Precipitation environment and preservation mechanism in formation of iron hydroxide in Satsuma Iwo-jima, Kagoshima, Japan.

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Satsuma Iwo Jima is a volcanic island located about 50 km south of Makurazaki City, Kagoshima Prefecture, on the northwestern edge of the Kikai caldera, and the size is about 6 km east to west and 3 km north to south. From the seabed of Nagahama Bay, in the southern part of the island, hot spring water rich in dissolved ferrous iron springs out, and red-brown iron hydroxide precipitates due to mixing with seawater. The purpose of this study is to investigate in detail the precipitation environment of iron hydroxide in Nagahama Bay, and to clarify the precipitate process until sediment is preserved as a stratum. For this purpose, we measured the water quality of Nagahama Bay water mass (1) and observed sediments samples collected from Nagahama Bay (2).

<Method>
(1) Water quality measurement: A multi-item water quality meter was dropped from a breakwater in Nagahama Bay, and each item was measured while changing the water depth by 20 to 50 cm. The measurement was performed in August and December in 2017, March in 2018, and April, May and August in 2019. The main measurement items are as below: water temperature, pH, ORP, turbidity.
(2) Sample observation and analysis: Core samples collected in 2018 to 2019 from Nagamama Bay were used. The sample length were 50~100 cm. For observation Smear slide and scanning microscope (SEM) were used. The analysis has been performed by X-CT imaging and gamma ray attenuation (GRA) and susceptibility measurement by MSCL thus far.

<Result>
1) As a general trend, it was confirmed that pH increased and turbidity decreased with increasing depth. Eh showed a trend be low value relatively in the lower part of the body of water, and that increased toward the middle part, and decrease rapidly near the water surface. The measured pH ranged from 5.9 to 8.7, and Eh ranged from +57 to +492 mV.
2) As a result of smear slide observation, the sediments are composed of amorphous iron hydroxide, clastics such as sand and silt supplied from other sources, and volcanic glass. As a result of X-CT and GRA measurements in addition to slide observation, relatively high density parts are rich in relatively large debris. The change of gamma-ray density and the magnetic susceptibility coincide. And additionally, High-magnification observations of sediments using FE-SEM revealed that, in addition to aggregates and debris of iron hydroxide, many stalk-like substances were observed from the middle to the lower part of the cores.

<Discussion>
1) It is presumed that the aggregation of iron hydroxide particles strongly depends on pH change in the water mass of Nagahama Bay. In addition, iron hydroxide is likely to be generated by physicochemical oxidation as an iron precipitation environment considered from pH and Eh, however, depending on conditions, it can be an environment where organisms preferentially oxidize iron. In particular, biological oxidation is likely to occur near the sea surface where both pH and Eh take small values.
2)The analysis results suggest that the content of clastics in iron hydroxide is the main determinant of the

density in sediments. The magnetic susceptibility is thought to indicate mainly the inclusion of detrital material, suggesting that the low-density and low-magnetic-susceptibility part has a high amorphous iron hydroxide content. In addition, the presence of stalk-like substances observed by SEM observation suggests the presence of iron-oxidizing bacteria in sediments. In Nagahama Bay, iron oxidation by the action of bacteria in chimney mounds has been reported before, so the action of iron-oxidizing bacteria may affect the preservation of iron even in the stratum.

Keywords: Satsuma Iwo-jima, iron hydroxide, Iron oxidizing bacteria

