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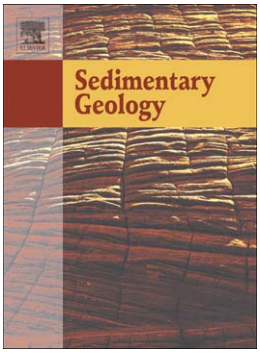

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PII: S0037-0738(16)30281-0
DOI: doi:10.1016/j.sedgeo.2016.11.005
Reference: SEDGEO 5132

To appear in: *Sedimentary Geology*

Received date: 5 October 2016
Revised date: 9 November 2016
Accepted date: 13 November 2016

Please cite this article as: Eltom, Hassan A., Abdullatif, Osman M., Makkawi, Mohammed H., Rare Earth Element Geochemistry of Shallow Carbonate Outcropping Strata in Saudi Arabia: Application for Depositional Environments Prediction, *Sedimentary Geology* (2016), doi:10.1016/j.sedgeo.2016.11.005

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Rare Earth Element Geochemistry of Shallow Carbonate Outcropping Strata in Saudi Arabia: Application for Depositional Environments Prediction

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Abstract

The interpretation of depositional environments provides important information to understand facies distribution and geometry. The classical approach to interpret depositional environments principally relies on the analysis of lithofacies, biofacies and stratigraphic data, among others. An alternative method, based on geochemical data (chemical element data), is advantageous because it can simply, reproducibly and efficiently interpret and refine the interpretation of the depositional environment of carbonate strata.

Here we geochemically analyze and statistically model carbonate samples (n=156) from seven sections of the Arab-D reservoir outcrop analog of central Saudi Arabia, to determine whether the elemental signatures (major, trace and rare earth elements [REEs]) can be effectively used to predict depositional environments. We find that lithofacies associations of the studied outcrop (pretidal to open marine depositional environments) possess altered REE signatures, and that this trend increases stratigraphically from bottom-to-top, which corresponds to an upward shallowing of depositional environments. The relationship between REEs and major, minor and trace elements indicates that contamination by detrital materials is the principal source of REEs, whereas redox condition, marine and diagenetic processes have minimal impact on the relative distribution of REEs in the lithofacies.

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