ICHNOFABRIC CONTROL ON PETROPHYSICAL SIGNATURE IN CARBONATE CONTOURITE DRIFTS

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PROJECT OBJECTIVES

- Test the hypothesis that different ichnofabrics in carbonate contourite drifts have distinct petrophysical properties.
- Compare ichnofacies and petrophysical signatures of slope deposits to those in carbonate contourite drifts to produce discriminating criteria.
- Incorporate these results into a more general catalogue for discriminating slope/basin deposits from carbonate contourite drifts using petrophysical logs.

BACKGROUND AND PROJECT RATIONALE

Bioturbation is common in contourite drifts. In fact, some researchers consider bioturbation to be a diagnostic feature that differentiates contourites from associated facies such as turbidites (e.g. Wetzel et al., 2008), while others have used the different ichnofacies solely as a paleoenvironmental indicator (e.g. Rodríguez-Tovar and Hernández-Molina, 2018, Rodríguez-Tovar et al., 2017). The integration of grain size, mineralogy, and ichnology define the ichnofabric of a rock. Ichnofabric analysis is, thus, an excellent tool to incorporate original sedimentary features (i.e. grain size, texture, and composition) with biodeformational aspects such as diversity, size, tiering, and cross-cutting relationship of ichnotaxa (Reolid and Betzler, 2018; Reolid, 2021).

In carbonate contourite drifts three main types of ichnofabrics are recognized: 1) coarse-grained and completely bioturbated sediment typical of delta drifts; 2) intensely bioturbated fine-grained deposits that may or may not exhibit discrete trace

Figure 1: One inch plugs of fine-grained wackestone with tiers of Zoophycos that is one of the typical ichnogenera for carbonate contourite drifts.

fossils out of the mottled background (Fig. 1); and 3) sediment with present to absent trace fossils and preserved sedimentary structures (Reolid and Betzler, 2018). The working hypothesis is that these different ichnofabrics can be separated by their petrophysical signature.

APPROACH AND DATA SETS

In the assessment of the relationship between ichnofabric and petrophysical signature we will begin with the large number of plugs from cores retrieved from the carbonate drifts of the Maldives (IODP Expedition 359). These plugs, which display variable amounts of bioturbation (Fig. 1), will be sorted out into the different ichnofabrics defined by Reolid and Betzler (2018). Porosity, permeability, sonic velocity and resistivity have been measured in all these plugs. Likewise, a similar, albeit a bit smaller, data set exists from the slope deposits that underlie the drift in the Maldives.

Cores through the Santaren Drift in the Bahamas were retrieved during ODP Leg 166. The Miocene portion of this drift is superbly preserved with excellent core recovery. Here, core photographs will be studied for the various ichnofabrics and, based on this analysis, we will request samples from the ODP core repository for laboratory measurements that would cover the same petrophysical properties as the ones from the Maldives.

In both study sites, contourite drifts and slope carbonates are deposited in and retrieved from the cores, allowing for a comparison of the petrophysical properties of these two systems. Kenter et al. (2002) measured the slope sections in the Bahamas, while Emma Giddens measured the slope carbonates in the Maldives.

GOAL

The goal of this study is to explore the potential for discriminating between depositional variations in carbonate drifts recorded in the ichnofabrics using petrophysical properties. If successful, these results will be incorporated into the comprehensive petrophysical database of carbonate contourite drifts that we are assembling at the CSL.

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