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A systematic study of resistant organic matter and soil carbon dynamics in South African drylands.

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The sheer area of the world's drylands means that its soil organic matter (SOM) comprises as much as 16% of the global soil carbon pool. It is frequently assumed that in arid and semi-arid environments organic matter concentrations in soils and sediments are very low, a function of strongly oxidising conditions, relatively high temperatures and the rapid turnover of SOM. The concept of selective degradation implies that in contemporary soils, especially within SOM-poor dryland environments, the most labile OM fractions will be rapidly mineralised resulting, at least for a time, in the preferential preservation of more recalcitrant OM. Although this concept is shown to work in geological settings, this idea has yet to be tested over much shorter timescales; despite its significant implications for the assessment of dryland soil carbon stocks.

The west coast of southern Africa is a renowned dryland environment and biodiversity hotspot of international significance. Here we examine the OM composition of contemporary soils and sediments in the Succulent Karoo and Fynbos biomes of this region. SOM is characterised at the molecular level by pyrolysis-GC/MS and FTIR analyses. An extensive programme of systematic field sampling provided plants and soils covering the full range of environments on the west coast of South Africa. This incorporates a number of major climatic and ecological transitions.

Here we report the following: 1) molecular characterisation of modern SOM pools in relation to environment (climate, substrate) and modern ecology (OM source); 2) selective degradation of SOM and the preservation of specific recalcitrant plant-derived macromolecules. In this region these are hypothesised to be closely associated with resistant leaf cuticles from succulent plants (i.e. cutan; Boom et al., 2005). The selective preservation of cutan, which is resistant to acid hydrolysis and base saponification should produce soils characterised by highly aliphatic pyrograms. 3) The implications for longer-term SOM turnover/preservation in dryland environments.