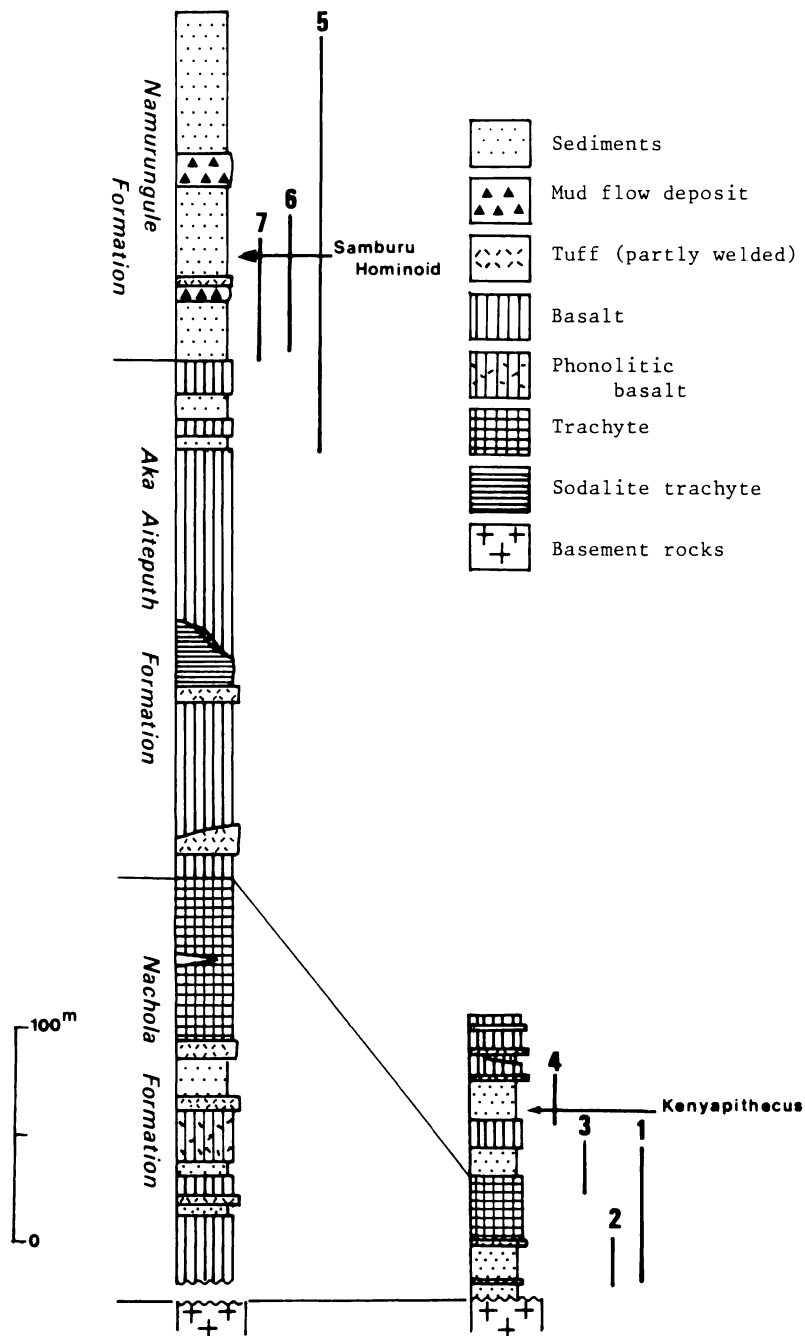


Fig. 2 Stratigraphy and horizons of columnar sections Lines numbered show the horizon of each section.

grading beds are observed. Massive silts bearing commonly pumice grains are intercalated with the sand beds.

Clastic material is supplied from the south. The sediments are considered to have been deposited mainly under the depositional environment of fluvial fan in the south and fluvial plain in the north. In the latter environment, the sands were deposited in sheet floods.

AKA AITEPUTH FORMATION

The Aka Aiteputh Formation mainly consists of lava flows of basalt. Sediments are intercalated with the lower part at the northern area (west of Nachola), and with the uppermost part at the western area (Samburu Hills) (Fig. 2).

Facies and columnar sections of the lower sequence are shown in Fig. 3—Locs. 1, 3 & 4. The sediments mainly consist of massive silt, but contain some intercalated sand and thin siliceous layers. The silts contain commonly pumice and granule-sized grains, and sometimes calcareous nodules. Cross lamination is rarely observed in the silt. The sands, containing commonly pumice grains, are generally massive, but rarely cross-laminated. The thin siliceous layers, mostly being greyey white chert, are intercalated with the silts. The lower sequence includes characteristically many fossils of silicified wood.

Lowermost part of columnar section (Fig. 3—Loc. 5) shows the uppermost part of the Aka Aiteputh Formation. Sediments overly conformably on thick sequence composed of lava flows of basalt (Fig. 2), and interbedded lava flows of basalt (Plate I-1). Sediments mainly consists of reddish brown pebble- to cobble- sized gravel, sand and granular silt containing basalt breccia with intercalated white chert, massive silt, and calcified lapilli tuff. The gravel and granular silt containing basalt breccia, called weathered basalt sediments by Makinouchi *et al.* (1984), stratify and show crude cross lamination (Plate I-3). The chert is interbedded with greyey white silt, and grades in lateral into siliceous or calcified silt. The lapilli tuff layers are stratified and calcified (Plate I-2). Thick cobble-sized gravel is observed in lower horizon than this section along the Asanyanait and Nakaporatelado Rivers (Makino-uchi *et al.*, 1984).

At the depositional stage of lower part of the Aka Aiteputh Formation, the sediments was accumulated around the coast of lake, appeared in the west to northwest of Nachola. After that, the products of volcanic eruption overly widely and thickly. At the depositional stage of uppermost part, the sedimentary basin along the present Rift Valley begin to depress largely and deeply. The sediments are considered to have been deposited in the fluvial environment. The volcanic activity continued intermittently, and threw the lavas on land. The lava flows were interbedded with the sediments. The chert is considered to have been deposited as evaporate in the depression part of flood plain.

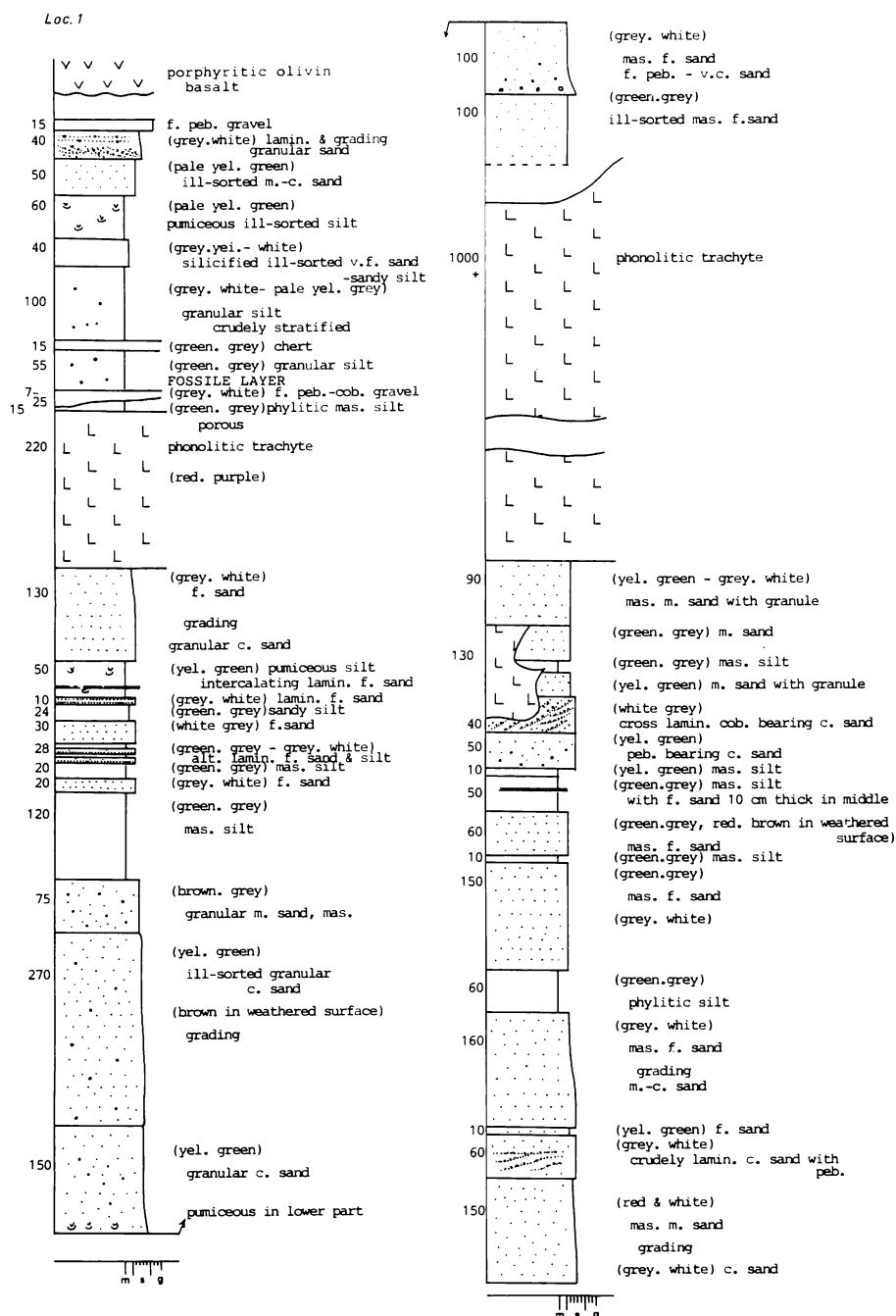
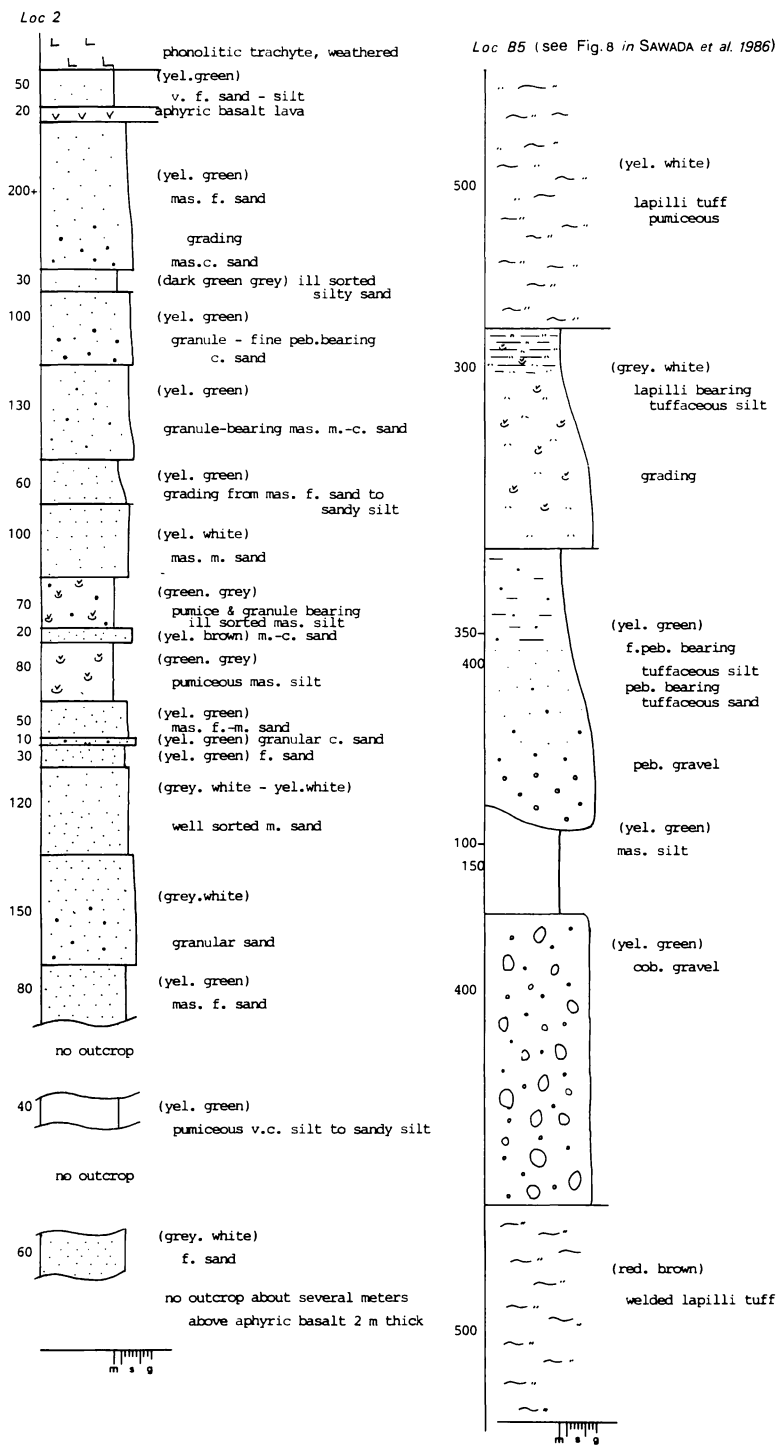
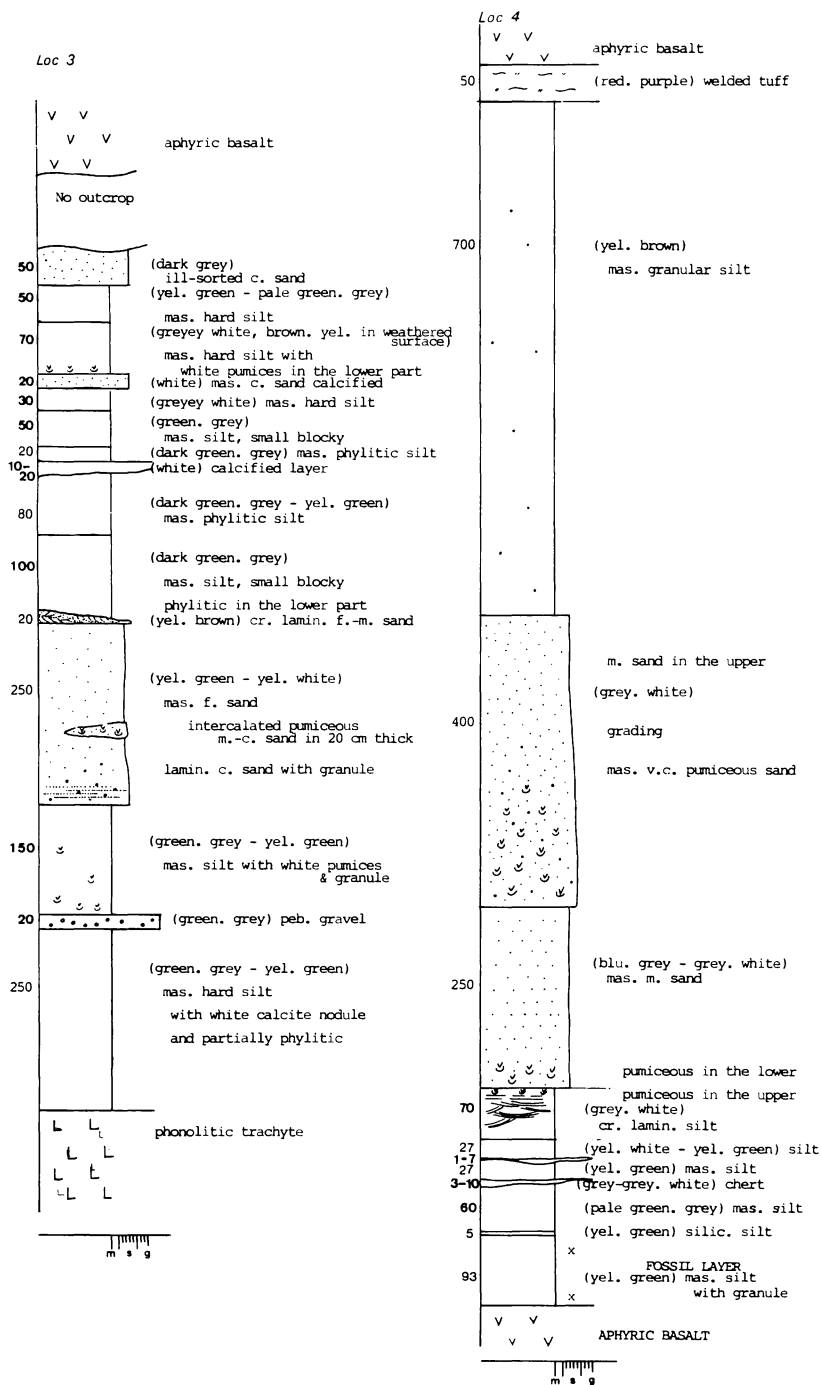


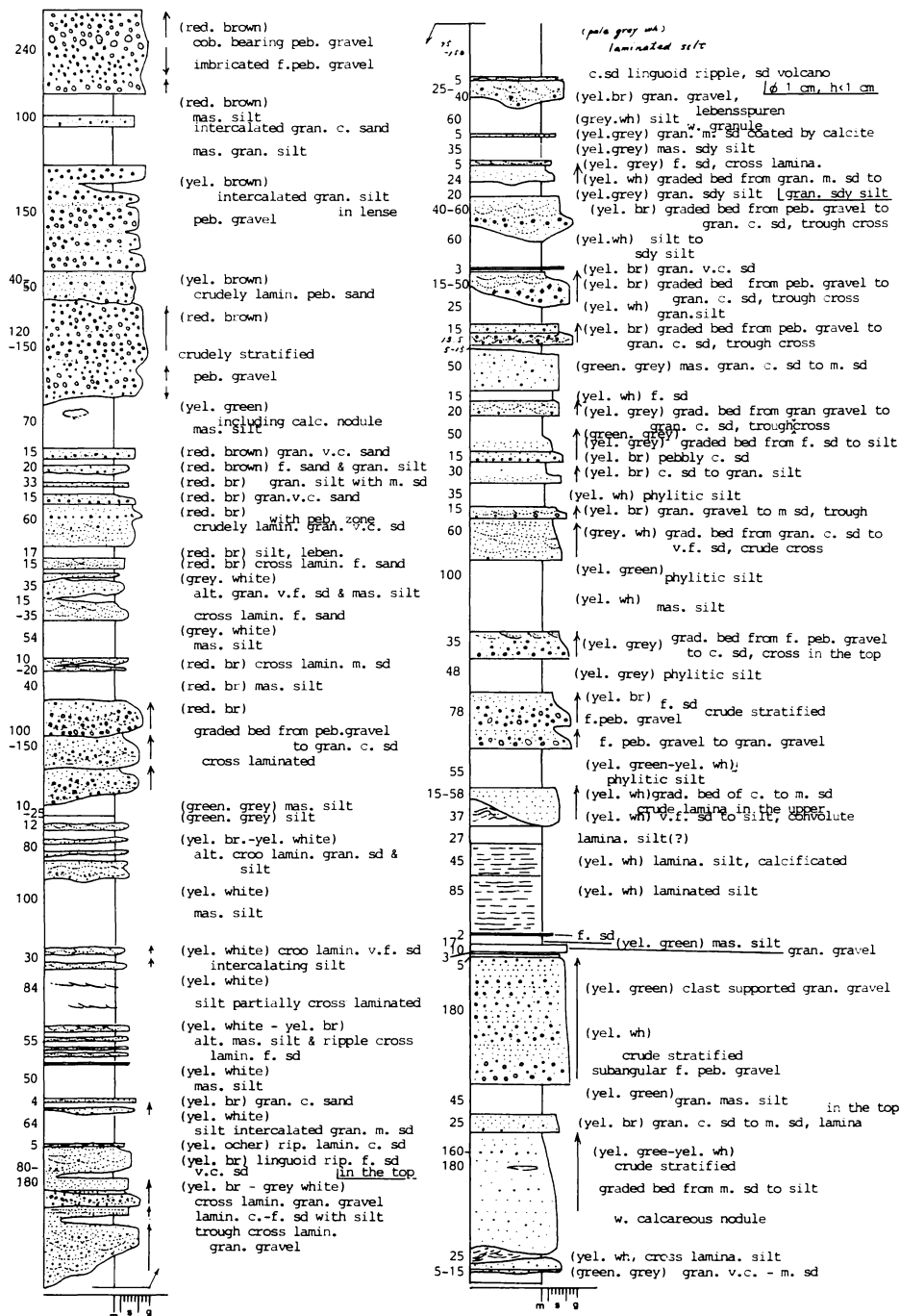
Fig. 3 Columnar sections and sedimentary facies of the Miocene in the Samburu Hills and Nachola area, northern Kenya (Locs. 1 - 7)

Section of Loc. 5 is shown throughout 5 pages.

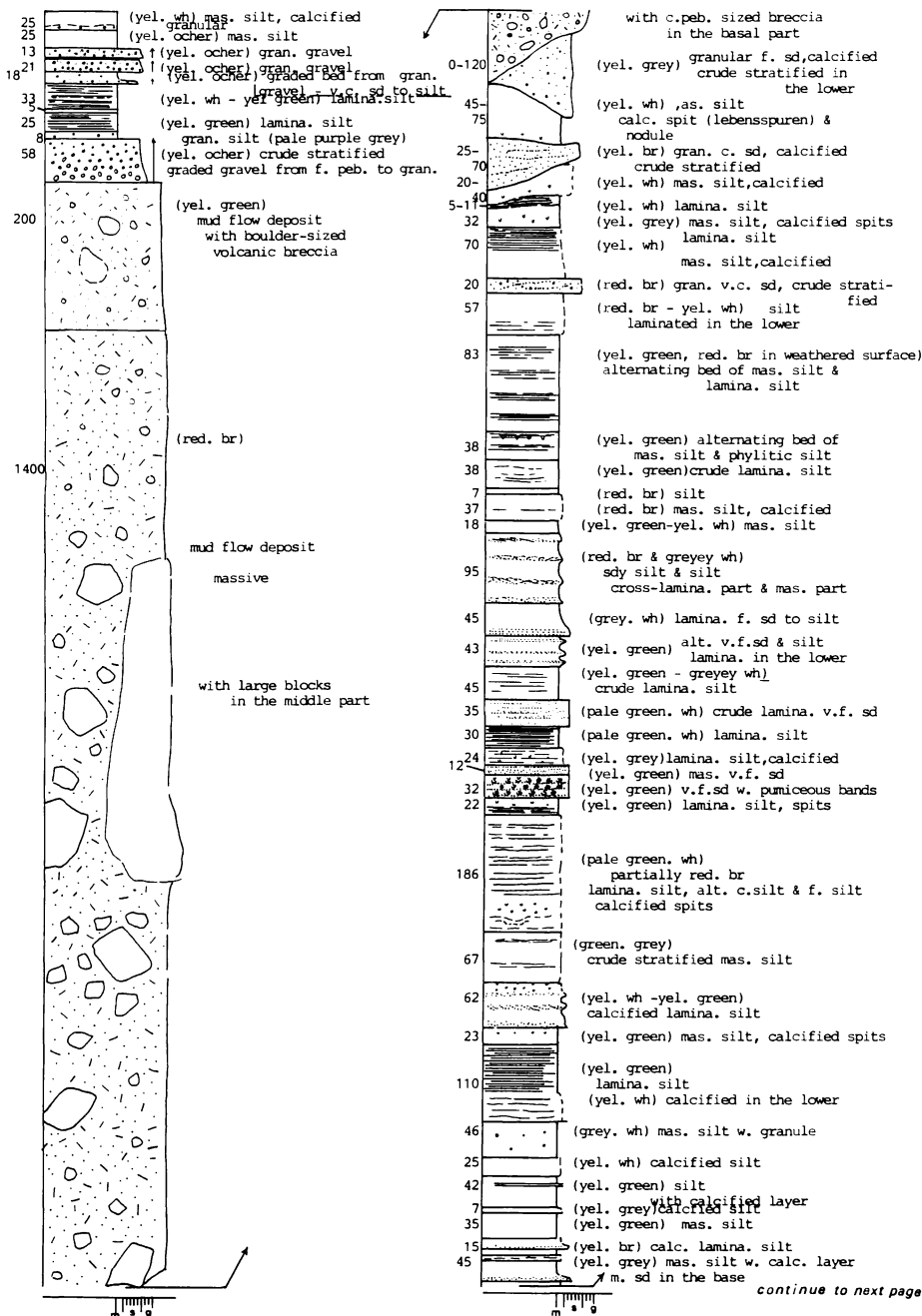




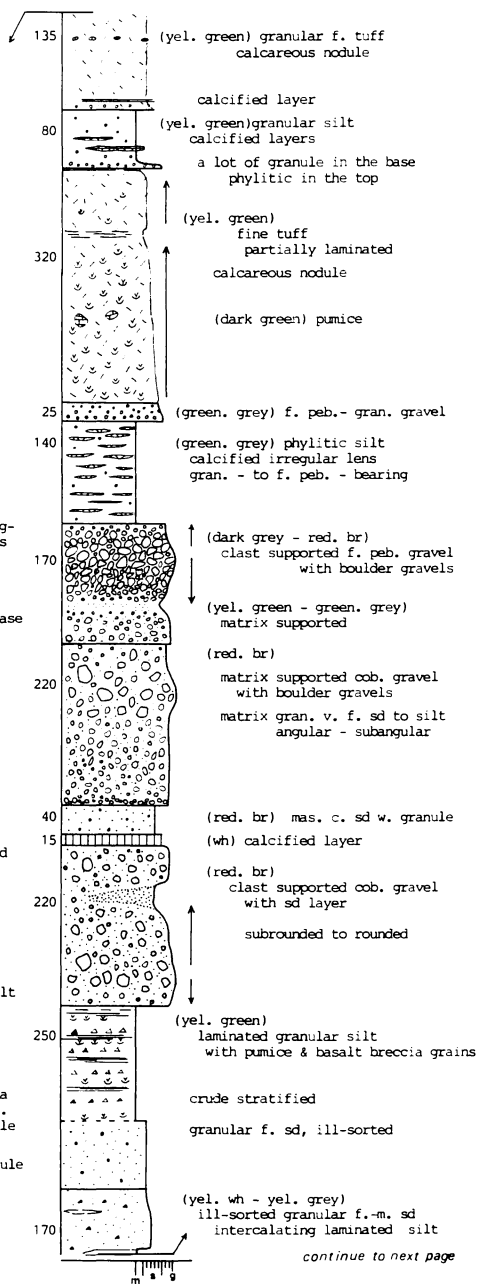
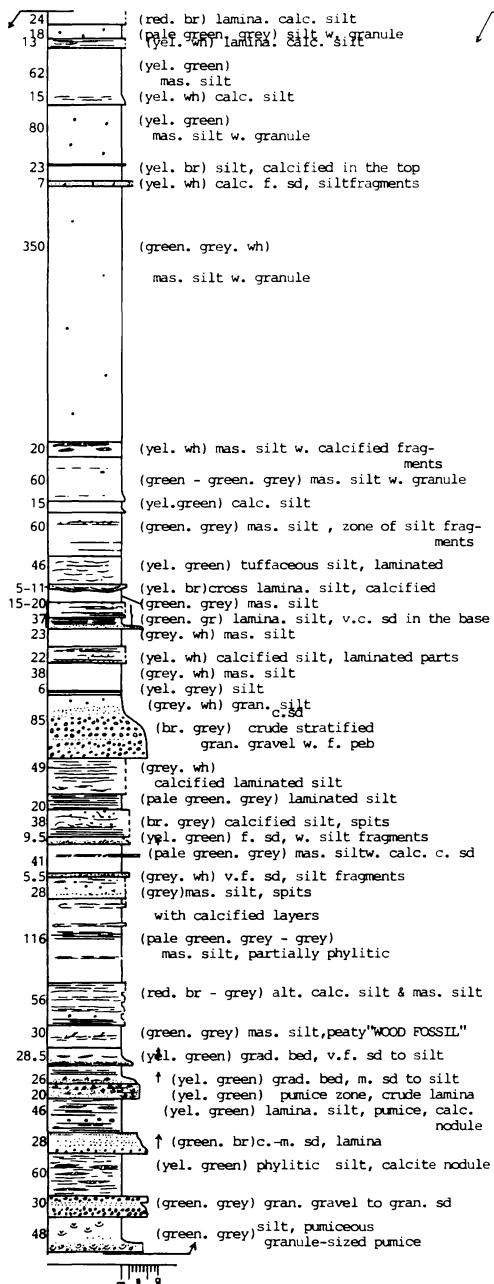
Loc 5-1



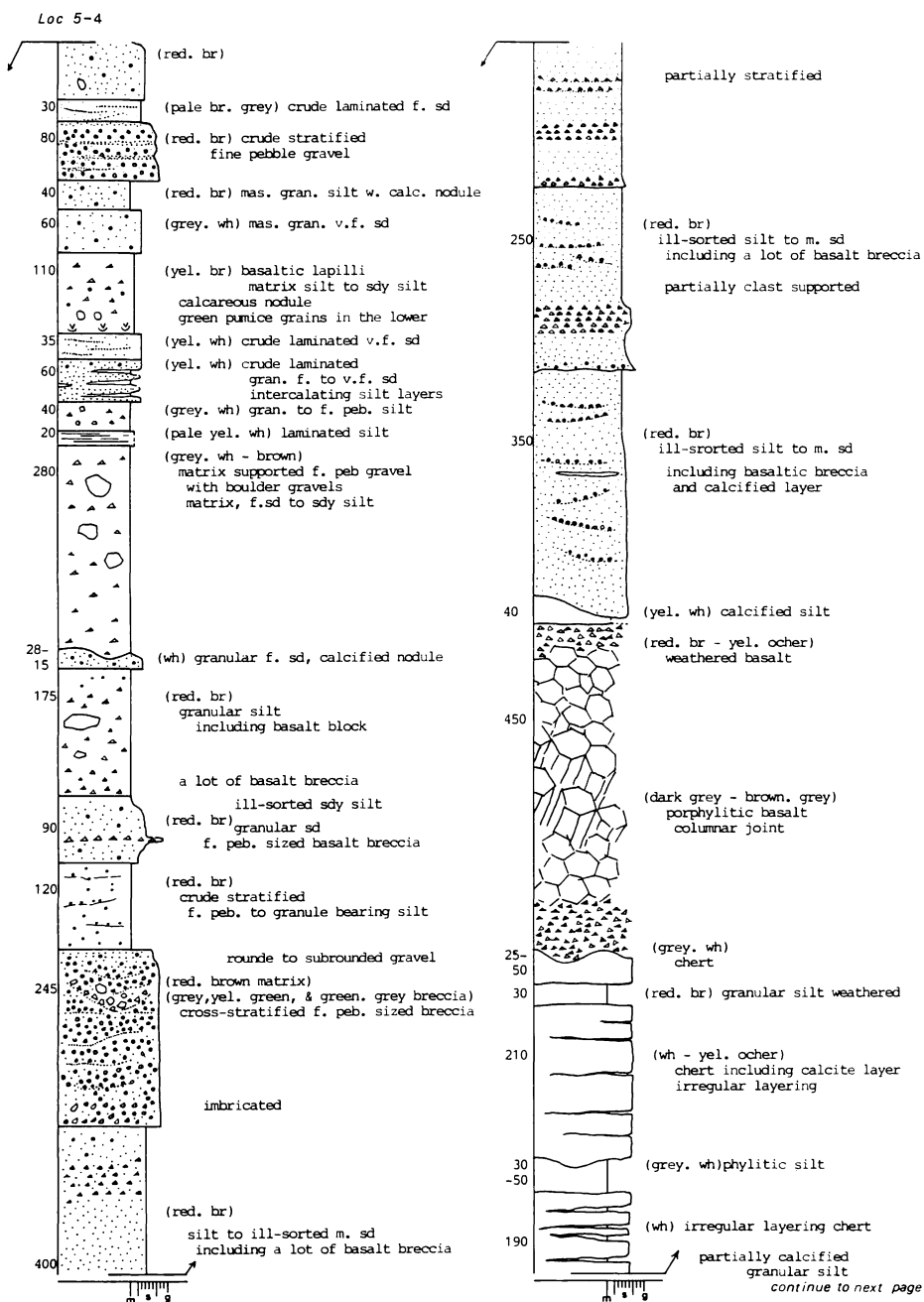
Loc 5-2 about 20m under the base of 5-1 section

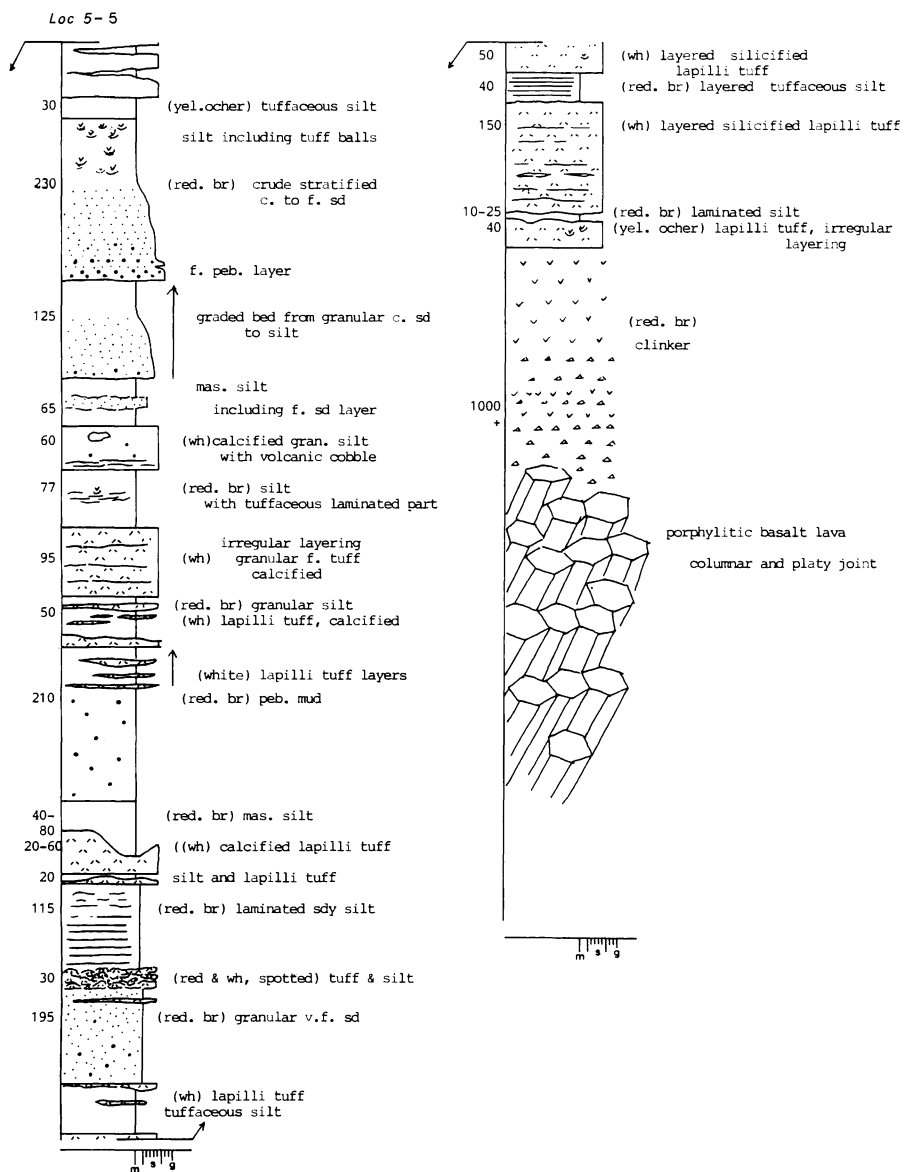


Loc 5-3

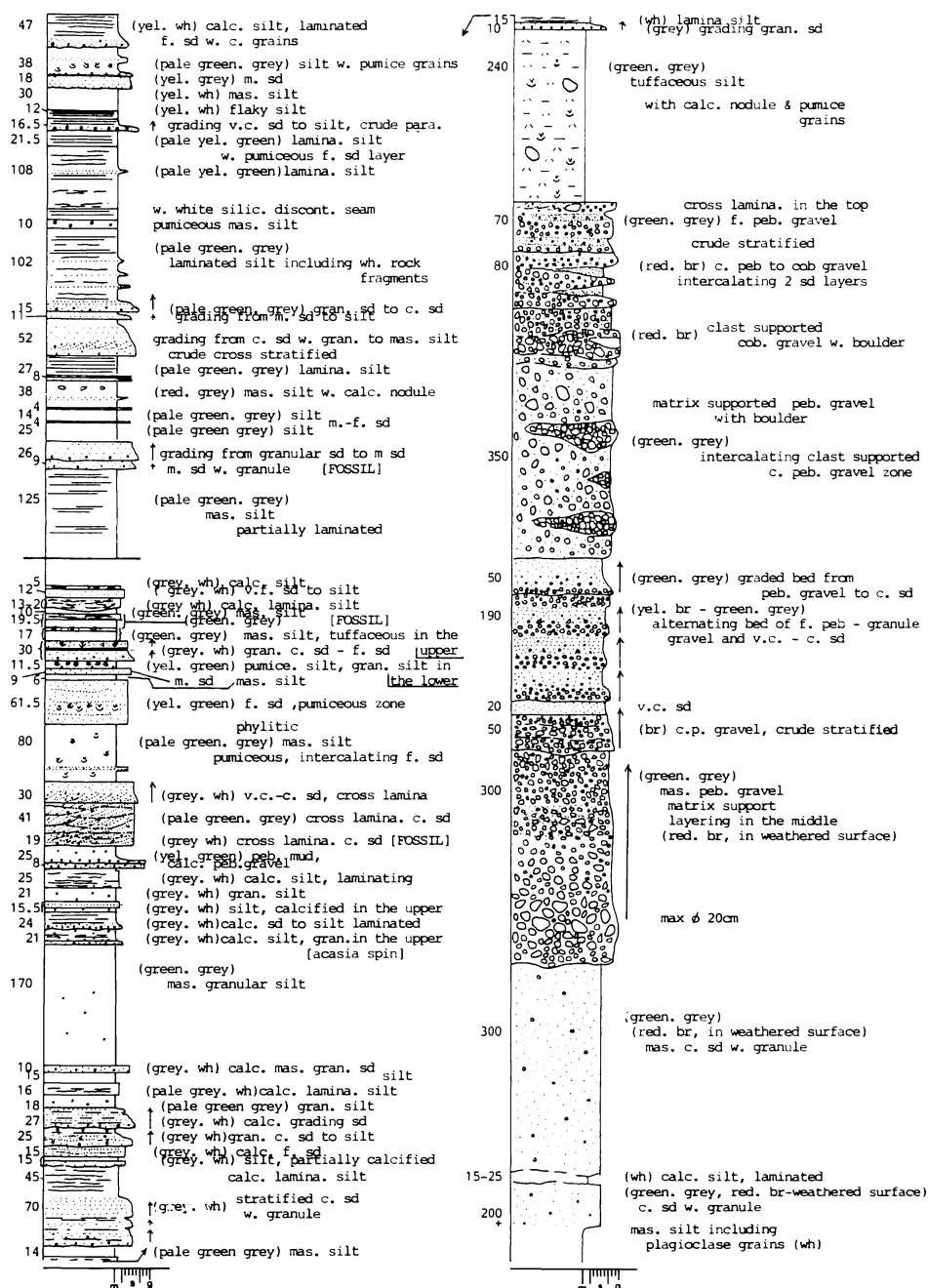


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Loc. 6 (Site SH22)



Loc 7

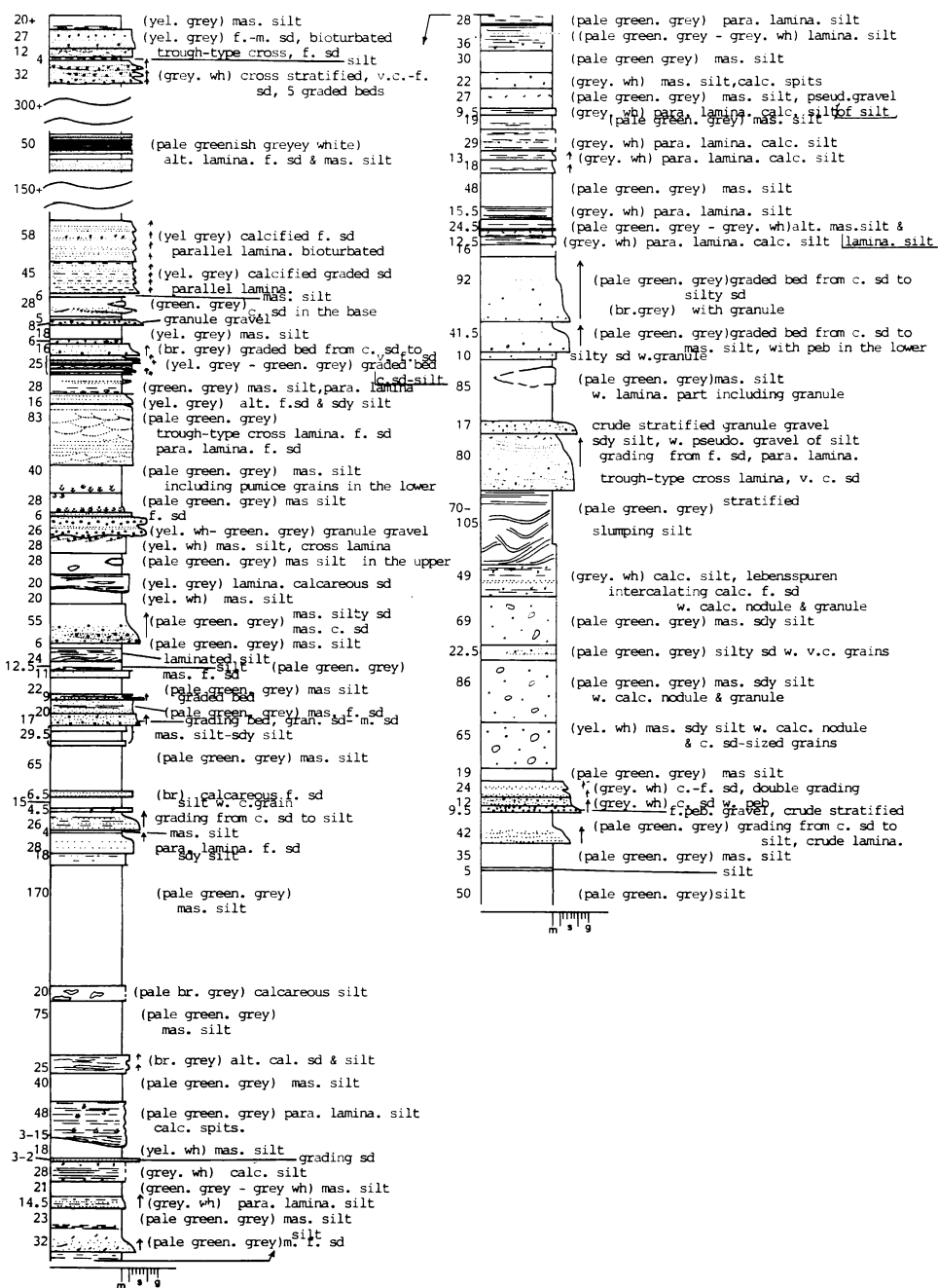


Plate I

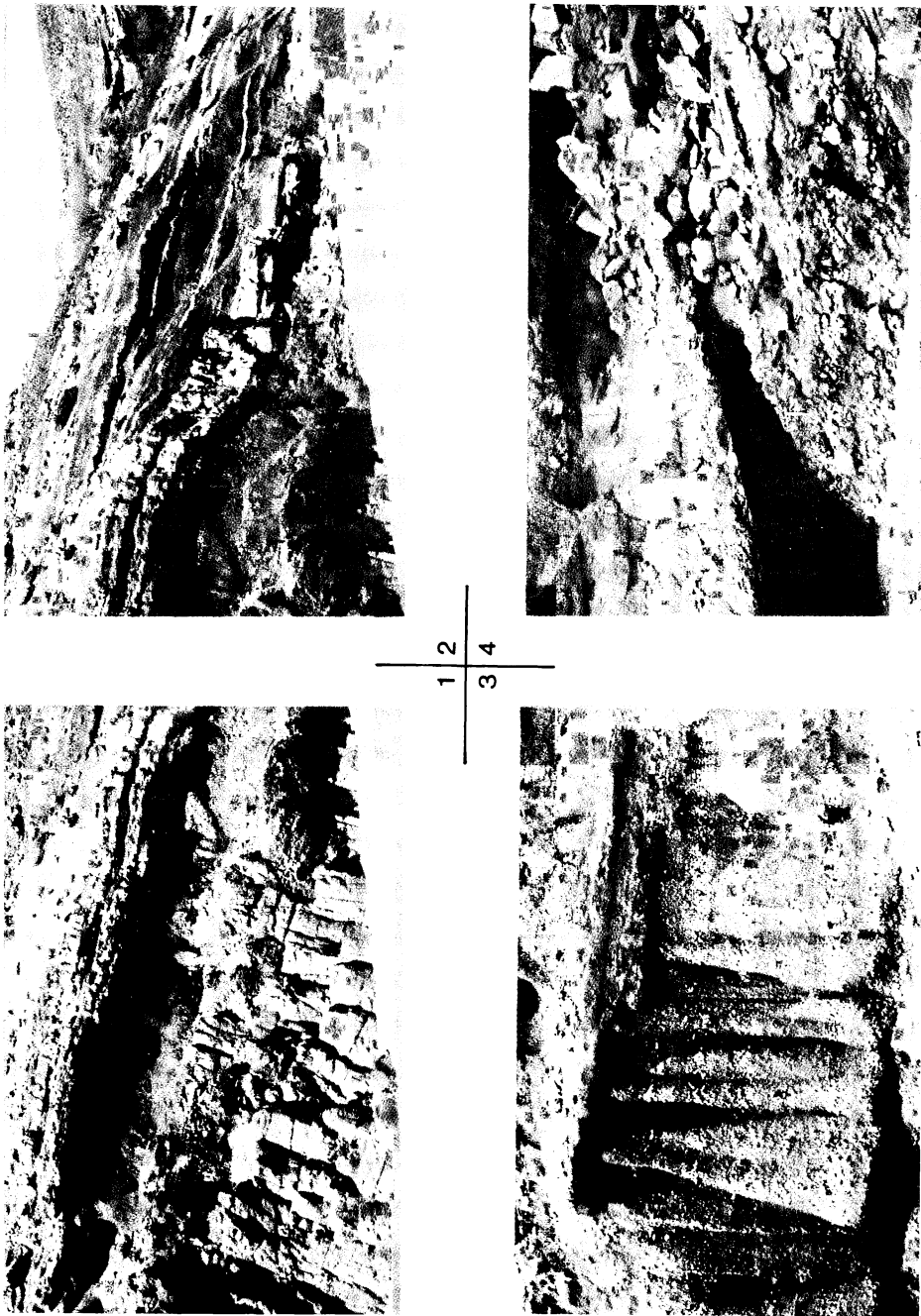


Plate II

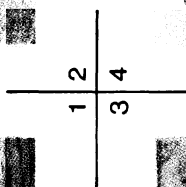
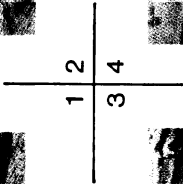
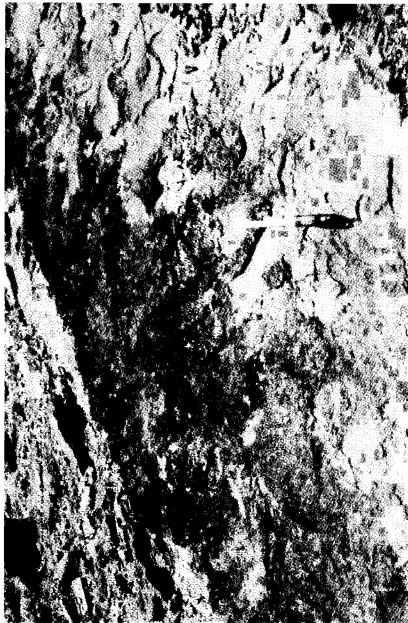


Plate III



NAMURUNGULE FORMATION

The Namurungule Formation is distributed widely in the west of the Samburu Hills (Makinouchi *et al.*, 1984 ; Sawada *et al.*, 1987). It is composed mainly of the clastic sediments with intercalated mud flow deposits and tuff layer (Fig. 3 — Locs. 5, 6, & 7). The lower mud flow deposit, observed along the Namurungule and Nakaporatelado Rivers (Makinouchi *et al.*, 1984), grades into cobble to pebble-sized gravel southward (Fig. 3 — Locs. 5, 6, & 7) (Plate I-4). Thick-bedded tuff layer overlies on the gravel layer correlated to the lower mud flow deposit (Plate II-4). The sediments under this gravel layer consists of the reddish brown pebble-sized gravel and ill-sorted

Explanation of Plate I

- Fig. 1** Columnar joint of basaltic lava flow and overlying calcified lapilli tuff observed in the uppermost part of the Aka Aiteputh Formation along the Nakaporatelado River (Loc. 5).
- Fig. 2** White layers in the upper are chert. Horizon is more or less upper than one of No. 1.
- Fig. 3** Crude cross-laminated pebble-sized breccia in the uppermost of the Aka Aiteputh Formation along the Nakaporatelado River (Loc. 5). It was called the weathered basalt sediment by Makinouchi *et al.* (1984)
- Fig. 4** Cobble gravel including boulder correlated with the lower mud flow deposit, in the lowest part of the Namurungule Formation along the Nakaporatelado River (Loc. 5).

Explanation of Plate II

Middle horizon of the Namurungule Formation

- Fig. 1** Alternation bed of dominant silt and sand along the Nakaporatelado River at Loc. 5. Upper mud flow deposit containing large blocks is observed in the upper left.
- Fig. 2** Alternating bed of dominant silt and sand at Loc. 7.
- Fig. 3** Laminated silt above the horizon occurred Samburu Hominoid at Loc. 6 (SH 22).
- Fig. 4** Massive tuff layer containing plagioclase phenocrysts and pumice grains at Loc. 7.

Explanation of Plate III

Upper horizon of the Namurungule Formation at Loc. 5

- Fig. 1** Alternating bed of dominant sand and silt. Sands shows ripple cross lamination.
- Fig. 2** Linguoid ripple mark observed on the upper bedding plane of sand.
- Fig. 3** Alternating bed of dominant sand and silt. Lower surface of sand are erosive. Silt is very illsorted, and contains pebble- to granule-sized basalt breccia.
- Fig. 4** Cross laminated very coarse to granular sand.

sand. The sediments between two mud flow deposits mainly consist of purple greenish grey or yellow green alternating bed of dominant silt and sand (Plate II-1 & 2). Characteristically they are calcified and contain small calcified spits, probably being trace fossils. The silts are generally massive, but sometimes shows fine lamination (Plate II-3) and slumping structure. The interbedded sands shows frequently cross lamination and are generally graded beds. The upper mud flow deposit is very thick and contains the large blocks up to 4 meters in diameter of alternating bed of sand and silt, and volcanic rocks (Plate II-1). The sediments above the mud flow deposit consist of alternating bed of dominant sand to gravel and silt (Fig. 3 — Loc. 5). Sand and gravel show graded and cross laminated bedding (Plate III-4). Their basal planes are commonly erosive on lower sediments (Plate III-3). Thin sand layers shows frequently ripple cross lamination (Plate III-1 and 2).

The sedimentary environment of the Namurungule Formation became firstly to the lake from the fluvial ones at the depositional stage of the uppermost part of the Aka Aiteputh Formation to the lowermost part of the Namurungule Formation. After that, it was turned again into the fluvial ones at the depositional stage of sediments above of the upper mud flow deposit. The volcanic activity around the Samburu Hills became weakly at that time, except of mud flows and tuff.

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