Sampling of the World's Oldest Stromatolites from Isua (Greenland): Damage to a Globally-Unique Locality

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- *New field work confirms the discovery and demonstrates rarity of early (3·7 Ga) stromatolite preservation*
- *Careless sampling by other researchers has resulted in substantial damage and wastage of the key outcrop*
- *Protection is urgently required to preserve this unique resource*

Preamble

This is an update on the 3.7 Ga (Ga = billions of years ago) stromatolites (Fig. 1) as an exceedingly rare occurrence preserved in the Isua supracrustal belt of Greenland (Nutman et al., 2016). A few months ago, we presented on Research Gate a field guide for to assist any visitors to this special locality (Technical Report June 2017 DOI: 10.13140/RG.2.2.13602.63681). Based on our field research there in July 2017, this new report provides an update on the Isua stromatolites. It includes a strongly-worded plea for responsible treatment of this unique occurrence – something that is of both Greenland and World special significance.

Figure 1. One of the two 3.7 Ga stromatolite occurrences of Nutman et al. (2016).

Purpose of July 2017 fieldwork

Our July 2017 field work was funded by the Australian Research Council. The team included Prof. Martin Van Kranendonk, who is an expert on stromatolites (an author on the Nature 2016 paper), but who had not yet visited the locality. The triple purpose of the field work was to (i) verify the authenticity of the structures interpreted as stromatolites, (ii) do more detailed facies interpretation of the associated sedimentary rocks in the immediate area of low strain at the locality and (iii) search for more stromatolites. Martin Van Kranendonk's appraisal of the stromatolites was an unreserved confirmation of their correct identification by the original field team - that they are biogenic in origin. This strengthens the case that these are the oldest-known macroscopic evidence for life on Earth.

The search for more stromatolites

Upon discovery of the stromatolites, the original field team surmised that they are preserved near the nose of a non-cylindrical antiform – where overall deformation is least (Nutman et al., 2016). Thus, in July 2017, our team made a methodical, detailed search of all other antiformal fold noses in the area with the suitable lithological assemblage of quartz+dolomite-rich rocks. This search, conducted over about a week, revealed that in all other possible structural locations, the deformation is too high and/or that the influx of fluids have allowed quartz + dolomite to react to form tremolite. Consequently, any possible stromatolites as seen at the discovery locality had been destroyed. Figure 2 illustrates a quintessential example of protolith destruction, a few metres from the Nutman et al. (2016) 'A' locality. This shows a finely-layered quartz + dolomite rock where reaction caused by ingress of a water-rich fluid transformed the rock into a tremolite-rich assemblage.

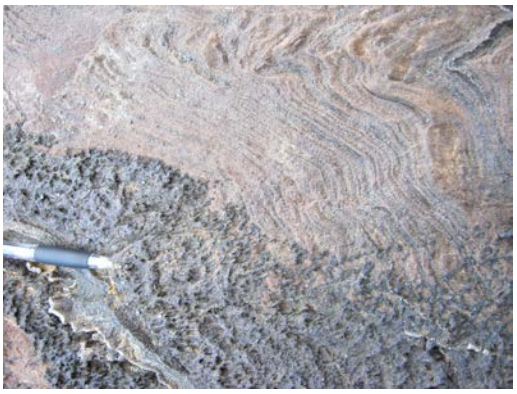

Figure 2. Fine-grained layered quartz + dolomite rock (top) being converted into a tremolite-rich rock (bottom).

The methodical search for more stromatolites demonstrates that, as far as is presently known, the Nutman et al. (2016) stromatolite locality is globally unique. The only exception to this is some loose blocks at the bottom of the slope, west of the locality, where some poorer-preserved relict stromatolites were found. These will have been derived from the outcrops via periglacial movement. *This means that the oldest macroscopic evidence for life on Earth is restricted to perhaps only 3m^2 of rock outcrop*! As such, this is not only an incredibly rare and special part of the geological record, but is also a significant part of the World's heritage.

Condition of the stromatolite discovery outcrops – July 2017

The snow cover had returned. On our first visit to the outcrops on the morning of 22nd July, the 'B' locality (Fig. 3) was still covered by a sheath of ice and almost 1 m of snow. An almost 2 m thick snowdrift covering the 'A' locality had been dug out by another team still present in the area. There was considerable damage to the western end of the 'A' outcrop, involving extensive hammering plus a minimum of 5 rock saw cuts. A significant amount of the outcrop was removed – this included several kilograms of the stromatolite outcrop simply left as discarded fragments on the ground at the base of the outcrop. To our knowledge, only two groups are known to have visited the locality – one in September 2016 and one in July 2017.

In Figure 4 we document the state of the outcrop. On the left-hand side on Figure 4 (top) is our 2012 sampling, where we carefully removed a narrow slab, with zero wastage (beyond the two parallel <5 mm saw cuts). Also, we deliberately avoided some of the most spectacular stromatolites in the middle portion of the outcrop (Fig. 1), realising that this should be left intact for all future visitors to observe. Figure 4 (lower) demonstrates the state of the western end of the outcrop in July 2017, where much rock that had been removed was discarded.

One of the key issues of the resampling is that the September 2016 group made two preliminary vertical saw cuts too far apart to remove material without wastage. (This is known from photographic evidence provided by the Greenland Government observer on that trip.) In fact, we counted at least 5 vertical saw cuts (by one or both of the visiting groups?) in order to acquire material – with much wastage as noted above.

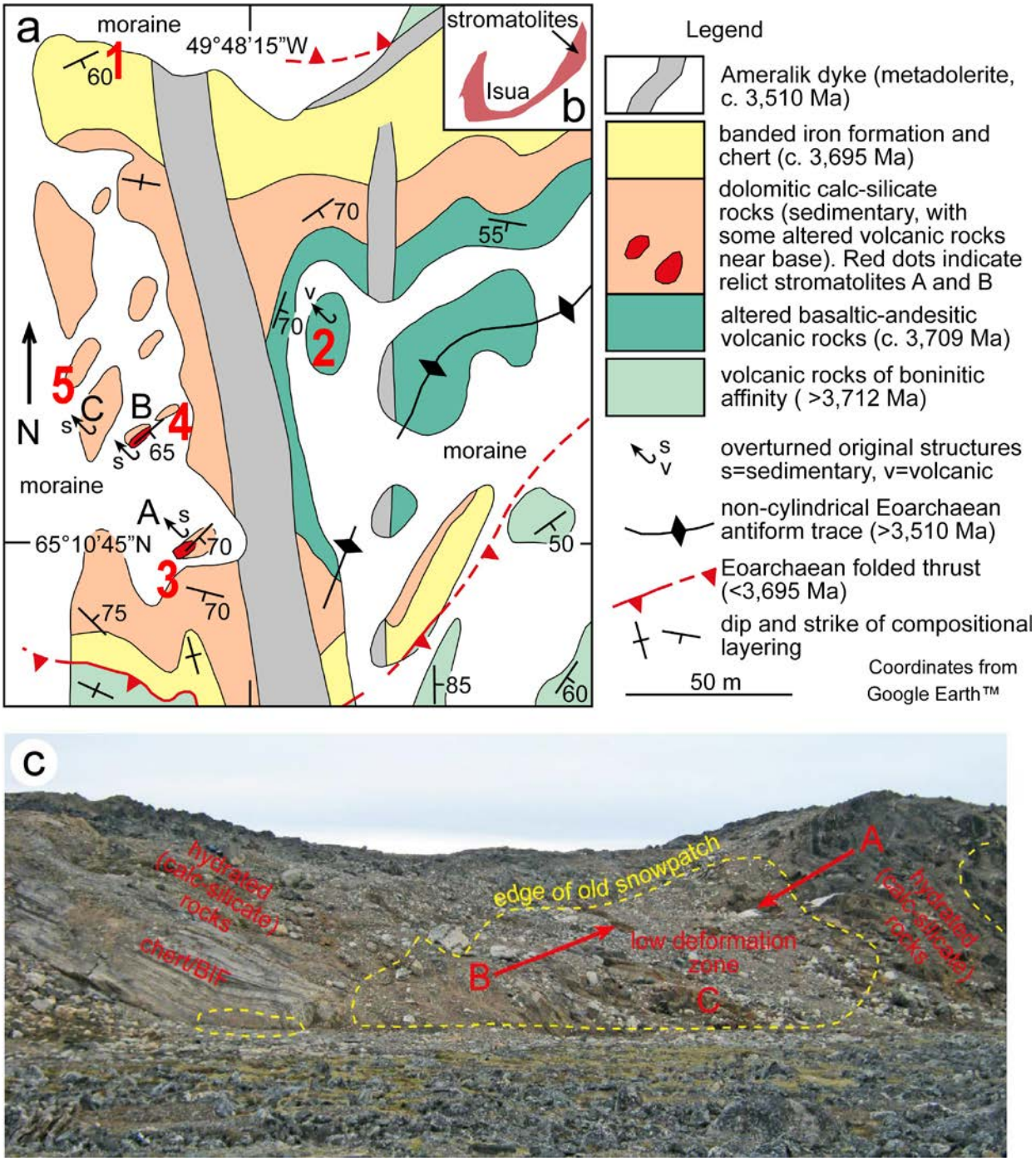

Figure 3. (a) Sketch geological map over the locality. ***Bold red numerals*** *on (a) are the discussed localities in the June field guide. (b) Location in the Isua supracrustal belt. (c) Ground view looking NE over the locality, showing sites 'A', 'B' and 'C'.*

Figure 4 (Top) shows the entire outcrop in late July 2017. On the left is our 2012 sampling, collected with no wastage and no damage to the rest of the outcrop. (Lower) shows the condition of the western end of the outcrop, with multiple saw cuts and a large piece missing off the top left corner.

Because large parts of the western end of the outcrop have been needlessly damaged, with much sample left as waste, we saved this discarded material, and it is now lodged with the Geology Department of the Ministry for Mineral Resources of the Government of Greenland in Nuuk.

We spent several hours carefully excavating the snow and ice layer off the ‘B’ occurrence. This was found to be intact and not sampled, because it had not been excavated by either of the 2 other groups who had visited the locality.

Responsible science and stewardship of world heritage

Nothing can redress the needless damage with wastage done to the 'A' stromatolite locality. Regrettably such acts are not unique – take for example the classic trophy-taking of the igneous cumulate layering of the Skærgaard gabbro intrusion illustrated by Wager and Deer (1939), that came to grace the desk of a University Professor in the 1970s (see exposé by Bridgwater et al., 1978). However, in the case of the Isua stromatolites, two extra factors are paramount. Firstly, they are only known to be exposed on ~3m^2 of rock, unlike something such as, for example, the classic graded igneous layering in Skærgaard, which occurs over several km^2. Secondly, and *totally deplorable*, is the wastage of valuable material by scientific team(s) – who damaged the outcrop and left a considerable amount discarded. This damage and wastage is inexcusable, because it has already been noted that pieces of the original first careful collection are available on loan for independent scientific study.

There are more Lunar samples available than the Isua stromatolites – the latter should be treated with an equal degree of care and reverence. We hope that the remainder of the stromatolite occurrence remains unviolated for future generations.

References

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