Magnetic rock fragments and the formation of the Namib Sand Sea

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The Namib Sand Sea on the west coast of Namibia is one of the world's oldest desert region and based on cosmogenic dating, it likely consists since the earlier Pleistocene. Among the possible sand sources, geomorphological and petrographic evidence points towards the Orange River catchment as the most prominent one. Little is known about the dynamics of transport and mixing of the sand during the desert formation and this is because the information about the Namib Sand Sea generally rests upon study sites at its edges. Here, we present a statistical analysis of magnetic components in sand samples collected along a south to north transect from Lüderitz to Walvis Bay, west to east profile along the Kuiseb river and Tsondab Valley and in the Namib Rand that form part of the eastern edge of the Sand Sea.

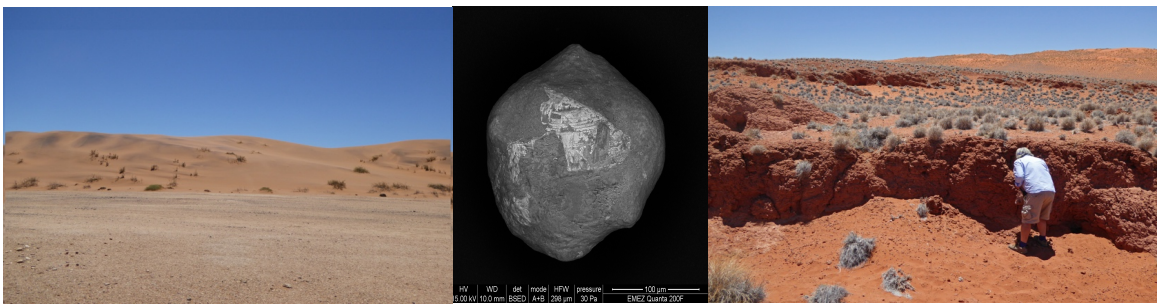

Figure 1: Dune with blackish areas at the crest due to basaltic rock fragments (left); back-scattering SEM micrograph of a sand-sized basaltic rock fragment White areas are consist of the magnetite crystals (middle); Tsonsab sandstone in the front overlain by a sand dune (right)

The dunes often show areas with a blackish hue that is caused by rock fragments mainly of basaltic origin (Figure 1). The magnetite (Fe_3O_4) constituents of the fragments determine the magnetic property. This property of the basaltic grains is used as proxy to infer the concentration of the fragments in sand dunes. Their statistically uniform magnetite concentration determined by the magnetic susceptibility of the sand of the dunes reveals no significant variation. This indicates no source other than the Orange River and thus a predominant northwards direction of the sand transport. This transport and the absence of a magnetic trend along the south-north and west-east transects suggest mixing of the sand prior to its deposition in the Namib Sand Sea, most likely during river transport and under high current conditions along the shoreline. Finally, the uniform magnetic pattern provides compelling evidence for a stable erosion regime in the Orange River catchment with a steady release of magnetic components at least since the Pleisocene. Preliminary data from the Namib Rand indicate a slight departure from the magnetic pattern found in the dunes. This is probably due to the input of magnetic constituents from the Protozoic rock formations in the vicinity.
In addition we sampled the Tsondab sandstone formation, which can be considered as Tertiary paleo-erg. The Tsondab sandstone underlies much of the Namib Sand Sea (Figure 1). The comparison of the magnetic content of the sand material of the two ergs shows similar properties. This suggests that the Namib dunes can partly contain reworked material from the Tsondab sandstone, mainly in the eastern part, where the dunes have a reddish colour similar to that of the Tsondab sandstone. Because of the similar magnetic pattern it can be assumed that the Tsondab sandstone had also the Orange River as primary sand source.

In summary, the analysis magnetic characteristics of dune in the Namib and paleo-dunes provides additional information to the formation of the Namib Sand Sea and can complement the rich geomorphological data set.

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Figure 1. Gobabeb Research and Training Centre in Namibia.

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