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HYDROTHERMAL ACTIVITY AND IRON SEDIMENTATION IN NAGAHAMA BAY, SATSUMA IWO-JIMA ISLAND, KAGOSHIMA

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Satsuma Iwo-jima Island is active volcanic island and 6 x 3 km in size, located 38km south of Kyushu Island, Japan. The reddish brown water along the coast of the Iwo-dake volcano at the center of the island is formed by neutralization through mixing of shallow hydrothermal fluid and seawater. The reddish brown water contains reddish ferrihydrite (Fe3+) that is derived from oxidation of Fe2+ from acidic hot spring (Shikaura and Tazaki, 2001). In Nagahama Bay with its opening to the south, red-colored Fe-rich water is affected by tidal current. Sedimentation of the ferric hydroxide is confirmed to occur in the ocean bottom (Ninomiya and Kiyokawa, 2009). Here we focus other lines of evidence from long term observations and meteorological records as important factor to form thick iron rich sediments.

Core sample: >1m thick Fe-rich sediments have the following lithological characteristics; the upper part, 10-20cm thick is composed of unconsolidated Fe-rich materials and the lower part shows alternation of weakly consolidated Fe-rich orange-colored mud, the organic-rich black mud and volcanic ash layers. The basal part has a distinctive pink ash layer that represents 1997 volcanic activity. Three-dimensional analysis of the sediments suggests that they are alternating sediments during quite weather periods (Iron mud) and reworked sediments (Tuff and Sand). Layer of fine-grained volcanic ash have the feature of fining-upward. All Iron mud samples show high FeO contents about 20˜25wt.%. The depth profiles of FeO and Al2O3 contents show parallel changes. SEM images and XRF results indicate very small (>1 micron) grains of amorphous Fe-bearing minerals such as ferrihydrite and/or feroxyhite. XRD results indicate that Iron mud contains Si-bearing minerals such as quartz, cristobalite and tridymite. Triangular Fe-Al-Zr diagram may indicate multiple origins for each layer in the examined sediment core: e.g. Iron mud is derived from hot spring water because Fe content rate in hot spring water is high, and elevated abundance of Al and Zr indicates that Sand and Tuff are reworked sediments.

Long term temperature monitoring: Measured seawater temperature seems to have fluctuated synchronically with the air temperature. But the temperature of the hot spring water remained rather constant regardless of the seasonal change. We observed that seawater temperature in Nagahama Bay is relatively lower during high tide and higher during low tide, and the difference between high and low peaks in temperature reaches maximum in the period of spring tide and minimum in the period of the neap tide. These observations suggest that an amount of discharged hot spring inversely correlated with that of seawater flowing into Nagahama Bay.

Meteorological and stationary observations: We used meteorological records in the Satsuma Iwo-jima Island and cross-checked with stationary observations, which enabled us to observe color changes of the surface water of Nagahama Bay. It was made clear that prevailing north wind in Nagahama Bay resulted in changes of the color from red to green, most likely by intrusion of open ocean water to the bay.

In Nagahama Bay, ”Iron mud” formed during quite periods of quiet weather and ”Tuff and Sand” formed as reworked sediments by storm and flood event. Neap tide would have induced enough supply of hot spring into seawater and prevailing south wind would have worked as a cap of underlying seawater. The fine-grained Fe-hydroxide formed and deposited during neap tide with prevailing south wind.

Keywords: Hydrothermal activity, Iron sedimentation