Liesegang banding and biochemically mediated geochemical self-organization

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The Kanab Wonderstone is sandstone from the Shinarump member of the Chinle Formation that is variably cemented and stained with iron oxide. These sandstones contain approximately 5% Fe occurring as one to 5 mm thick, undulatory bands of iron oxide cement (IOC) that crosscut and obscure sedimentary structures. Between each pair of IOC bands are alternating bands of rock that are tinted with iron oxide stain (IOS) and unstained rock. The bands of IOS also crosscut and obscure sedimentary structures. The interior-most portion of the sandstone bed may contain a bleached sandstone core enclosed by a band of IOC. The IOC and IOS are related spatially to vertical joints that cut the sandstone at regular intervals. The IOC in the Shinarump comprises a mixture of acicular grains (goethite) and hexagonal plates with dendritic manganese oxide locally projecting from the cemented sandstone into more bleached rock. Although these features are unusual, they are not unique to the Shinarump member: similar features have been reported from other fluvial rocks worldwide. These features have been typically referred to as Liesegang bands, a type of geochemical self-organization.

The spacing of IOS is consistent with a Jablczynski coefficient [1] of 1.04 and the width of the IOS is a function of distance from the initial reaction front; characteristics that are typical of Liesegang bands [2]. Bands of IOC, on the other hand, exhibit more variable spacing and a relationship between IOC band thickness and distance between IOC. The Shinarump Wonderstone and similar rocks combine features of true Liesegang and biogenically mediated geochemical self-organization. Iron-oxidizing bacteria colonized the interface between siderite-cemented sand and porous sandstone, oxidizing iron and generating acid that caused dissolution of siderite. Aqueous ferrous iron diffused back to the biofilm where it was oxidized. Bands of IOS retain the morphology of reaction front fingers.

[1] Jablczynski (1923) *Bull. Chim. Soc. France* **33**, 1592–1597. [2] Chopard *et al.* (1994) *Phys. Rev. Letters* **72**, 1384–1387.

Origin and evolution of post-collisional volcanism: An example from Neoproterozoic Dokhan Volcanics at Gabal Nugara Area, Northeastern Desert, Egypt

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Nugara volcanics are one of the northernmost outcrops of the Arabian-Nubian Shield (ANS). Two distinct volcanic successions are found in the Nugara basin: (1) old volcanic sequence composed of voluminous medium- to high-K calc-alkaline lavas, and minor alkali basalt; and (2) young volcanic sequence composed of subordinate tholeiitic mafic lavas. Their eruptions were punctuated by occasional volcaniclastic deposits that generated fall, flow or reworked suites compositionally identical to the lava flows. These volcanics are a part of a post-subduction and extensional-related magmatic event in Northeastern Desert of Egypt.

Volcanic rocks of the Nugara basin are characterized by strong enrichment in LILE relative to HESF, high LILE/HFSE ratios and depletions of Nb on MORB-normalized multi-element diagrams. Geochemical features of the volcanic rocks suggest that they experienced fractional crystallization, along with mixing processes. Crustal contributions to the magma sources may also have occurred during magmatic evolution. These processes have resulted in scattered major and trace element variations with respect to increasing silica contents. The model proposed for their origin involves contrasting ascent paths and differentiation histories through crustal columns with different thermal and density gradients.

Geochemical features of the most mafic samples suggest that the volcanic rocks in the region were derived from a mainly lithospheric mantle source that had been heterogeneously metasomatized by previous subduction events during convergence between the East and West Gondwanaland. The volcanic activity in the region is best explained by delamination of lithospheric mantle slices that were heterogeneously enriched by previous subduction-related processes.