Iron isotopes on Fe-Mn crusts from Canary Islands Seamount Province as records of genetic processes in their growth history

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Ferromanganese (Fe-Mn) crusts form mineral deposits on seamounts and submarine plateaus along all the world oceans. In Canary Island Seamount Province (CISP) have been recognized a hundred of hot-spot seamounts and submarine hills and plateaus most of them covered by these deposits. Fe-Mn crusts from CISP have not been thoroughly studied until now. In order increase the knowledge of Fe-Mn crusts from CISP this project has been focused not only on the study of their mineralogy and geochemistry but also in their isotopic signature. In this way we propose an InterRidge Fellowship in order to find out if is possible identify the hydrothermal influence both of Mid Atlantic Ridge and local intra-plate volcanism in the Fe-Mn oxyhydroxides that forms CISP Fe-Mn crusts. Selected samples have been chosen as representative of the most important seamounts of the area, Tropic, The Paps and Echo Sms.

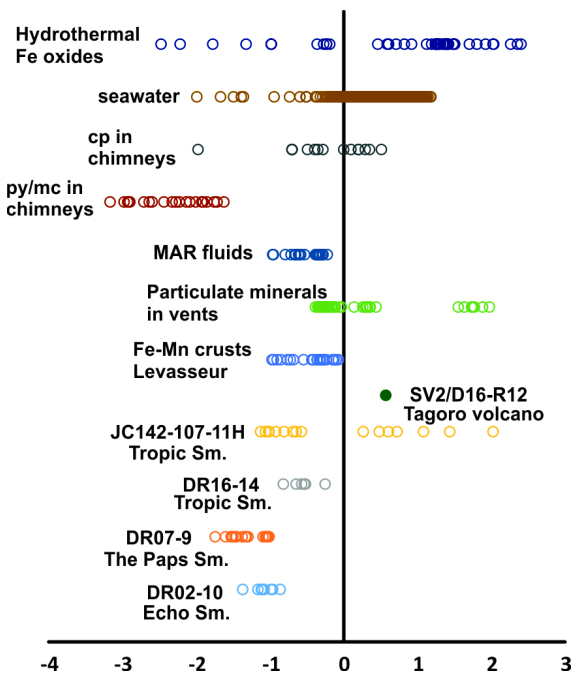

Figure 1. $\delta^{57}Fe$ values of several marine minerals and hydrothermal fluids from different authors compared with samples

This work represents a cooperative project of the Geological Survey of Spain (IGME), the Federal Institute for Geosciences and Natural Resources (BGR), Germany and the Leibniz University of Hannover in the study of Fe-Mn crusts from CISP. Fifty-two spot analyses with LA-ICP-MS have been performed on the five selected crusts obtaining a great range of $\delta^{57}Fe$ values. Several authors studied the $\delta^{57}Fe$ of Fe-Mn crusts find out that the hydrogenetic process results in negative values, from -1.2 to -0.25‰ (Fig. 1; Levasseur et al., 2004). The result of the analyses shows that the $\delta^{57}Fe$ of CISP Fe-Mn crusts vary from very negative at the basal part to more positive through the top. Obtained values of crust DR07-9 shows $\delta^{57}Fe$ values from (-1.06‰) at the base and more positive (-0.70‰) near the top. The same results are observed also in DR02-10 (from -0.94 to -0.65 ‰ $\delta^{57}Fe$) and in crust JC142-11H (from -0.80 to -0.45‰ $\delta^{57}Fe$).

Some Fe-rich laminae found through the crusts lamination have been analyzed showing some differences between them. In crust DR16-14 the very shallow Fe-rich lamina found near the top have a low negative $\delta^{57}Fe$ value (-0.16‰), while similar lamina found in JC142-11H have more negative value (-0.63‰). These Fe-rich laminae have been probably precipitated during a hydrothermal event and after their exposure to the hydrogenetic process have changed their isotopic signature to more negative.

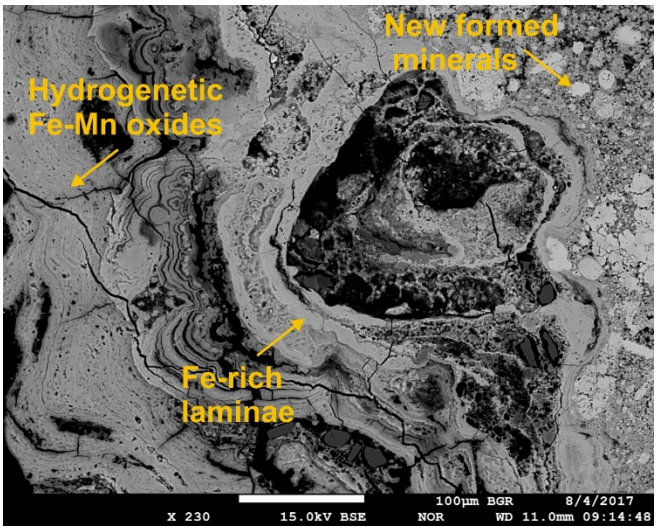

Figure 2. Backscattered image of crust 107-11H (Tropic Seamount) in which is possible differentiate hydrothermal new formed minerals, Fe-rich laminae with hydrothermal origin and hydrogenetic Fe-Mn oxides.

New formed hydrothermal minerals have been found in the substrate rock of the sample JC142-11H (Fig. 2). Results of their analysis show values from +0.18 to +1.34‰ δ^{57}Fe that is consistent with data obtained from minerals precipitated in hydrothermal chimneys from the MAR (Fig. 1; Rouxel et al. 2004). Finally Fe-rich laminae in contact with the substrate rock found in this crust also show positive δ^{57}Fe (from +0.27 to +0.60‰). This is consistent with Fe-oxyhydroxides obtained from the active hydrothermal system of Tagoro volcano in El Hierro Island with +0.57‰ δ^{57}Fe also analyzed in this study.

The result of the Fe isotopic study on CISP Fe-Mn crusts show that these deposits have been formed by the action of different genetic processes. Hydrogenetic formation is the main process in forming Fe-Mn crusts with negative δ^{57}Fe values (from -2 to -0.4‰). The influence of hydrothermal events is marked by continuous Fe-rich laminae through the lamination that also show negative δ^{57}Fe due to their exposure to the hydrogenesis. Finally is possible identify the presence of some Fe-rich laminae in the contact with the altered substrate rock (crust 107-11H) in which the hydrothermal isotopic signature is still visible.

References

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