



Anthropo-Calcretisation: Human Effects on Calcrete Formation

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Calcretes are near-surface terrestrial accumulations of secondary calcium carbonate (CaCO_3) that form in soils and permeable rocks in regions of arid to dry-summer subtropical climates. While the formation of calcrete under natural conditions has been extensively studied, no reports of anthropogenically induced calcretisation exist in current literature. Following a detailed study of soil micromorphology at the Binyanei Ha-Uma site (Jerusalem) (Itkin, submitted), it becomes evident that a natural Nari-calcrete (Wieder et al. 1993; Itkin et al. 2012) has been overprinted by a secondary calcretisation, specifically arising from human activity ~ 2 ka ago (related to the production centre of the Tenth Roman Legion in Jerusalem). I hereby introduce the concept of 'Anthropo-Calcretisation', as the sum of processes, by which human actions lead to the accumulation of pedogenic calcium carbonate.

Based on soil micromorphological analysis of the Binyanei Ha-Uma site (Itkin, submitted), and other archaeological sites, two characteristic Anthropo-Calcretisation modes can be discerned. The first pathway, termed 'biogeochemical', is dominated by pedogenic chemical reactions, resulting from soil liming, agriculture, and an unintentional soil contamination by calcined lime. The second pathway, termed 'hydropedological', arises from modified soil-water relations due to man-made reshaping of geomorphological units (e.g., agricultural terraces). Anthropo-Calcretisation can follow either of the pathways, and even include both.

The study of Anthropo-Calcrete can be applicable (i) to quantify the extent by which (pre)historic human beings have utilised and affected their environment; (ii) to reconstruct paleoclimate, and (iii) to constrain soil development in time by dating associated archaeological artefacts. Furthermore, Anthropo-Calcrete can be also used as a diagnostic tool for evaluating modern human actions (e.g. soil liming, intentional enrichment of soil biomass, or soil contamination by anthropogenic carbonate dust). Examination of archaeological sites for the presence of Anthropo-Calcrete has therefore the exciting potential to unravel human long-term influences on the environment. Similar examination of Anthropo-Calcrete in industrial and agricultural areas can enhance our environmental planning for the future.

Bibliography

Itkin, D., Geva-Kleinberger, A., Yaalon, D. H., Shaanan, U. and Goldfus, H. 2012. *Nari in the Levant: Historical and Etymological Aspects of a Specific Calcrete Formation*. *Journal of Earth Sciences History*, 31:210–238.

Itkin, D. (Submitted). The Geology and Geoarchaeology of Binyanei Ha-Uma Site, In: *Excavations at the Site of the Jerusalem International Convention Center (Binyanei Ha-Uma–Crowne Plaza Hotel) 2009-2010 Pottery Workshops from the Second Century BCE to the Second Century CE near Jerusalem. Vol. I: Stratigraphy and Architecture, Other Finds and Syntheses*. Edited by Ron Be'eri and Danit Levi. Israel Antiquities Authority.

Wieder, M., Sharabani, M., and Singer, A. 1993. Phases of calcrete (Nari) development by micromorphology. In: *Developments in Soil Science, Soil Micromorphology: Studies in Management and Genesis* 22. Edited by Anthony J. Ringrose-Voase and Geoff S. Humphreys, 37– 49. Amsterdam, London, New York and Tokyo: Elsevier.