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Influence of shallow-water hydrothermal activity on the REE geochemistry of iron-rich surface sediment in the Nagahama B

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Satsuma-Iwojima Island is a part of mostly-submerged Kikai Caldera in southwest Japan. Active low-temperature, shallow-water hydrothermal activity in the semi-closed Nagahama Bay of the island supplies dissolved Fe in its baywater, which is then oxidized to ferric hydroxide to form as brownish precipitates. Because of this, seawater of the Nagahama Bay is colored in brown. Such environments may be regarded as a modern analogue for depositional site of ancient banded iron-formation (BIFs). BIFs are chemical sediments, and their trace element contents may reflect those of seawater from which BIFs precipitated. Here we report geochemical characteristics of rare earth element (REE) and yttrium (Y) compositions for various acid-leach from iron-rich modern sediments deposited in the Nagahama Bay. Major motivation of this study comes from questions regarding potential preservation of positive Eu anomaly and negative Ce anomaly, which are typical signatures of hydrothermal fluids and oxygenated seawater, in rapidly-precipitating iron-rich materials in shallow-water hydrothermal environments. Absence of negative Ce anomaly as well as presence of weak negative Eu anomaly and absence of elevated Y/Ho ratios, all observed from chondrite-nomalized REE patterns, consistently suggest that modern iron-rich sediments with high sedimentation rate do not necessarily record typical REE+Y (REY) signatures for hydrothermal fluids and oxygenated seawater. This study has important implications for interpretation of REY geochemistry of ancient BIFs to extract information on paleo-ocean chemistry and signature of submarine hydrothermal activity.

Keywords: Rare Earth Element, Eu Anomaly, Nagahama Bay