EVOLUTION, ECOLOGY AND BIODIVERSITY IN OLD, INFERTILE LANDSCAPES

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OCBIL theory[1] aims to develop an integrated series of hypotheses explaining the evolution and ecology of, and best conservation practices for, biota on very old, climatically buffered, infertile landscapes (OCBILs). Conventional theory for ecology and evolutionary and conservation biology has developed primarily from data on species and communities from young, often disturbed, fertile landscapes (YODFELs), mainly in the Northern Hemisphere. OCBILs are rare, but are prominent in the Southwest Australian Floristic Region, South Africa's Greater Cape, and Venezuela's Pantepui Highlands (Fig 1). They may have been more common globally before Pleistocene glaciations. Based on the premise that natural selection has favoured limited dispersability of sedentary organisms, OCBILs should have elevated persistence of lineages (Gondwanan Heritage Hypothesis) and long-lived individuals (Ultimate Self Hypothesis), high numbers of localised rare endemics and strongly differentiated population systems. To counter such natural fragmentation and inbreeding due to small population size, ecological, cytogenetic and genetic mechanisms selecting for the retention of heterozygosity should feature (the James Effect). The climatic stability of OCBILs should be paralleled by persistence of adjacent semi-arid areas, conducive to speciation (Semiarid Cradle Hypothesis). Special nutritional and other biological traits associated with coping with infertile lands should be evident, accentuated in plants, for example, through waterforaging strategies, symbioses, carnivory, pollination and parasitism. The uniquely flat landscapes of southwestern Australia have had prolonged presence of saline lakes along palaeoriver systems favouring evolution of accentuated tolerance to salinity. Lastly, unusual resiliences and vulnerabilities might be evident among OCBIL organisms, such as enhanced abilities to persist in small fragmented populations but great susceptibility to major soil disturbances. In those places where it is most pertinent, OCBIL theory hopefully lays a foundation for future research and for better informed conservation management.

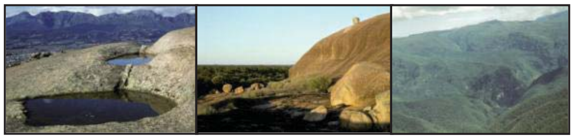

Figure 1: Old granite landscapes in South Africa (left) and Western Australia (middle), unglaciated since the Permian (photos S.D. Hopper), and the sandstone Neblina massif (right) in the Guiana Highlands (photo B. Stannard).

[1] Hopper S.D. (2009) *Plant and Soil* **322**, 49-86.

Reconstructing deep-ocean nutrients with paired Cd/Ca and Cd isotopes in deep-sea corals

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The abyssal ocean is a major sink for nutrients, heat, and carbon, and plays an important role in modulating glacial-interglacial climate. Archives of deep-water chemistry, particularly those which can be precisely dated, are therefore of great use in understanding the temporal interactions between ocean circulation and global climate.

Deep-sea corals, which typically live between 500–2,000 m, are well positioned to record changes in deep-water chemistry in their aragonitic skeletons, which can be absolutely dated with U-series techniques [1]. In particular, they have shown some utility in recording oceanic Cd/Ca [2] which can be used to reconstruct seawater phosphate concentrations (because Cd is pseudo-linearly correlated with P). However, physiological 'overprinting' of the environmental signal is a significant issue in deep-sea corals and requires empirical calibration before such archives can be used to reconstruct seawater compositions (e.g. [3]).

Here, we investigate the controls on the Cd isotope composition of deep-sea coral aragonite using a previously collected series of modern and fossil samples from the New England Seamounts located in the North Atlantic [4]. Inorganically precipitated calcium carbonate has previously been shown to have a constant fractionation from seawater [5], therefore deviations from constant fractionation in coral aragonite would indicate a biological overprint that may enable interpretation of Cd/Ca ratios in terms of biomineralization and past seawater composition. The isotope composition of coral aragonite may also allow reconstruction of the past isotope composition of deep-waters, providing clues to changing nutrient cycling during periods of global change.

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[2] Adkins *et al*. (1998) *Science* **280**, 725-728.
[3] Gagnon *et al*. (2007) *Earth Planet. Sci. Lett.* **261**, 280-295.
[4] Robinson *et al.* (2007) *Bull. Mar. Sci.* **81**, 371-391.
[5] Horner *et al*. (2011) *Earth Planet. Sci. Lett.* **312**, 243-253.