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Jiawang Wu, Zhifei Liu, Chao Zhou

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Provenance and supply of Fe-enriched terrigenous sediments in the western equatorial Pacific and their relation to precipitation variations during the late Quaternary

Jiawang Wu*[1], Zhifei Liu**, Chao Zhou

State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China

* Corresponding author. Tel.: +31 30 253 4991; fax: +31 30 253 5302.
** Correspondence to: Z. Liu. Tel.: +86 21 6598 4877; fax: +86 21 6598 8808.
E-mail address: j.w.wu@uu.nl (J. Wu), lzhifei@tongji.edu.cn (Z. Liu).
[1] Now at Utrecht University, P.O. Box 80.021, 3508 TA Utrecht, the Netherlands.

Abstract

Iron (Fe) deposition in the equatorial Pacific has important implications for the global carbon cycle, while the provenance of Fe supply and its change remain highly debated. Here, we geochemically characterize the provenance of terrigenous sediments deposited on the pathways of the Equatorial Undercurrent (EUC) and the New Guinea Coastal Undercurrent (NGCUC). The Fe-enriched sediments in the western equatorial Pacific are mostly derived from fluvial inputs of Papua New Guinea (PNG), while nearly negligible impact from aeolian dust could be detected. Variability of the terrigenous Fe-enriched deposition (7.4–13.4%) for core KX21-2 in the western equatorial Pacific over the past 380 ka shows dominant precession periods, superimposed on a clear glacial-interglacial trend with higher input during glacials. The precession periods are correlated with the precipitation over PNG, in response to the local summer insolation (5°S, March) and meridional migration of the Intertropical Convergence Zone (ITCZ). The glacial-interglacial trend is induced by sea level fluctuations that significantly influence the fluvial input from southern PNG. The different expression of precession periods between glacials and interglacials in core KX21-2 is tightly associated with the undercurrent. The subdued precession periods during interglacials can be attributed to the weakness of the NGCUC, which may link to La Niña-like conditions. The enhanced precession periods during glacials should result from increased input from southern PNG on one hand, and an intensified NGCUC on the other hand, due to the El Niño-like conditions. Compared to Fe, the proxy ln (Ti/Total) (XRF log-ratio of Ti/Total counts) for core KX21-2 preferentially indicates the northern PNG input, and therefore could be used to reflect the glacial changes in the NGCUC. Our records imply that the NGCUC was particularly stronger in MIS 6 and 10, and weaker in MIS 8.

Keywords: iron; geochemistry; precession period; glacial-interglacial change; New Guinea Coastal Undercurrent; western equatorial Pacific

1 Introduction

Vast areas of the modern ocean are characterized by excess nutrients yet low concentrations of chlorophyll in the euphotic zone. Martin (1990) proposed that primary productivity in these high-nutrient low-chlorophyll (HNLC) regions is limited by the availability of iron (Fe). This hypothesis has been demonstrated in the equatorial Pacific, one of the largest HNLC regions (e.g. Behrenfeld et al., 1996; Coale et al., 1996a; 1996b; Gordon et al., 1997). Moreover, deposition of