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Covering more ground more quickly: an approach for rapid dunefield dating using a portable luminescence reader

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Understanding Late Quaternary dunefield landscape evolution helps to constrain the mechanisms behind long-term changes in key climate variables such as precipitation, moisture balance and the wind. In turn this provides a basis to understand how predicted changes to moisture balance and windiness may influence dunefield activity under future climate change. In order to reconstruct landscape and palaeoenvironmental evolution we need a dataset from the sedimentary dunefield archive with wide spatial coverage and a density of dating that is great enough to facilitate an accurate dunefield-scale reconstruction. However, dunefield-scale reconstructions are extremely time-consuming and resource intensive, particularly undertaking laboratory-based luminescence dating protocols.

Being able to make a rapid assessment of sediment burial age using a portable luminescence reader (POSL) is therefore extremely useful. However, moving beyond relative- age information that guides initial field interpretations toward rapid age assessment has been more challenging. This research is the first, widespread, demonstration of a simple, elegant and practical calibration of POSL signals into sample age estimates. This involved measuring the POSL signals from 148 samples with established published ages from across southern Africa, and a regression analysis (Stone et al., 2015; Stone et al., under review). The data show that a regional-specific approach to calibration is needed, with regional patterns in POSL signals that are supported by 159 further undated samples. Sample composition data, such as quartz to feldspar ratios appears to account for the largest contrasts within the dataset, whilst inherent POSL signal brightness and grain coloured-coatings (iron and clay) may also influ-ence signals. The strength of the regressions (R^2 of 0.99, 0.93, 0.81 and one moderate at 0.52) between POSL signals and sample age demonstrates the practicality and huge value of this simple approach, circumventing the need to irradiate bulk sediment samples from (or in) the field to correct for sensitivity. The implication is that region-specific calibrations must be built prior to using the POSL reader for rapid age assessments. This approach is a cost and time effective method for inter-dunefield landscape-scale analyses, which will cast light on the key climatic variables driving landscape change in sand-rich drylands during the Late Quaternary.

References

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