Chapter 3

Holocene Stratigraphy from the Mawaki Archaeological Site and the Occurrence and Significance of Dolphin Bones

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Abstract

The Mawaki archaeological site area comprises thick Holocene sediments, which were deposited as a series of marine transgressive and regressive cycles. From the sedimentary sequence, a shallow estuarine sedimentation system is recognized and is seen to be associated with a coastal environment. The distribution of the sediments, intercalated with many dolphin bones, is concordant with the sedimentation processes recorded in the borehole sequence.

3.1 Introduction

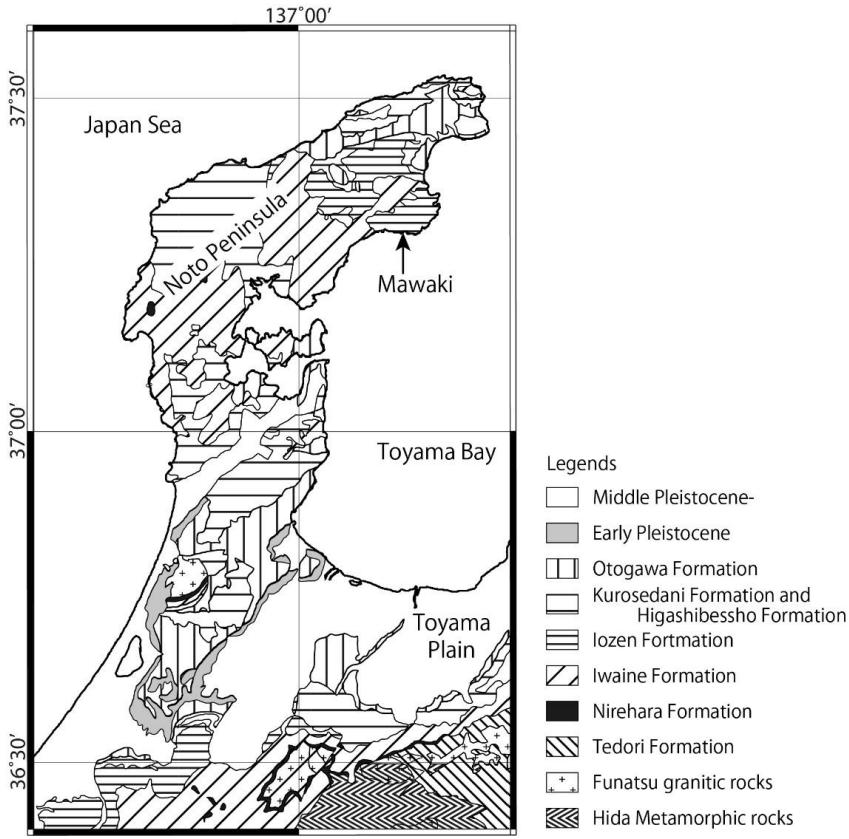

Figure 3.1 *Location of Mawaki Site of the Noto Peninsula with geological information.*

The Mawaki archaeological site is located in the northern part of Noto Peninsula, and faces Toyama Bay to the south (Figure 3.1). Following the early phase of excavation from 1980 to 1983 (Board of Education of Noto Town and Investigating Commission for Mawaki Site, 1986), the Mawaki site was designated as a National Historic Site on the basis of its significance for the Jomon culture along the Japan Sea coast. The late phase of excavation started in 1997 during which fundamental geological drilling, geoslicer coring, and geoarchaeological research was carried out. Pollen and diatom analyses and precise ^{14}C dating were undertaken in order to fully understand the distribution of sediments intercalated with dolphin bones. This work contributed to an understanding of the significance of the Mawaki site and the distribution of human remains during the Holocene (Board of Education of Noto Town and Investigating Commission for Mawaki Site, 2002; 2006; 2010).

In this section, we summarize the stratigraphy of drilled core samples and geoslicer coring sediments samples from above the Miocene basement rocks. Geoslicer coring is an operational system of directly oriented coring using sheet piles ("YAITA" in Japanese) and obtains vertical thin sections of unconsolidated soil layers (Nakata and Shimazaki, 1997; Haraguchi et al., 1998).

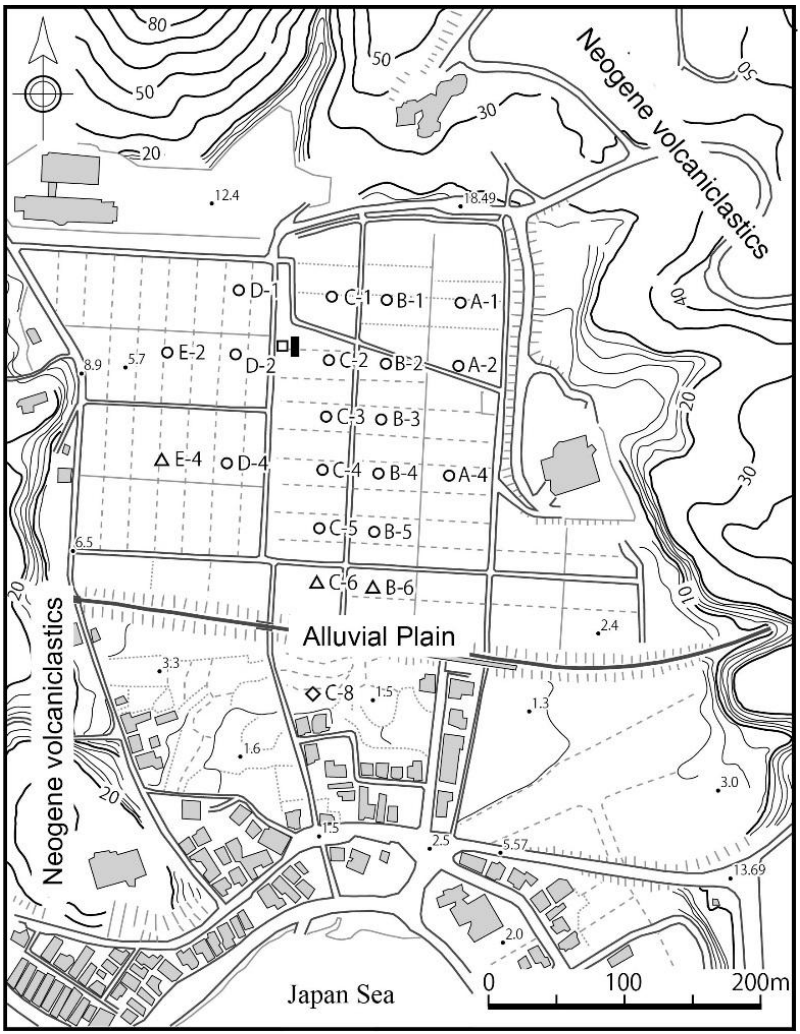

Figure 3.2 *Borehole and geoslicer locations around the Mawaki archaeological site. Open circle: drilling in 1997 & 1998, open triangle: drilling in 2002, open rhombus: drilling in 2005, solid rectangle: geoslicer coring.*

3.2 Drilling Operations and Geoslicer Sampling at the Mawaki Site

During the late phase at the Mawaki site, drilled cores were obtained in order to study the distribution of the strata intercalated with dolphin bones. The borehole

locations are shown in Figure 3.2. In 1997 and 1998, boring operations were carried out at 17 points, and the complete sequence of sediments was obtained (Photo 3.1: coring, Photo 3.2: core sediments). In 2001, we carried out further boring operations near the present shoreline in order to better understand the continuity from the present shoreline to the Mawaki archaeological site. Geoslicer coring was carried out to check the sedimentary facies along the former shoreline during the Jomon period, and its relation to the dolphin bone occurrences (Photo 3.3: geoslicer coring, Photo 3.4: geoslicer sediments).

Photo 3.1 *Coring.*

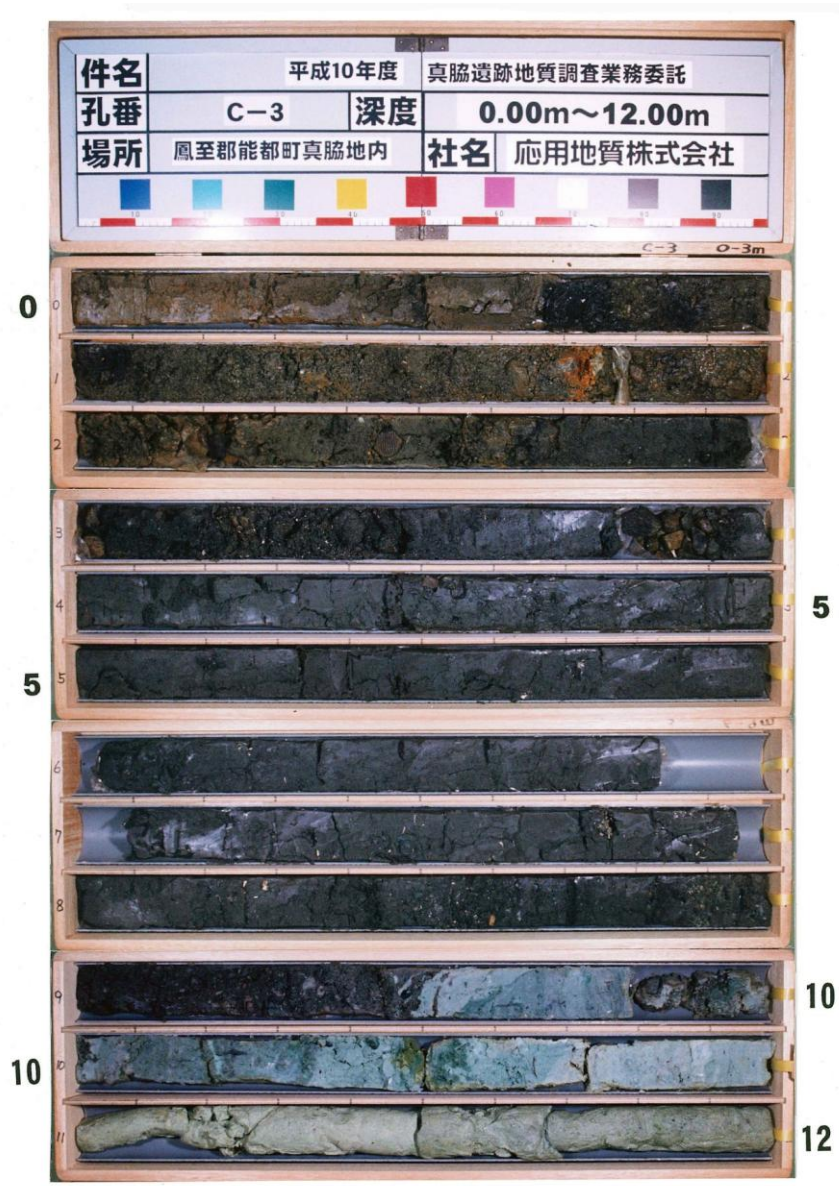

Photo 3.2 *Core sediment samples. Japanese explanations on the core box: Subject: Geological Research at Mawaki Site (2008), Borehole No.: C-3, Depth: 0.00m – 12.00m, Location: Mawaki, Noto Town, Operation: Oyo Corporation Co., Ltd.*

Photo 3.3 *Geoslicer sampling.*

Photo 3.4 *Geoslicer sample.*

3.3 Stratigraphy of Drilled Core and Geoslicer Sediment Samples

The Mawaki site faces the sea and is surrounded by low hills composed of Miocene andesitic volcaniclastics. These volcaniclastics form the basement to the late Quaternary sediments at Mawaki. On the basis of the sediment core observations, the stratigraphy can be summarized as five units (units A to E in ascending order) above the Miocene volcaniclastic basement (Figure 3.2 and Figure 3.3). The lithological unit nomenclature is that of Itoh et al. (2011).

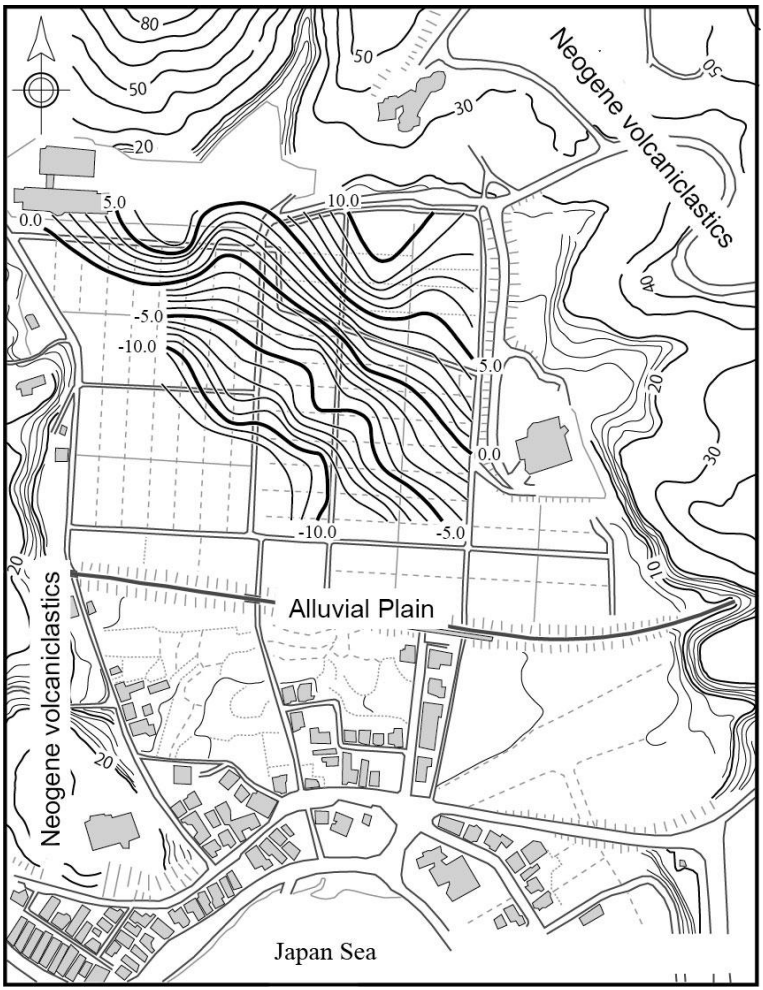

Figure 3.3 *Basement topography. Contours delineate the buried topography of basement rocks (the elevation of the surface of the Miocene volcaniclastics).*

Basement: Miocene volcaniclastics composed of tuff and tuffaceous mudstone.

Unit A: Sands and gravels, poorly sorted, containing charcoal grains.

Unit B: Clays and silts with abundant remains of marine organisms, intercalations of well-sorted sandy layers, containing shell and plant fragments.

Unit C: Silty sands with gravels, well-sorted medium sands, containing

abundant shells and plant fragments.

Unit D: Sands and gravels, poorly sorted, containing pottery fragments and charcoal grains.

Unit E: Cultivated soil.

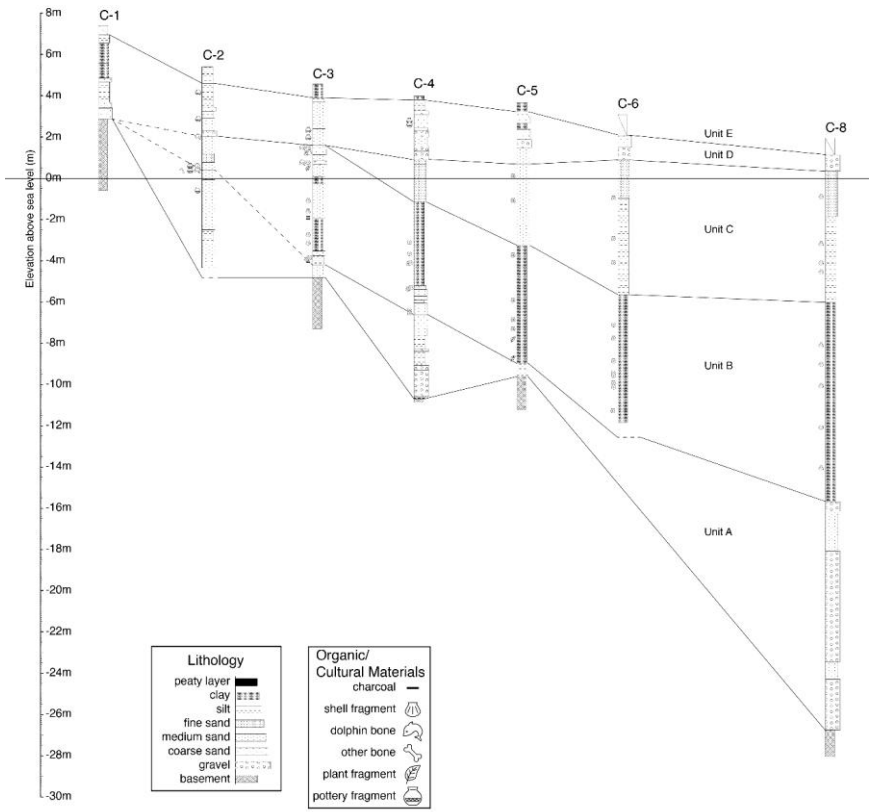

Figure 3.4 *Geological profile along cross section of C-Line.*

The cross section along the C-Line (Figure 3.4) clearly shows that the clays and silty sands with abundant marine organisms were deposited in marine environments (units B & C). The deposits in marine environments are thicker on the coastal side and the bottom horizon is lower.

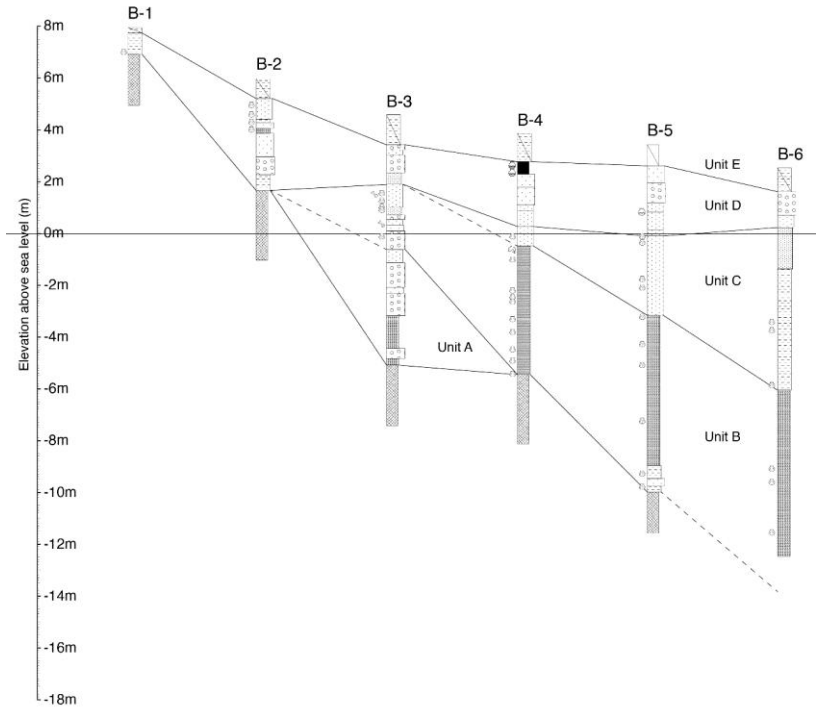

Figure 3.5 *Geological profile along cross section of B-Line.*

The cross section along the B-Line (Figure 3.5) also clearly indicates that the clays and silty sands with abundant marine organisms were deposited in marine environments (units B & C) and they are thicker on the coastal side; the basal horizon is shallower towards the shoreline.

The cross section along the 2-Line (Figure 3.6), at a higher elevation, shows that the sediments are mainly composed of poorly sorted sands and gravels with intercalations of coaly silts and sands from Unit D. At this elevation, the marine transgressive sediments seen in units B & C are recognized at narrow horizons. The boundary between the sedimentary sequence and the basement rocks is irregular in shape due to erosion, the topography being deeper to the west, with the thick sediments of Unit A indicating the former valley before the marine transgression.

The cross section along the 4-Line (Figure 3.7), at a middle elevation, shows a thick marine sequence composed of silts and clays with abundant shell fragments, and also an irregular basement topography, deeper to west with thick subaerial sediments (Unit A) indicating the conditions before the marine transgression.

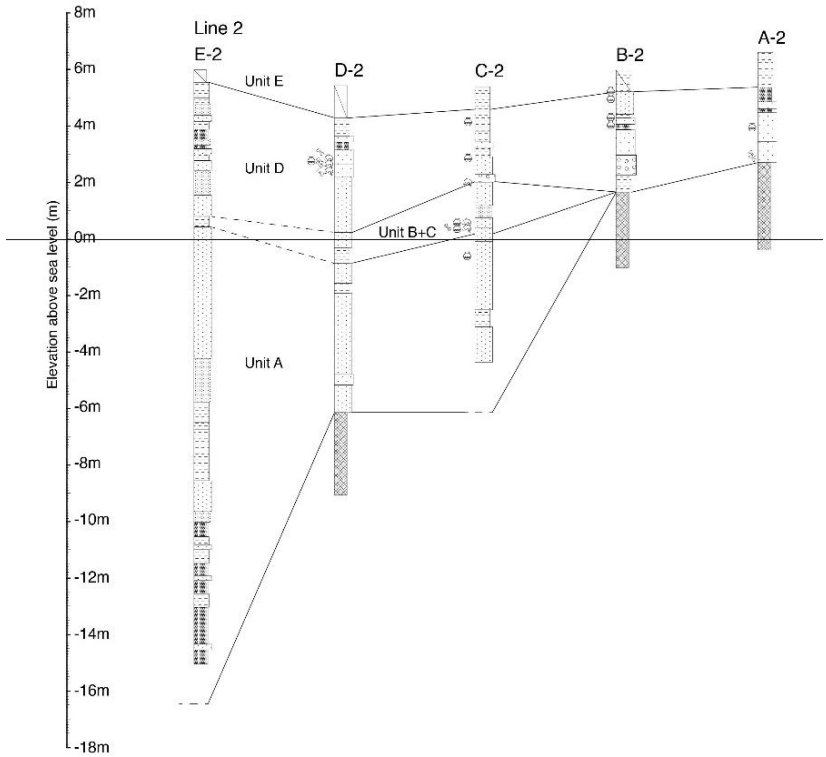

Figure 3.6 *Geological profile along cross section of 2 Line.*

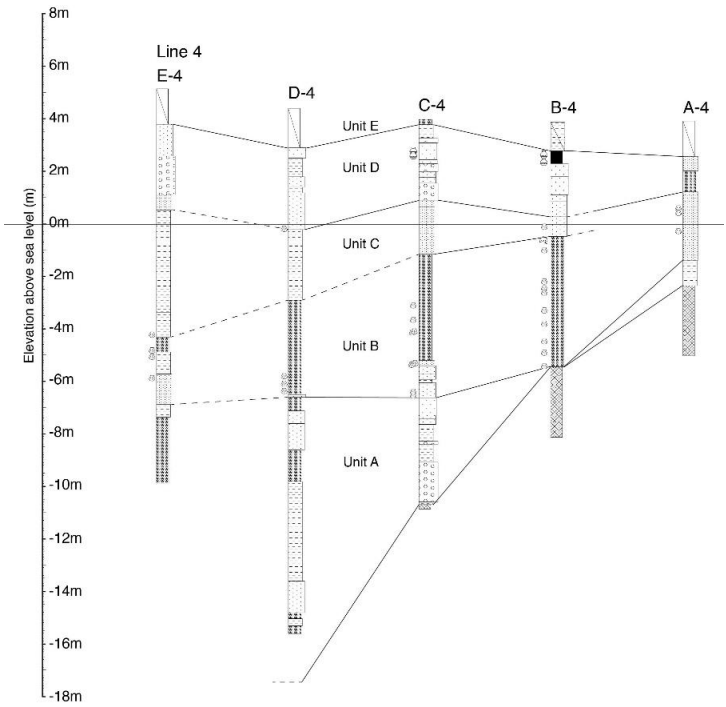

Figure 3.7 *Geological profile along cross section of 4 Line.*

Geoslicer coring was carried out in order to study the sedimentary facies of coastal area, including the dolphin bones. The lithology of the samples is complicated; the sediments are composed of poorly sorted silts and sands, with plant fragments, pottery and dolphin bones.

3.4 Holocene Lithostratigraphy to the Shoreline at Mawaki

3.4.1 Basement Structure

The basement relief (Figure 3.3) indicates the surface of the Miocene volcaniclastics and shows the topography before the Holocene marine transgression. The relief is steeper than that of the present-day valley slopes, and this is a result of erosion in Last Glacial times.

3.4.2 Sedimentary Facies and Sedimentary Environment Change

Sedimentary facies are characterized upward in time, and spatial distribution (Figs 3.4, 3.5, 3.6 and 3.7). The thick marine clays of Unit B indicate rapid sedimentation in bay environments, and the upper part of Unit B is intercalated with alternations of silts and sands with plant fragments typical of estuarine environments. The sand sequence of Unit C indicates the development of a sand bar at that time. The distribution of lithologies at the Mawaki site in space and time, show thick clay sediments of bay environments, followed by estuarine sediments to shoreline deposits related to the development of the sand bar shown in Unit C.

3.4.3 Facies of Transgression and Regression

The sequence at the Mawaki Site is composed of lower terrestrial, middle marine, and upper terrestrial environments. This indicates a series of marine transgressions and regressions during the Holocene. The distribution of marine environments was developed at an elevation of 3m above present-day sea level. This indicates that the former sea level was higher than that in the present day.

3.4.4 Characteristics of Sediments Including Dolphin Bones Horizon

Abundant dolphin bones are distributed in a narrow horizon within the sedimentary sequence, which includes poorly sorted silty sands with plant fragments of a near marine environments (Figs 3.4, 3.5 and 3.8). The data indicate that the areal distribution is limited. The distribution and occurrence of the horizons are the subject of further discussion related to sea level rise, sedimentation processes, paleogeographical change, and human activities.

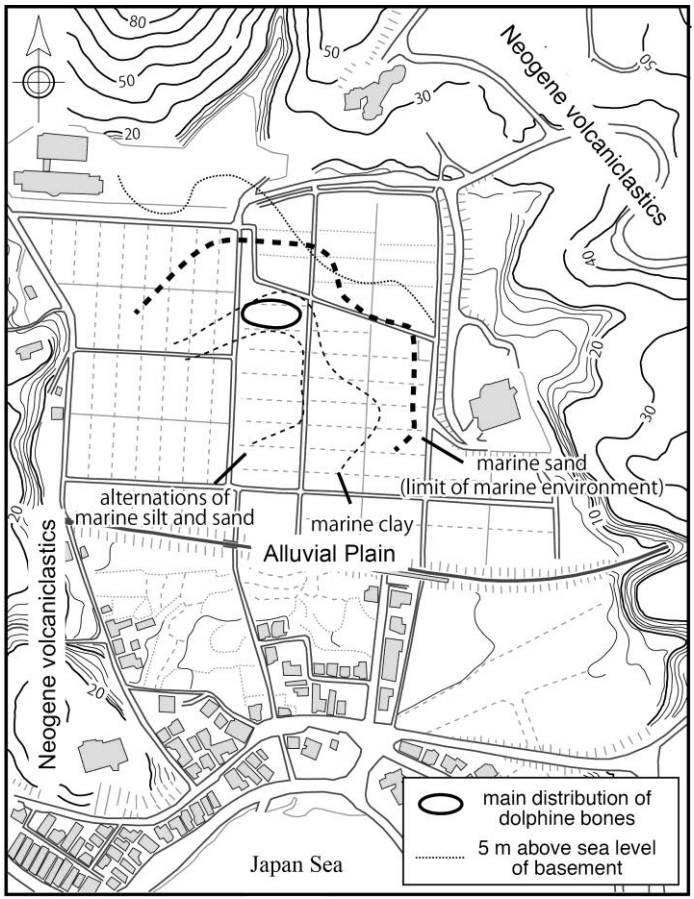

Figure 3.8 *Distribution of sediments intercalated dolphin bones and sediments of marine environments.*

3.4.5 Development of Terrestrial Topography and Transition of Human Relics

The distribution of human relics represented by pottery and bones is characteristics (Figure 3.9). Human relics belonging to the Early Jomon period are distributed more abundantly in higher elevation than that from other periods. This means that the sea level rise and marine transgression was larger in the Early Jomon period.

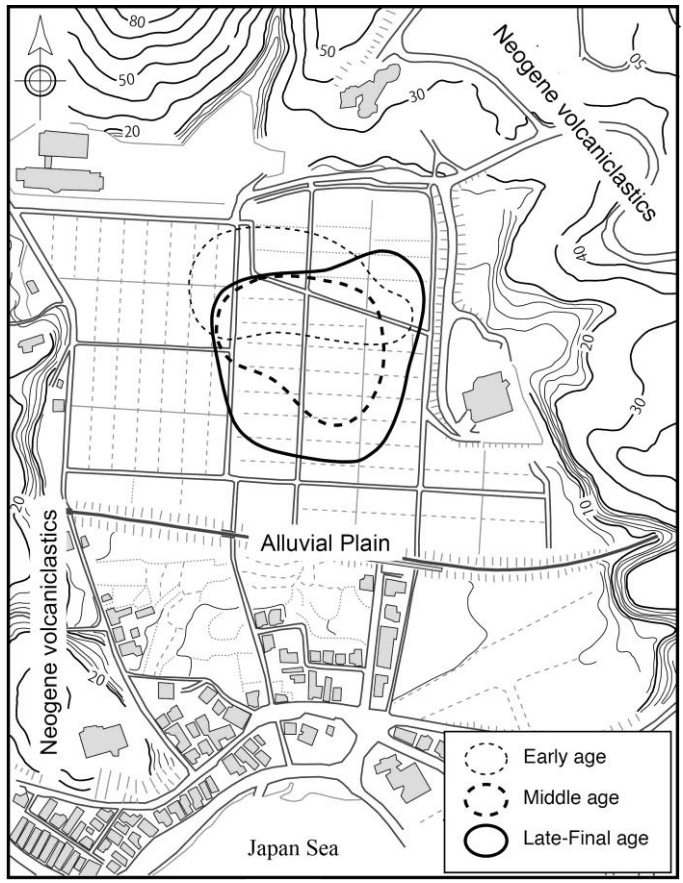

Figure 3.9 *Distribution of Jomon relics at each ages of Jomon period.*

3.5 Summary

The stratigraphy of Mawaki site comprises mainly five sequences of alluvial unconsolidated sediments above the Miocene basement rocks. The sediments are divided into five units, A to E in ascending order, typical of terrestrial and marine (bay and estuarine) environments. Around the Mawaki site a bay environments developed, and in the late stages of Early to Middle Jomon period, sea level was stable and the bay comprises barrier sediments composed of well-sorted fine to medium sands and silts with dolphin bones found at the

shoreline during this stage.

References

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