# The Neogene Indian Ocean Record of Asian monsoon Driven Ocean Currents and Winds from the Maldives (IODP Exp. 359)

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November 22, 2022

**Abstract**

The Maldives archipelago acts for over 25 myrs as a giant natural sediment trap in the eastern Arabian Sea. Drifts and periplatform deposits bear the record of environmental changes such as sea-level fluctuations but also of monsoon-driven changes of the surface and intermediate water mass current regime, and of wind-driven dust influx. Carbonate drifts in the Inner Sea indicate the establishment of a strong wind-driven current regime in the Maldives at 12.9 – 13 Ma. Ten unconformities, dissecting the Miocene to Recent drift sequences, attest to changes in current strength or direction. A major shift in the drift packages is dated at 3.8 Ma that coincides with the end of stepwise platform drowning and a reduction of the OMZ in the Inner Sea. The lithogenic fraction of the Maldives carbonate drifts provides a unique record of atmospheric dust transport during the past 4 myrs as grain size provides proxies for dust flux as well as wind transport capacity. Entrainment and long-range transport of dust in the medium to coarse silt size range is linked to the strength of the Arabian Shamal winds and the occurrence of convective storms which prolong dust transport. Dust flux and the size of dust particles increased between 4.0 and 3.3 Ma, corresponding to the closure of the Indonesian seaway and the intensification of the South Asian Monsoon. Between 1.6 Ma and the Recent, dust flux again increased and shows higher variability, especially during the last 500 kyr. Transport capacity increased between 1.2 and 0.5 Ma but slightly decreased since then. Dust transport varies on orbital timescales, with eccentricity control being the most prominent (400 kyr throughout the record, 100 kyr between 2.0 and 1.3 Ma, and since 1.0 Ma). Higher frequency cycles (obliquity and precession) are most pronounced in wind transport capacity. The published and ongoing studies of IODP Expedition 359 cores show that deposits surrounding carbonate platforms, i.e. carbonate drifts, bear a previously underestimated potential to add substantial knowledge for the understanding of the monsoon evolution on million-year, but also on shorter time scales. Potential targets for further research and drilling are for example the Laccadives, the Mascarene Plateau or the South China Sea platforms.

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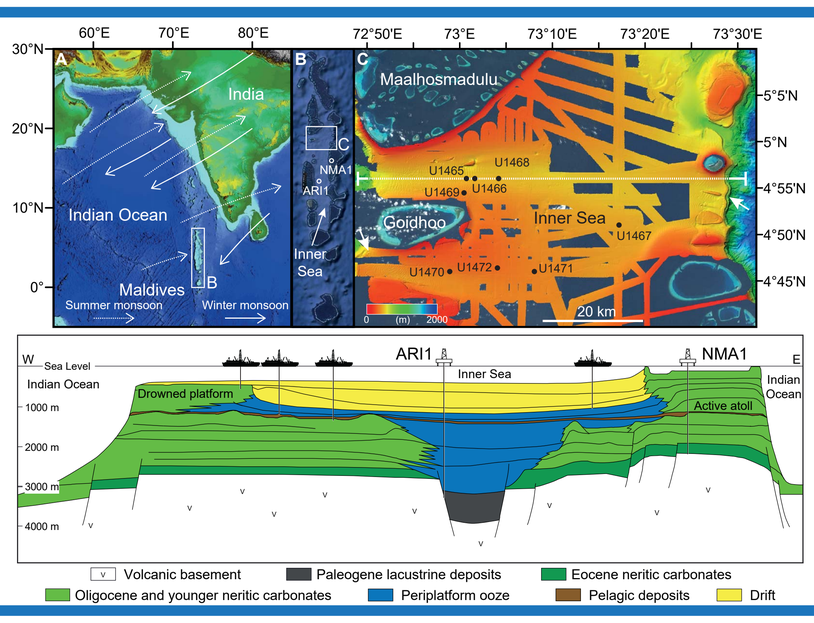
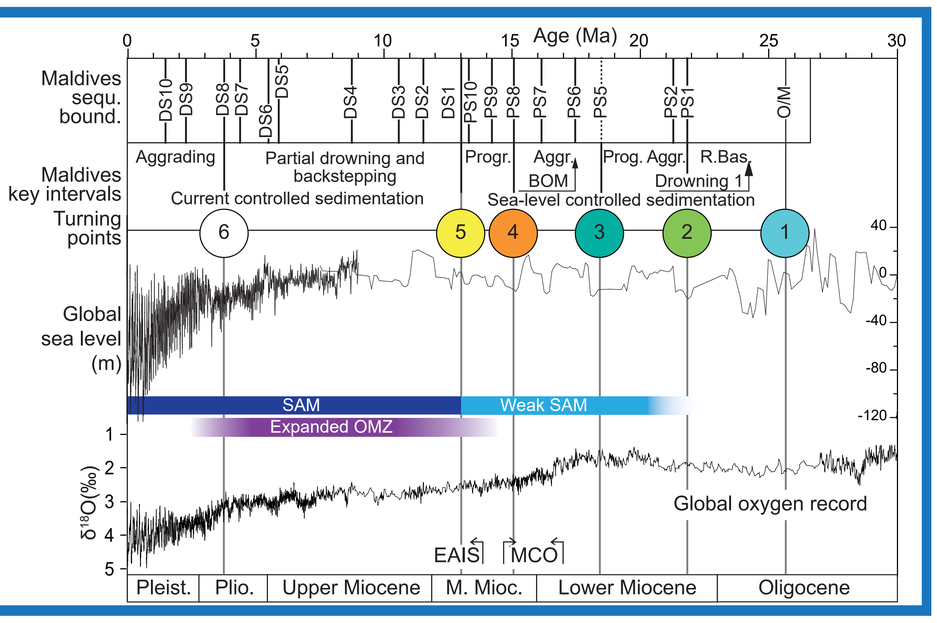
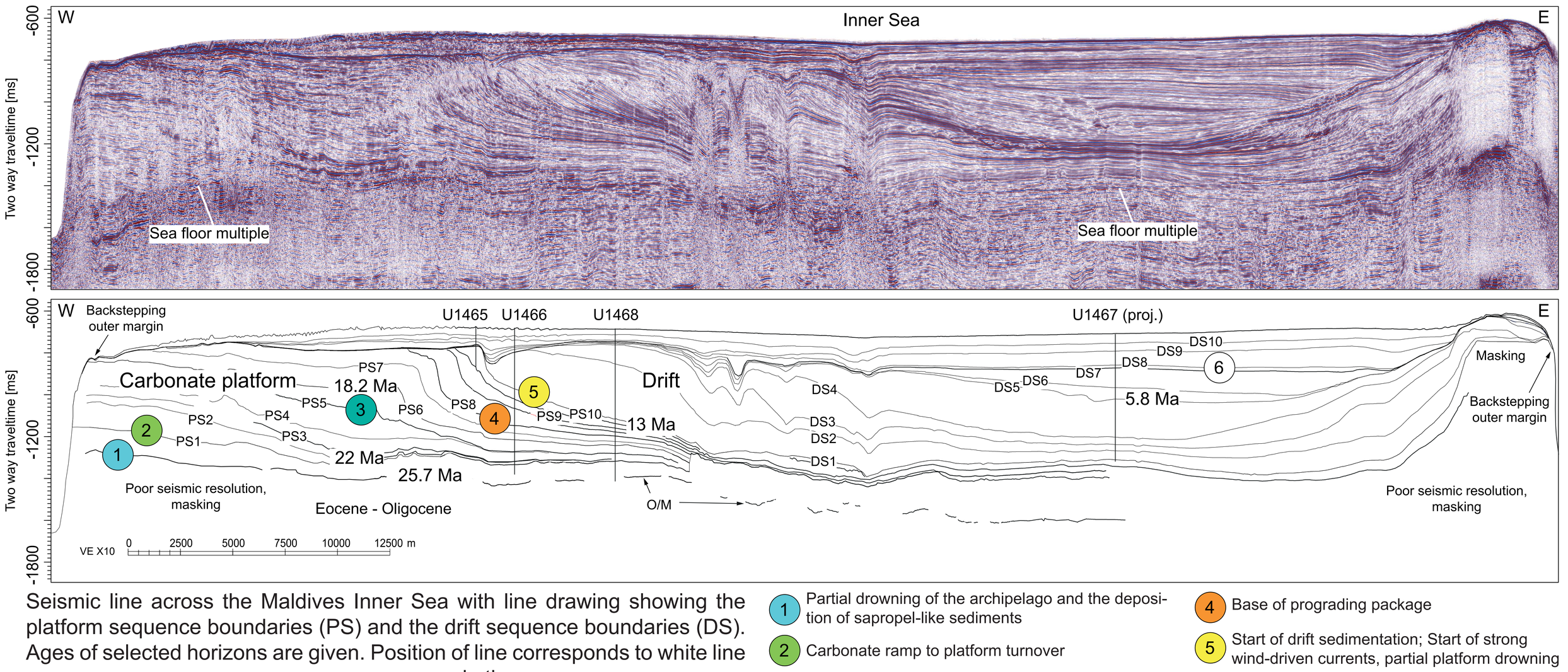
## Introduction

The Maldives archipelago acts for over 25 myrs as a giant natural sediment trap in the eastern Arabian Sea. Drifts and periplatform deposits bear the record of environmental changes such as sea-level fluctuations but also of monson-driven changes of the surface and intermediate water mass current regime, and of wind-driven dust influx. Carbonate drifts indicate the establishment of a strong wind-driven current regime in the Maldives at 12.9 – 13 Ma. A major shift in the drift packages is dated at 3.8 Ma that coincides with the end of stepwise platform drowning and a reduction of the OMZ in the Inner Sea.




## Currents and drifts

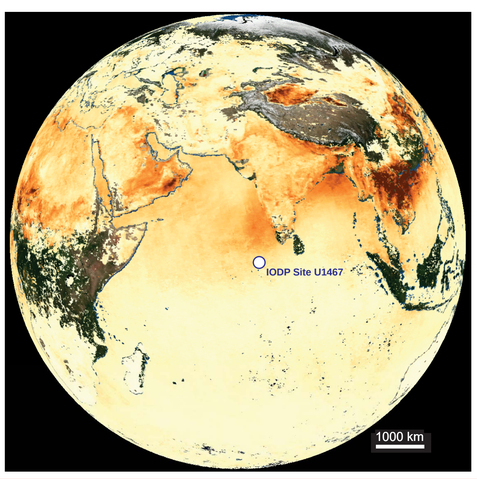


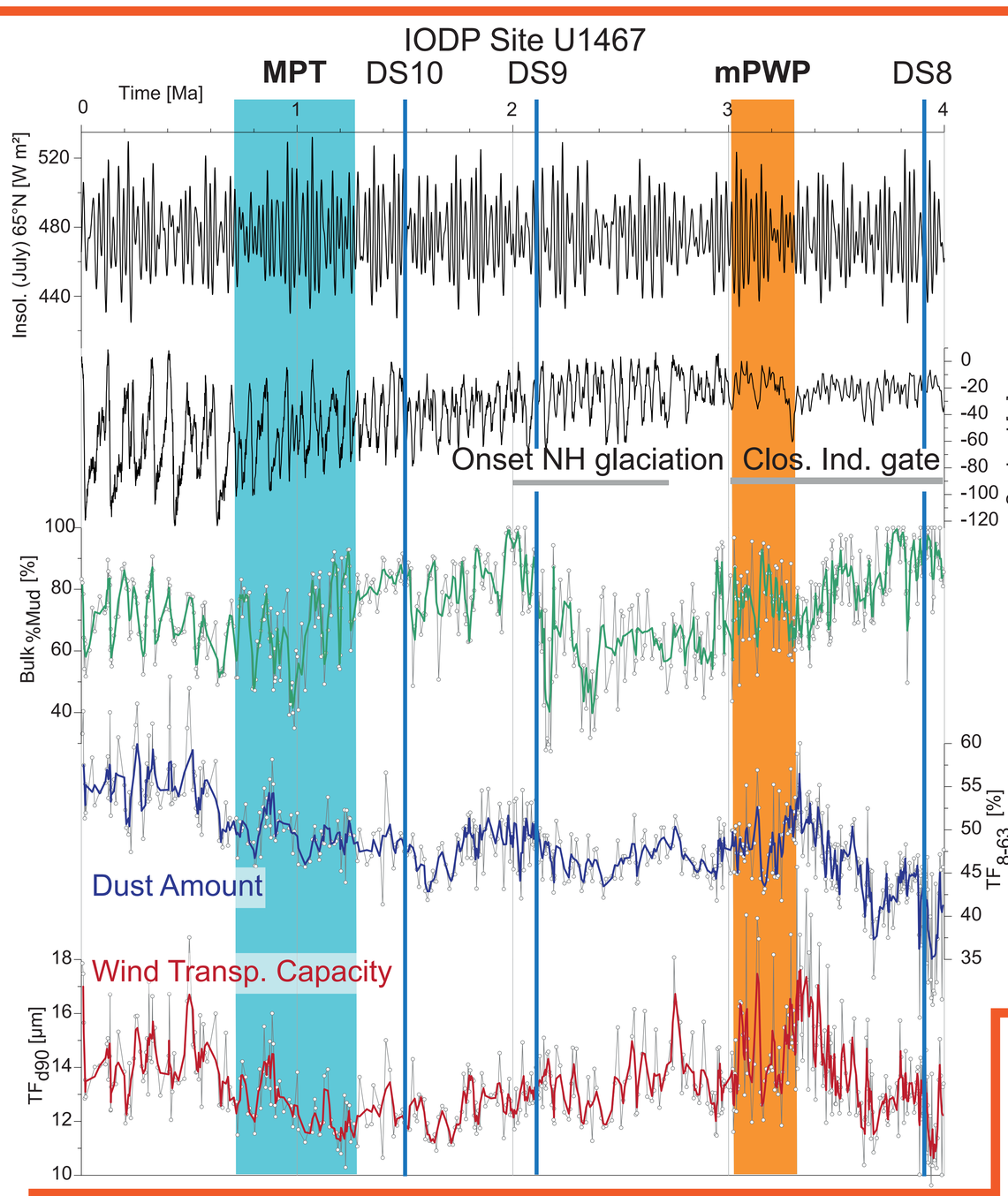

Seismic line across the Maldives Inner Sea with line drawing showing the platform sequence boundaries (PS) and the drift sequence boundaries (DS). Ages of selected horizons are given. Position of line corresponds to white line in the map.

1. Partial drowning of the archipelago and the deposition of sapropel-like sediments
2. Carbonate ramp to platform turnover
3. Base of aggrading-prograding package
4. Base of prograding package
5. Start of drift sedimentation; Start of strong wind-driven currents, partial platform drowning
6. End of platform drowning steps

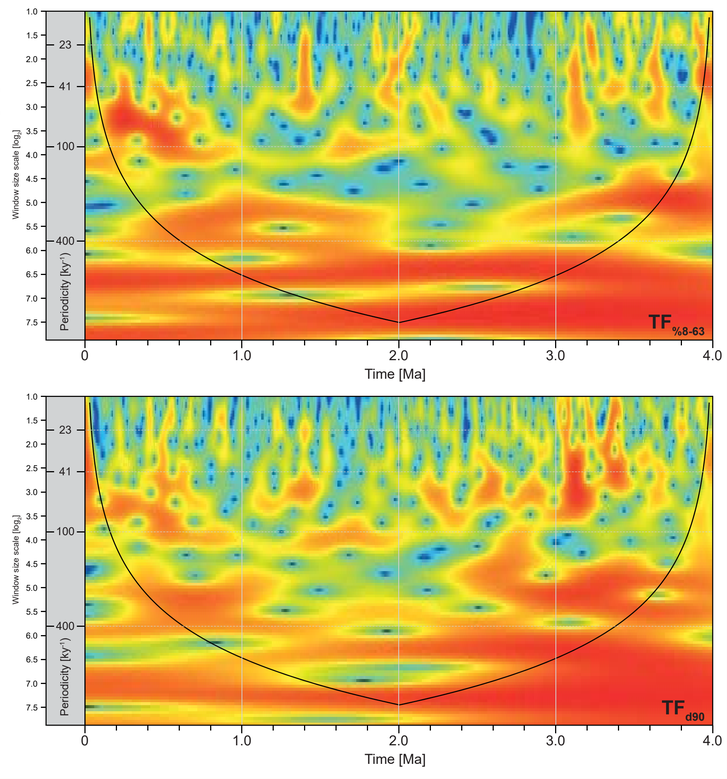
## Dust in the wind

The lithogenic fraction of the carbonate drifts provides a unique record of atmospheric dust transport during the past 4 myrs as grain size provides proxies for dust flux as well as wind transport capacity. Entrainment and long-range transport of dust in the medium to coarse silt size range is linked to the strength of the Arabian Shamal winds and the occurrence of convective storms which prolongate dust transport. Dust flux and the size of dust particles increased between 4.0 and 3.3 Ma, corresponding to the closure of the Indonesian seaway and the intensification of the South Asian Monsoon. Between 1.6 Ma and the Recent, dust flux again increased and shows higher variability, especially during the last 500 kyr. Transport capacity increased between 1.2 and 0.5 Ma but slightly decreased since then.




Dust transport varies on orbital timescales, with eccentricity control being the most prominent (400 kyr throughout the record, 100 kyr between 2.0 and 1.3 Ma, and since 1.0 Ma). Higher frequency cycles (obliquity and precession) are most pronounced in wind transport capacity.




### Further details:

Betzler, C., Eberli, G.P., Lüdmann, T. et al. (2018) Refinement of Miocene sea level and monsoon events from the sedimentary archive of the Maldives (Indian Ocean). Progress in Earth and Planetary Science, 5, DOI 10.1186/s40645-018-0165-x.

Lindhorst, S., Betzler, C. and Kroon, D. (2019) Wind variability over the northern Indian Ocean during the past 4 million years – Insights from coarse aeolian dust (IODP Exp. 359, Site U1467, Maldives). Palaeogeography, Palaeoclimatology, Palaeoecology, 536, DOI 10.1016/j.palaeo.2019.109371.

Funding by the BMBF, DFG, and IODP is gratefully acknowledged