

Sedimentary environment and paleosols of middle Miocene fluvial and lacustrine sediments in central Japan: Implications for paleoclimate interpretations

Nozomi Hatano ^{a,*}, Kohki Yoshida ^b

^a Graduate School of Science and Technology, Shinshu University, Matsumoto 390-8621, Japan

^b Department of Geology, Faculty of Science, Shinshu University, Matsumoto 390-8621, Japan

ARTICLE INFO

Article history:

Received 8 July 2016

Accepted 4 November 2016

Available online 21 November 2016

Editor: Dr. B. Jones

Keywords:

Fluvial and lacustrine sediments

Miocene

Paleosols

Weathering condition

Sedimentary facies analysis

ABSTRACT

Sedimentary facies analysis and description of paleosols were carried out for the middle Miocene Tokiguchi Porcelain Clay Formation (PCF) in central Japan in order to interpret the soil-forming environments during a long hiatus in the Japanese Islands. The sedimentary facies suggests that deposition occurred mainly in a lacustrine environment, with minor channel-fill and debris-flow deposits associated with alluvial fan environments. The coarse-grained sediments, which are inferred to have been deposited in channel-bar and debris-flow deposits, are present only in the marginal area of the sedimentary basin. Mature paleosols are identified in the Tokiguchi PCF, characterized by illuviated clay, identifiable soil horizons including Bt horizons and many *in situ* plant fossils, and are then similar to Ultisols. Most tree trunk fossils, however, were preserved by burial beneath debris-flow deposits. Most of paleosols formed on lacustrine deposits and were covered by lacustrine clay and silt deposits, without intervening coarse-grained deposits, such as flood-flow deposits. This change of sedimentary facies indicates a dramatic change of hydrologic environment, from stagnant water to entirely desiccated conditions, promoting weathering and soil formation. The relationship between sedimentary facies and Pedotypes, consequently, implies the repetition of specific events, *i.e.*, submergence and emergence of lake bottom, most likely due to formation and drainage of a dammed lake. These isolated events and development of mature paleosols might suggest specific characteristics of middle Miocene weathering conditions, such as seasonally heavy rainfall and/or warm climatic conditions in the Japanese Islands.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Miocene to Pliocene duration is a critical period for considering the history of weathering and climatic conditions in east Asian region because it is considerably recognized as a period that has appeared and greatly changed the East Asian monsoon (Quade et al., 1989; An et al., 2001; Guo et al., 2002), and that has occurred that some water marine climatic events due to the invasion of the tropical sea water currents as a result of closure of Indonesian Seaway and warm surface water pileup over the far western Pacific (Kennett et al., 1985; Ali et al., 1994; Nishimura and Suparka, 1997; Li et al., 2006). In the Japanese Islands, which are distributed in far eastern Asia, the middle Miocene to the early Pliocene period (5–15 Ma) was a time of long hiatus associated with global regression and regional orogenic movement (Makinouchi, 1985; Yoshida, 1992; Fig. 1-C). Therefore, there are sparse depositional records and little is known about the weathering, climate and environment during this time interval. The middle Miocene

Porcelain Clay Formation (PCF), which is interpreted as a fluvial deposit (Akamine, 1954; Fujii, 1967, 1978), is one of the rare geological records preserved during the middle Miocene time interval in the Japanese Islands (Fig. 1-C).

The PCF produces high-quality ceramic material, which is characterized by very high concentrations of aluminium (Fujii, 1967). These isolated sediments are inferred to have formed under warm, wet terrestrial weathering conditions (Fujii, 1967, 1978). The PCF is interpreted as having been deposited in a small sedimentary basin with a radius of several kilometers, in Gifu and Aichi Prefectures, central Japan (Nakayama, 1985; Todo Collaborative Research Group: TCRG, 1985). In particular, the PCF that is distributed in Gifu Prefecture is called the Tokiguchi Porcelain Clay Formation (Akamine, 1954), and that distributed in Aichi Prefecture is called the Seto Porcelain Clay Formation (Matsuzawa et al., 1960). Depositional processes of the PCF were interpreted based on sedimentary facies analysis. Nakayama (1991, 1999) carried out sedimentological studies related to the Seto PCF in the southern part of Nagoya in Aichi Prefecture, and proposed a reconstruction during the middle Miocene that consisted of a fine-grained alluvial system with fan, fan delta and lake and/or pond environments. Saneyoshi et al.

* Corresponding author.

E-mail address: hatano.n6@gmail.com (N. Hatano).

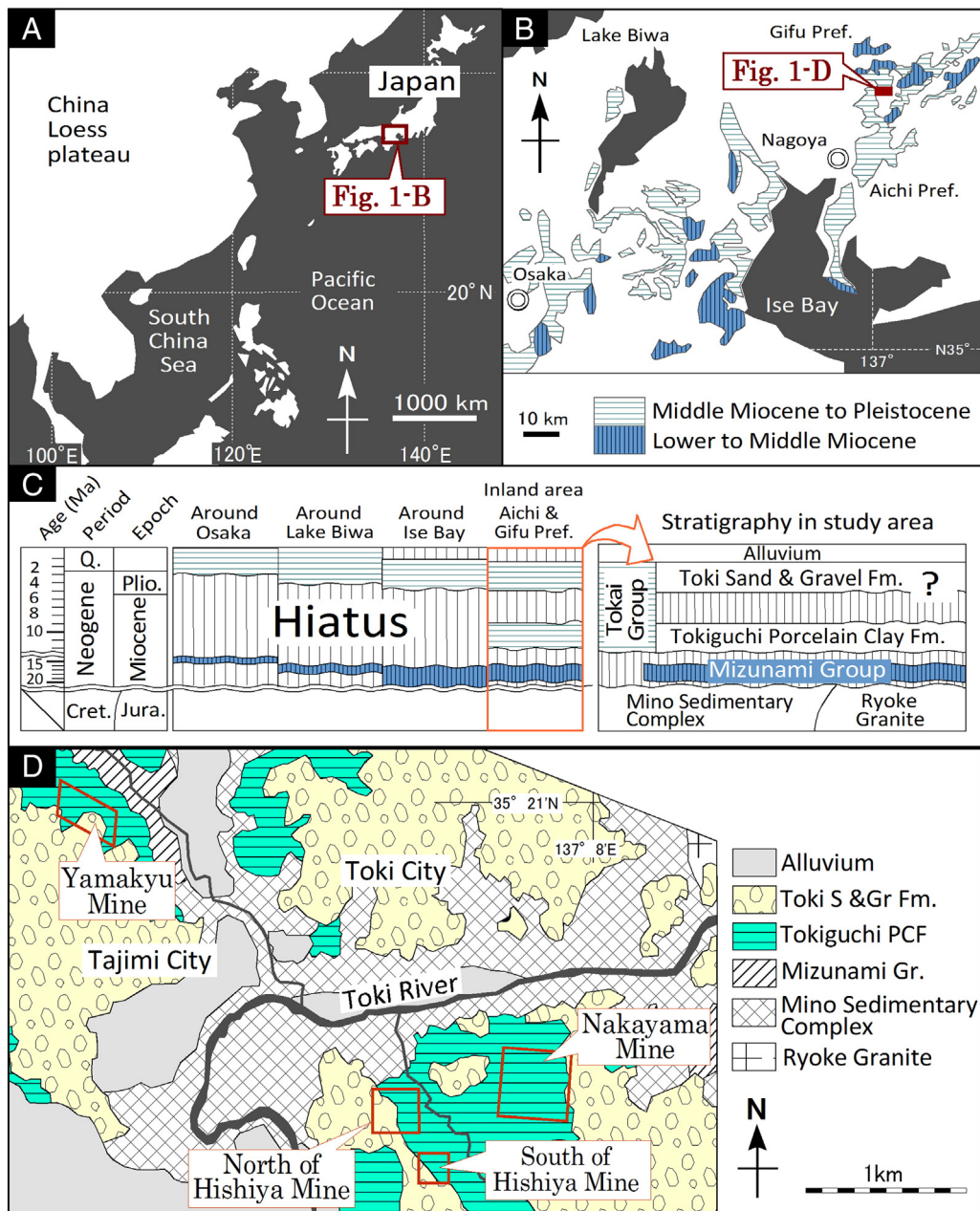


Fig. 1. A) Map of the east Asian region and location of Fig. 1-B. B) Distribution of the lower Miocene to Pleistocene in southwest Japan and location of Fig. 1-D (modified from Yoshida, 1992). C) Stratigraphic correlations of the lower Miocene and the middle Miocene - Pleistocene formations distributed in southwest Japan (based on Yoshida, 1992), and stratigraphy in the study area. D) Geological map of the study area, around Toki - Tajimi Cities in Gifu Prefecture (modified from TCRG, 1999). Q.; Quaternary, Plio.; Pliocene, Cret.; Cretaceous, Jura.; Jurassic, Toki S & G Fm.; Toki Sand and Gravel Formation, Tokiguchi PCF.; Tokiguchi Porcelain Clay Formation.

(2000) and Nakajima et al. (2004) showed that the sedimentary environment of the Tokiguchi PCF, distributed in Toki - Tajimi Cities in Gifu Prefecture, was that of a youthful sandy, braided fluvial system with extensive swamp and stagnant water areas, which were developed proximal to the mountain and/or hilly area.

In the case of fluvial deposits such as the PCF, a sedimentological approach can be interpreted depositional processes, environments and products of sedimentation. However, such an approach can only provide limited information, which is incomplete for successions formed in fluvial environments, because these deposits essentially comprise multiple short hiatuses developed due to sub-aerial erosion and soil formation within the deposits. During the hiatuses, the surface of deposits is influenced by soil formation, characterized by physical, chemical and biological weathering (Retallack, 2001). Indeed, the PCF has yielded

many indigenous plant fossils with good preservation, for example, of pine fossils (*Pinus trifolia*; Miki, 1939, 1941). Meanwhile, paleopedological reconstruction of paleosols can support interpretations of the history of depositional processes, weathering, climate and other geologic events that influenced the sedimentary basin during the hiatus developed in the middle Miocene to the early Pliocene in the Japanese Islands.

In this study, the results of sedimentary facies analysis and description of the paleosols in the Tokiguchi PCF are reported in order to reconstruct the paleoenvironmental change of the sedimentary basins during the middle Miocene during a long hiatus in southwest Japan. In addition, the relationships of the sedimentary facies and paleosols are important in interpreting conditions within the sedimentary basins, because the depositional processes involved variable depositional

Download English Version:

<https://daneshyari.com/en/article/5781331>

Download Persian Version:

<https://daneshyari.com/article/5781331>

[Daneshyari.com](https://daneshyari.com)