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Chibanian, Middle Pleistocene

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Abstract. In Japan, studies and researches of the earth started in the late 19th Century after the opening of the doors to the western countries. Japanese had to learn most geological concepts discovered in the western countries. A few concepts such as tsunami, Wadati-Benioff zone and Brunhes–Matuyama reversal have been given Japanese or partly Japanese names.

From the late 20 Century, the International Union of Geological Sciences (IUGS) tried to brush up the new geologic time scale based on the development of plate tectonics, especially the history of earth's magnetic field. In the Quaternary Era, IUGS invited type locality of new Epoch. Japanese geologists proposed Chibanian, type locality of which is in the Boso Peninsula, near Tokyo. At the type locality, the strata thickly continued without break, because plate tectonics of Japanese Islands made rapid stratification of Quaternary sediments. It was very unique around the world. The Chibanian section includes good tuff key layers, abundant microfossils and good evidences of the change of the Earth's magnetic field. It is currently estimated to span the time between 0.770 Ma and 0.126 Ma (770–126 ka). The beginning of the Chibanian is the Brunhes–Matuyama reversal, in which the Earth's magnetic field last underwent reversal. Chibanian ends with the onset of the Eemian interglacial period.

The Chibanian name was officially ratified in January 2020. The Japanese Government has designated Chibanian section as a natural monument.

Keywords: Chibanian – M. Matuyama – Brunhes-Matuyama reversal

1. Geological terms in Japanese

After the opening of the doors to the western countries in 1854, studies and researches of the earth started in Japan. In the Index of the book "*Thinking about the Earth: A History of Ideas in Geology*" (Oldroyd, 1969), there are only one Japanese word and only one Japanese person's name, Tsunami and Wadati, Kiyoo. Tsunami is now used around the world. Wadati was an early seismologist at the Central Meteorological Observatory of Japan researching deep (subduction zone) earthquakes. His name is attached to the Wadati–Benioff zone. It was Wadati (1928)'s paper on shallow and deep earthquakes, comparing maximum below surface displacement against distance from the epicentre.

Wadati–Benioff zone (also Benioff–Wadati zone or Benioff zone or Benioff seismic zone) is a

planar zone of seismicity corresponding with the down-going slab in a subduction zone. Wadati and Benioff independently discovered the zones. This concept led to that of subduction in plate tectonics.

2. Matuyama's magnetic reversal

Brunhes–Matuyama reversal was not mentioned in Oldroyd (1969)'s book, but it is very important for Chibanian.

Matuyama, Motonori (1884-1958) (Fig. 1) was a Japanese geophysicist who was (in the late 1920s) the first to provide systematic evidence that the Earth's magnetic field had been reversed in the early Pleistocene and to suggest that long periods existed in the past in which the polarity was reversed. He remarked that the Earth's field had later changed to the present polarity

Matuyama was the first person to document clearly from basalts in the Genbudō (basalt caves), Japan (Matuyama, 1929).

Brunhes-Matuyama reversal (Fig; 2), the reversed magnetic polarity interval from 2.58 to 0.773 Ma that we now call the Matuyama Reversed Polarity Chron was proposed in 1964 (Cox et al.).



Fig. 1. Matuyama, Motonori (Yamasaki, 2005)

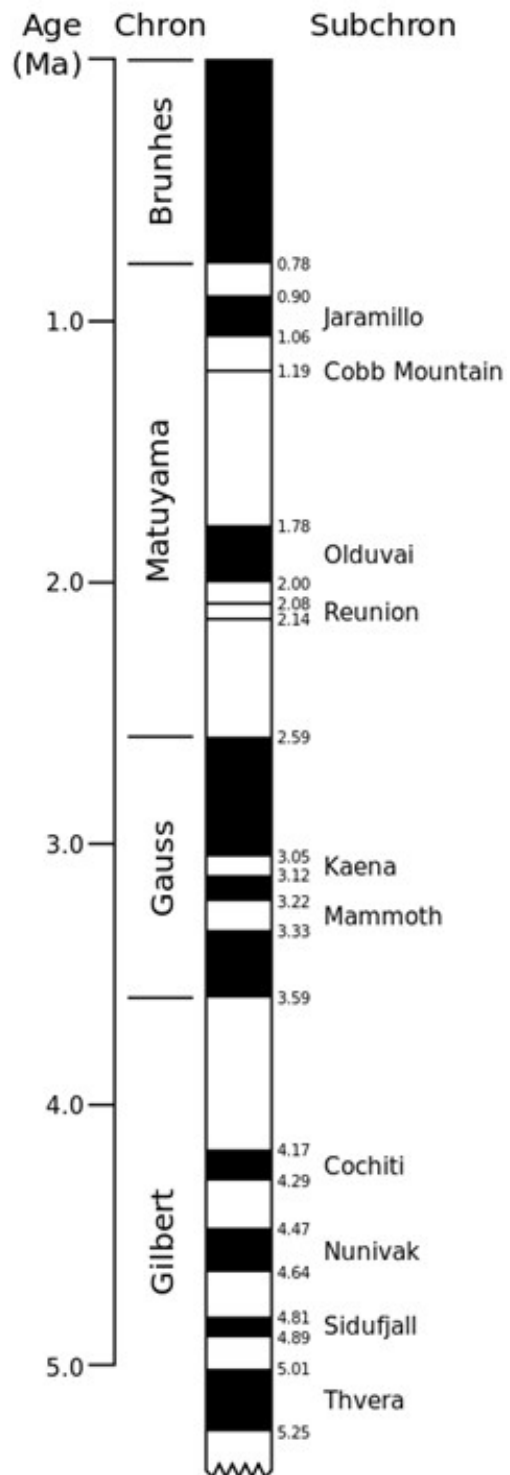


Fig. 2. Brunhes-Matuyama reversal (Wikipedia)

3. Proposal of New Epoch

From the late 20th Century, the International Union of Geological Sciences (IUGS) tried to brush up the new geologic time scale based on the development of plate tectonics, especially the history of earth's magnetic field. In the Quater-

nary Era, IUGS invited type locality of new Pleistocene Epoch.

Three places, two places in Italy and one place in Japan, were proposed for the Brunhes–Matuyama reversal. From Japan, Chibanian was proposed.

4. The strata of Chibanian (Fig. 3)

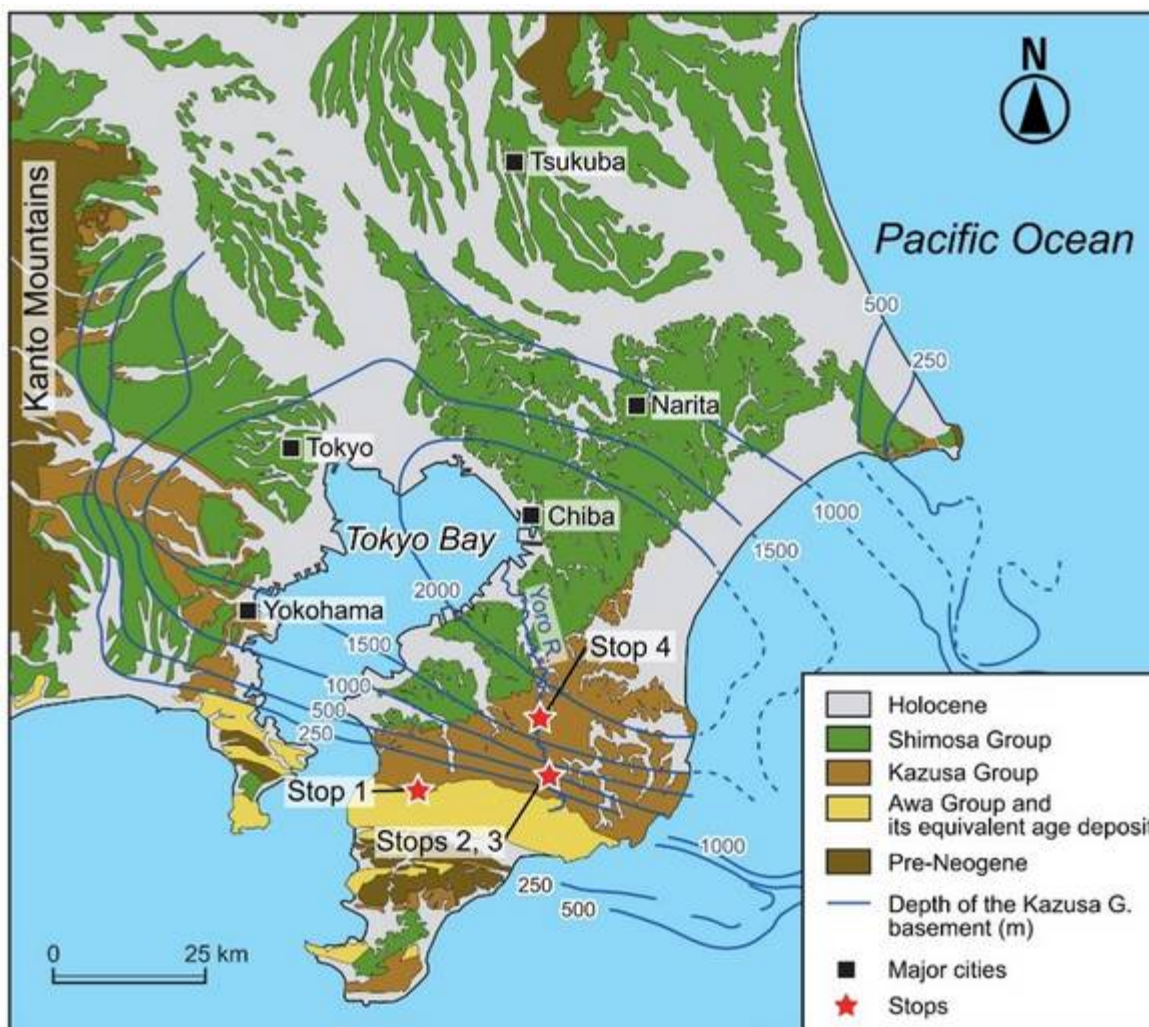


Fig. 3. The locality of Chibanian (Okada, 2023). Stop 4 is type locality of Chibanian.

Japanese geologists proposed to name “Chibanian” the geological time period ranging between from 1.29 to 0.774 Ma. Type locality is in the Boso Peninsula, 60km SE from Tokyo (Fig. 4). The Boso Peninsula is composed of thick Quaternary strata deposited in the Paleo Tokyo Bay. The type locality of Chibanian shows more than 5000 m depth of basement. The paleo Tokyo Bay opened to north and was larger than

Recent Tokyo Bay (open to south). Sediments stratified very thickly without gap in the Paleo Tokyo Bay. At the type locality, the strata thickly continued without break in the paleo Tokyo Bay, because plate tectonics at Japanese Islands made stratification of Quaternary sediments rapid in Japanese islands. It was very unique around the world.

The Chibanian section includes good tuff kye layers, abundant microfossils and good evidences of the change of earth's magnetic field. Mt Fuji and many volcanoes erupted many times in the

Quaternary in Japan. The Jet stream blows from west to east. The strata of the Boso Peninsula have many pyroclastic flows which shows good dating.



Fig. 4. Golden spike on the boundary of Chibanian. Makoto Okada (front) is the president of the Geological Society of Japan and main person proposing the Chibanian. (For the courtesy of Okada, this figure is given)

5. The name of Chibanian

Chiba owes its name to then Chiba family. For example, Boso Peninsula is in Chiba Prefecture. So new epoch name should be Chiba + ian = Chibian. But Chibi means Lilliputian in Japanese, and Japanese People do not like the word Chibi. So Japanese people think Chiba no (of Chiba) + ian = Chiba n + ian =Chibanian.

All Japanese people are glad to hear the news of Decision of Chibanian. The Chibanian name was officially ratified in January 2020. The

Japanese Government has designated Chibanian section as a natural monument. In 2022 golden spike (Fig. 4) was settled on the outcrop of Chibanian (METI, 2020).

6. Anthropocene?

In the Quaternary Era, IUGS invited type locality of new Epoch of Anthropocene. Japan will propose the sediment of Oita Bay for type sediment, but there will be no Japanese name as geological term.

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