Magnetostratigraphic Analysis of ferromanganese deposits

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Introduction

Ferromanganese deposits (nodules / crusts) are iron-oxyhydroxides and manganese oxides. These are chemical precipitates on the seafloor that grow over periods of tens of millions of years. Their secular records of chemical, mineralogical, and textural variations are archives of deep sea environmental changes. However environmental reconstruction requires reliable high-resolution age dating (Fig. 1).

Ultrafine-scale magnetostratigraphy utilizing SQUID microscopy is a new chronological tool for estimating ages and growth rates for ferromanganese deposits. It provides chronological constraints with the accuracy promised by the astronomically calibrated magnetostratigraphic time scale.

OBJECTIVES

- To find the suitability of ferromanganese deposits for magnetostratigraphy;
- To date the ferromanganese deposits by magnetostratigraphy;
- To reconstruct paleoenvironment, based on the dated ferromanganese deposits;
- To compare results from Rio Grande Rise and Tropic seamount.

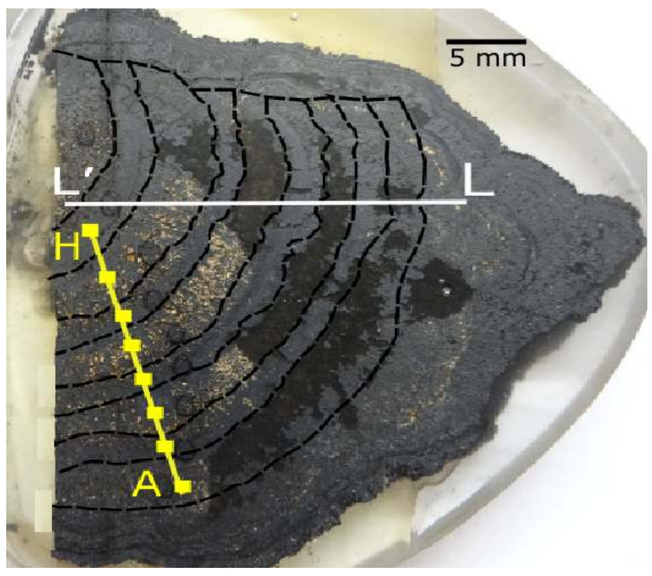

Fig. 3: Fe-Mn nodule sample. The line L-L´ shows geochemical measurements while the line A-H shows magnetic measurements.

MATERIALS AND METHODS

Since samples are delicate and fragile, it is intended to fix them with epoxy resin. The samples will be cut per required experiment, for instance, for magnetic measurements it is intended to cut them thin, according to the growth layers.

Scanning SQUID microscopy will be the fundamental method to characterize distinctive magnetic parameters, *e.g.,* Natural Remanent Magnetization (NRM)

Other rock magnetic and paleomagnetic measurements such as, Hysterisis parameters, calculation of First Order Reversal Curves (FORCs), Isothermal Remanent Magnetization (IRM) and Anhysteric Remanent Magnetization (ARM) etc., will be applied on the samples utilizing Alternating Gradient Magnetometer (AGM) or Vibrating Sample Magnetometer (VSM).

HYPOTHESIS

It is hypothesized that ultrafine scale magnetostraigraphy of ferromangeanese deposits provides reliable high resolution age dating, consequently giving a better understanding of the paleoenvironmental conditions involved in the formation of these deposits (Fig. 1).

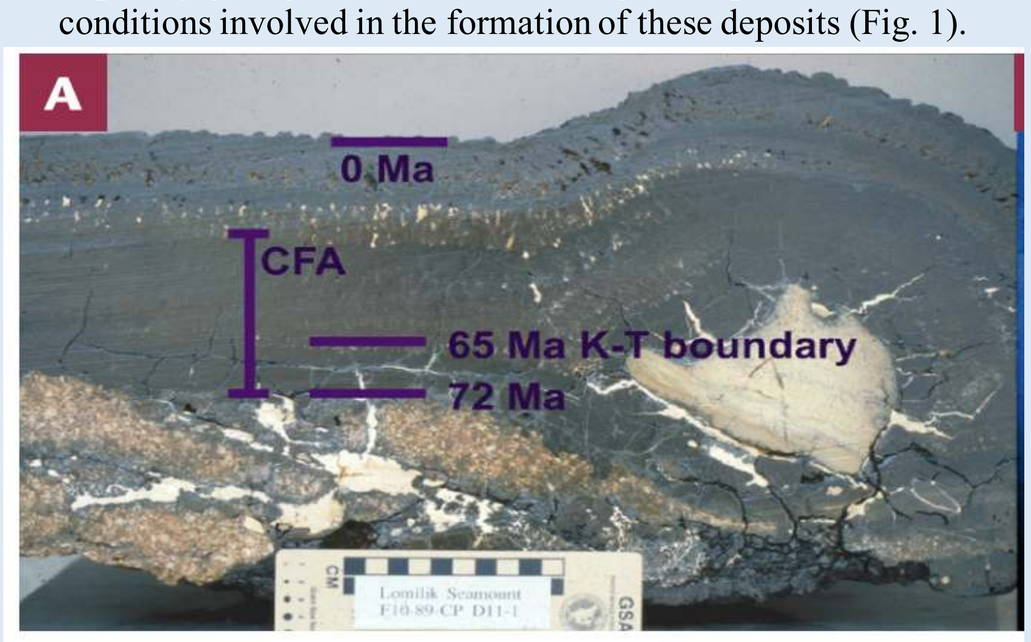

Fig. 1: CFA= Carbonate Fluorapatite, (Koschinsky and Hein, 2017)

STUDY AREA

- Tropic seamount is located in the north-east tropical Atlantic (23.5° N, 20.4° W, Fig. 2) 650 km southwest of Canary Islands, Tropic Seamount has an area of about 770 km². Samples have already been collected using Remotely Operated Vehicle (ROV).
- Rio Grande Rise is located in the south-west Atlantic (31.0°S, 35.0 °W, Fig. 2). Samples will be collected using ROV in September-October 2018. ROV provides a nice spatial resolution in terms of sample location and water depth.

Fig. 2

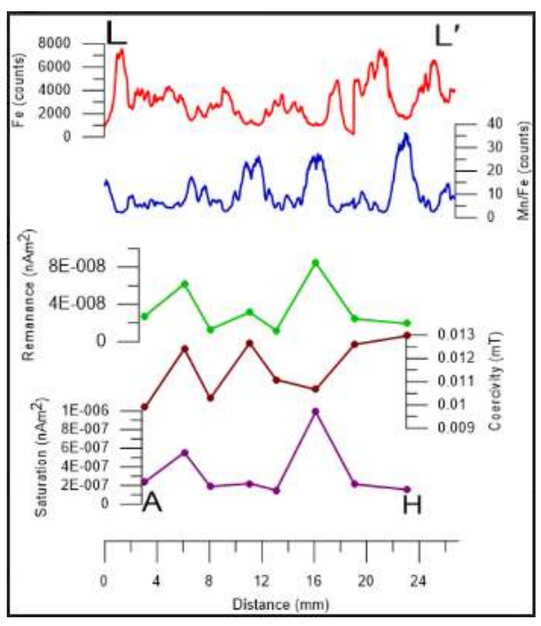

Fig. 4: Red and Blue curves show geochemical results while green, brown and purple curves show rock magnetic measurements.

PRELIMINARY RESULTS

A ferromanganese nodule sample from Clarion-Clipperton Zone (north-east pacific) was collected by Agassiz Trawl method at water depth 4130m. (Fig.3)

It was found that the sample had a variety of elements including Ni, Co, Cu, Ti and REY, but it was realized that the alternative Iron rich layers corresponded to porous and fragile part while Manganese layers corresponded to solid and consolidated part of the sample (Fig. 4). The geochemical studies (micro-XRF analysis) was performed at Laboratório Nacional de Luz Síncrotron (LNLS), (Benites et al., 2018-submitted).

Hysteresis and FORCs of 8 sub-samples (Fig. 3) revealed the presence of non-interacting single domain magnetic particles with the coercivity ranges between 4 mT to 50 mT. Magnetic measurements were perfomed at Centro Oceanográfico de Registros Oceanográficos (CORE) IOUSP by using Alternating gradient Magnetometer. (Fig. 4&5)

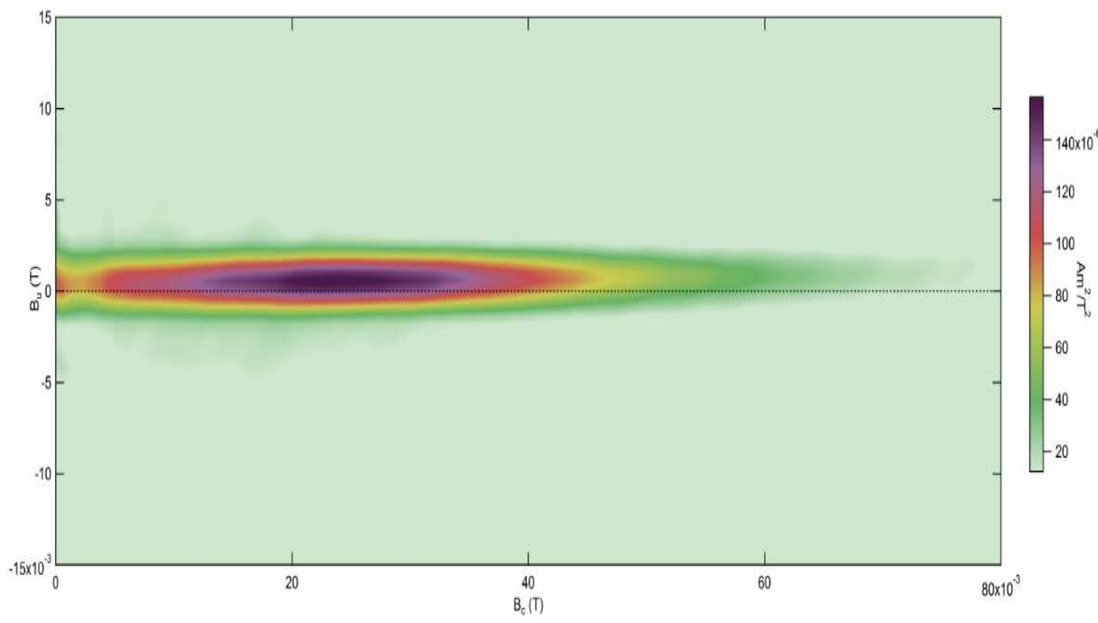

Fig. 5: FORC of one of the sub-samples "D"

ACKNOWLEDGEMENT

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