PHOTOSYNTHETIC (?) MICROBIAL MATS OF THE MIDDLE ARCHEAN MOODIES GROUP, BARBERTON GREENSTONE BELT (SOUTH AFRICA)

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The composition of the Archean atmo- and biosphere, the circumstances favoring the evolution of microbial life, and the origin of (oxygenic) photosynthesis are vigorously disputed.

Probably one of the best places to address some of these issues is the Moodies Group (3.2 Ga) of the Barberton Greenstone Belt (South Africa), which exposes one of Earth's oldest siliciclastic sequences with common macroscopic microbial mats. In order to constrain their setting, facies, and habitat we measured ten detailed stratigraphic sections spread ~11 km apart along strike in the interior of the greenstone belt where Moodies strata are relatively unmetamorphosed, preserving the remains of microbial mats and associated sedimentary structures in outstanding quality. Our results indicate a tidally influenced coastal depositional system in which microbial mats occur within an interval of ~1000 m thickness. They form green anastomosing or flat laminations < 1mm thick, interbedded with medium- to coarse-grained and gravelly sandstones. Microbial mats colonized coastal (and fluvial?) habitats of varying energy and occasionally experienced subaerial exposure.

Based on the microbially induced sedimentary structures, we distinguished four facies along a land-to-sea transect: 1) wavy laminae interbedded with nodular Fe-oxide concretions indicative of a restricted shallow-water setting; 2) nearly flat laminae associated with high shear stress suggestive of an intertidal setting; 3) wavy laminae associated with herringbone cross-bedding, underlain by bedding-parallel chert bands ~0.2 cm thick, indicating a subtidal setting and 4) crinkly laminae associated with petees (~0.7 cm height) and gas or fluid escape structures of up to 6 m height, of a yet unknown setting.

We tentatively conclude, based on exclusion arguments, the phototactic micromorphology and consistent shallow-water facies that the Moodies microbial mats, were at least in part photosynthetic communities.

DECIPHERING THE MONIAN SUPERGROUP: EVIDENCE OF ?CAMBRIAN AVALONIAN NEOPROTEROZOIC ARC EXHUMATION FROM THE NEW HARBOUR GROUP, NORTH WALES, U.K.

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The Monian Supergroup (MSG) is a low grade, variably deformed, metasedimentary sequence exposed in northernmost Wales. It has been interpreted as a Peri-Gondwanan, fore-arc accretionary complex although the age of depositional remains contentious - proposals range from Neoproterozic to Early Ordovician. U-Pb detrital zircon data from the basal unit (South Stack Group) indicate a Cambrian (Series 3, Guzhangian) maximum depositional age. However in resolving one problem, this age questions the relationship between the South Stack Group and the overlying New Harbour and Gwna groups. Although the New Harbour Group shows a coherent structural history with the South Stack Group, some workers suggest that the Gwna Group metabasites are correlatives of 550-560 Ma blueschist metabasites. If such an interpretation is correct this implies that the MSG is not a contiguous stratigraphy.

New U-Pb detrital zircon data from the upper part of the New Harbour Group (Skerries Formation) in northern Anglesey have been obtained to provide an additional age constraint on MSG deposition. The Skerries type locality succession includes boulder beds of granite and granophyre. These igneous clasts have a calc-alkaline arc affinity and an igneous U-Pb zircon age of 649.1 ± 5.0 Ma, with an inherited component of c. 1500 Ma. Detrital zircons from the sandstones interbedded with the boulder beds show the main population at 560 – 760 Ma with other significant populations at 1500 Ma and 1100 Ma. The zircon inheritance age suggests an almost exclusively arc-dominated source of East Avalonian affinity for these sediments, although the granites cannot be matched directly to any exposed complexes in Southern Britain. This is consistent with Sm-Nd data for the New Harbour Group which suggest an immature source. A northerly or north-easterly-derived source has been established for the New Harbour Group (on the basis of sedimentary structures) suggesting an outboard provenance for the boulders and cobbles. This contrasts with the southerly derived underlying South Stack Group which has a more mature Sm-Nd signature and Palaeoproterozoic and Archean inherited zircon components, not seen in the New Harbour Group. This therefore suggests a significant change in depositional architecture and exhumation of an arc block in the latest Cambrian or early Ordovician which has implications for the existing tectonic interpretation. The only alternative to this model is a major structural discontinuity between the South Stack Group and New Harbour Group that has not as yet been identified.

RECENT DEVELOPMENTS UNDERSTANDING THE VOLCANIC, MAGMATIC, TECTONIC, AND METALLOGENIC EVOLUTION OF THE ELY GREENSTONE FORMATION, VERMILION DISTRICT, NE MINNESOTA

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The Ely Greenstone Formation comprises a well-preserved stratigraphic sequence of Neoarchean supracrustal and associated intrusive rocks in the southwestern part of the Wawa-Abitibi Terrane in the Vermilion District of northeastern Minnesota. The Lower Member of the Ely Greenstone (LMEG) comprises calc-alkalic and tholeiitic basalt and basalt- andesite lava flows and tuffs with subordinate felsic lava flows, tuffs, epiclastic rocks and iron formations. The Soudan Iron Formation Member (SMEG) comprises Algoma-type interlayered cherty iron formation, basalt lava flows, epiclastic rocks and felsic tuffs. The Upper Member of the Ely Greenstone Formation (UMEG) is composed of a monotonous sequence of poorly-vesiculated tholeiitic basalt lava flows and localized Algoma-type iron formation lenses. The UMEG is commonly interstratified with the Lake Vermilion Formation (LVF), which is composed of greywacke, slate, conglomerate, and dacite tuff, as well as subaerial to submarine dacite to trachyandesite lava flows, tuffs, and associated intrusions (the informally named Gafvert Lake Sequence (GLS). Locally, it is believed that the LVF unconformably overlies the LMEG and SMEG strata. Previous studies (Schulz, 1980) interpreted volcanological and sedimentary textures to indicate a change from a subaerial / shallow subaqueous setting to a deeper subaqueous environment during the temporal genesis of the Ely Greenstone Formation. This interpretation is supported by our more recent and detailed field studies. Previous lithogeochemical studies by Southwick *et al.* (1998) indicate that a sharp transition from arc-like volcanism (LMEG) to MORB-like volcanism (UMEG) occurs abruptly at the top of the SMEG. However, new major- and trace element data indicate the lithogeochemistry of volcanic rocks in the LMEG is more complicated than previously recognized. Arc-like basalts and basaltic andesites and FI- and FII-type rhyodacites and rhyolites characterize the FLS. In the CBS, arc-like basalts and basaltic andesites transition up-section into E-MORB, OIB and back-arc basin-like basalts. These basalts are temporaly associated with FIII-type felsic volcanic rocks. The UMEG is characterized by MORB-like basalt compositions that may also be the product of back-arc spreading (Southwick *et al.*, 1998). A model encompassing initial arc development followed by back-arc development and rifting during the final stages of the LMEG immediately prior to SMEG deposition appears to be most consistent with the observed volcanological and lithogeochemical characteristics in this part of the Vermilion District. Iron formations within the SMEG occur immediately up-section from the proposed arc – back-arc transition, a stratigraphic position shown in many studies to have high prospectivity for hosting volcanogenic massive sulfide orebodies.