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Vegetated linear dunes – chronologically discontinuous archives of several short-term and major dune growth episodes

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Quartz sand dunes cover massive areas defined as arid, making them a potentially important archive of past climates and environments. But, dunes, being highly dynamic and relatively uniform in sedimentological composition, often compromise this potential. Most inland dunes are of the linear type that has a sinuous planar shape. Linear dunes, also associated with active seif dunes, are elongated by oblique cross-(dune) crest deflection of sand grains due to acutely bimodal sand-transporting winds. This prevents formation of long-term and stratigraphically continuous internal dune structure (though fully exposed internal linear dune structures to support this conclusion are rarely found). Therefore, dating of the dune sand by luminescence methods is mainly restricted to the last (re)mobilization phase and cannot track earlier dune growth history.

Vegetated linear dunes (VLDs), mainly found in low-latitudes, are characterized by a straight planar shape and a partial shrub cover, and have been proposed to comprise an independent dune type. The stratigraphic cross-section of the VLD includes a sequence of chronologically discontinuous sand units forming the dune core. The accumulation of the units is generally interpreted to pertain to major episodes of strong wind power when sand was available. Possible minor events of sand accumulation are presumed to have been erased by major episodes. The units, often structureless and of similar sedimentological properties can only be discerned by luminescence dating as contacts between units do not necessarily imply chronological boundaries. The VLD core is overlaid by a mantle of sand that while being intermittently morphologically and structurally configured by seasonal winds to depths of several meters, preserves the dune core stratigraphy. Therefore, in a sense, the VLD is a prominent sedimentary body archiving influential short-time and possibly extreme events.

Based upon exposed dune stratigraphy, ground-penetrating radar profiling and morphologic analysis, coupled with spatial dense optically stimulated luminescence (OSL) dated full dune cores, the VLD core structure is found to repeat itself in the northwestern Negev (Israel) dunefield, for three time orders, each representing different palaeoclimatic and palaeoenvironmental conditions. Accordingly, a full dune core coring strategy for retrieving luminescence ages which date the major VLD core units is required for adequately dating a vegetated linear dunefield. Exposed sections of VLD cores that reveal the full dune core structure are very important for such dating strategies.

The VLD type is suggested to inherently comprise a distinct archive of unique past conditions, mainly since the last glacial. However, further study is required for robust palaeoclimatic interpretation of these archives.