Depositional Environments and Paleosols in the Lower Cretaceous Shiohama Formation of the Kanmon Group, SW Japan

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The Yoshimi area is located in Yamaguchi Prefecture, SW Japan. The Shiohama Formation of the Cretaceous Kanmon Group is distributed in this area. In this area, there are some studies about depositional environments and paleosols. These previous studies, however, don't clarify the relationship between depositional environment and paleosol development. In this study, we tried to clarify depositional environments of the sediments and to reconstruct the paleosol forming process.

The Shiohama Formation of the investigated area can be divided into Lower, Middle and Upper Members. The Lower, Middle and Upper Members consist mainly of very fine-grained sandstone and conglomerate, conglomerate, and volcanogenic conglomeratic sandstone, respectively. The Lower Member contains sediment gravity flow and floodplain deposits. Sediment gravity flow deposits are composed of conglomerates which are characteristic of alluvial fan deposits. Floodplain deposits include abundant paleosols which are characteristic of meandering river deposits. Based on these sedimentary facies, we can mention that the Lower Member was deposited on floodplain of meandering rivers on a distal alluvial fan setting. The Middle Member contains sediment gravity flow deposits and subordinate floodplain deposits. It is considered that these facies reflect increasing occurrence of sediment gravity flows and that the Middle Member is nearly the same setting as the Lower Member. The Upper Member consists mainly of sand facies and subordinate floodplain deposits. The former facies includes volcaniclastic sediments abundantly. Floodplain deposits contain weakly developed paleosols. This suggests the floodplain is unstable and is frequently covered by new sediments from channels. The Upper Member contains less amounts of conglomerate facies than the Lower and Middle Members. This means decreasing occurrence of sediment gravity flows. It is probable that the Upper Member was deposited on floodplain which was closer to channel. The paleosols generally present red colour and are developed mainly in the Lower and Upper Members. We could observe some soil features such as trace of life, soil horizons and soil structures. The paleosols of the Shiohama Formation characteristically contain calcretes abundantly. It is known that the calcrete generally occurs in arid and semi-arid soils. In the investigated area, calcretes occur at about 110 horizons. These calcretes show nodular shape and occur along bedding planes. Under the microscope, we could observe the microfabrics such as dense microfabric, floating sediment grains, coated grains, nodules and complex cracks. These microfabrics suggest that the calcrete was formed in the areas under more arid climate and less biological activity. The oxygen and carbon isotope compositions of the calcrete are -21.1%0 and -5.7%0 on the average, respectively. Based on these data, we could estimate that atmospheric PCO2 ranged from 2300 to 4500 ppmV.

The calcrete generally occurs in soil B horizon. The Lower Member is characterized by repetition of soil B horizon. Also the Upper Member is represented by repetition of soil B and C horizons. Namely, we can mention that the cycle of erosion, sedimentation and soil development happened repeatedly on the floodplain. The difference of paleosol profiles of the Lower and Upper Members reflects the amount of sediments. The floodplain of the Upper Member accepted more abundant sediments than that of the Lower Member. Based on sedimentary facies and paleosol profiles, we could conclude that the depositional site of the Upper Member was closer to channel than that of the Lower Member.