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Combined heavy mineral and biomarker analysis in silt: a novel approach for provenance studies (Indus Fan, IODP Expedition 355)

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A high-resolution mineralogical study of Indus Fan turbiditic sediments cored during IODP Expedition 355 (Arabian Sea Monsoon) in the Laxmi Basin was carried out to investigate and quantify the different compositional signatures encoded in the sand, silt, and clay fractions. The turbidite deposits recovered at IODP Sites U1456 and U1457 in sedimentological Unit II were chosen as the best candidate for such a study. The integrated dataset presented here was obtained by coupling traditional and innovative bulk-sediment to single-grain analytical techniques, including bulk petrography, heavy-mineral and biomarker analyses on the same samples. Reliable quantitative results even in the medium to fine silt classes, which represent the dominant sediment sizes encountered in the recovered cores, were obtained by point-counting under the microscope, assisted by Micro-Raman spectroscopy (Andò et al., 2011; 2014).
Preliminary data from the studied turbidites document rich and diverse heavy mineral assemblages in both the sand and silty-sand fractions. Heavy-mineral concentrations, as well as the number of mineral species, reach a maximum in sand and tend to decrease with grain size, becoming minimal in the clay fraction. Conversely, the biomarker analysis is generally focused on the finer sediment fractions and clay, where better preservation of biomarker compounds are obtained. The two approaches are thus complementary. Because biomarkers tend to be depleted in sand and heavy minerals in clay, the medium silt fraction represents the most suitable size window for the joint application of these two techniques. Comparing heavy-mineral assemblages with biomarkers allows us to evaluate both continental and marine inputs in turbidites and the hemipelagic deposits of the Indus Fan. This new methodological approach plays a key role in the identification of the effects of climate change on marine depositional environments and helps us to differentiate among the diverse Himalayan versus Indian Peninsular sources of detritus. Considered together, the organic and inorganic compositional fingerprints of sediments opens up a new frontier for future studies of the largely unexplored deep-marine sedimentary record.

Cited references

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