Morphotype disparity in the Precambrian

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Introduction

Prokaryotes have dominated life on Earth for >2 billion years often acting as biological impetus to prompt environmental changes. However, microbes from the **Precambrian** are poorly preserved and thus little is known about ancient communities. In order to better understand how these communities changed throughout the Precambrian we examined **spheroidal microfossils** from three different deposits for changes in **size, abundance and biovolume**. We used light microscopy and **Synchrotron Radiation X-ray Tomographic Microscopy**[1] to perform novel analyzes on these microbial remains to assess how these three factors varied throughout this period of Earth's history.

Materials

Strelley Pool, Australia—3.45 Ga
Gunflint Chert, Canada—2.1 Ga
Rasthof Cap Carb, Namibia—650 Ma

Methods

Light Microscopy

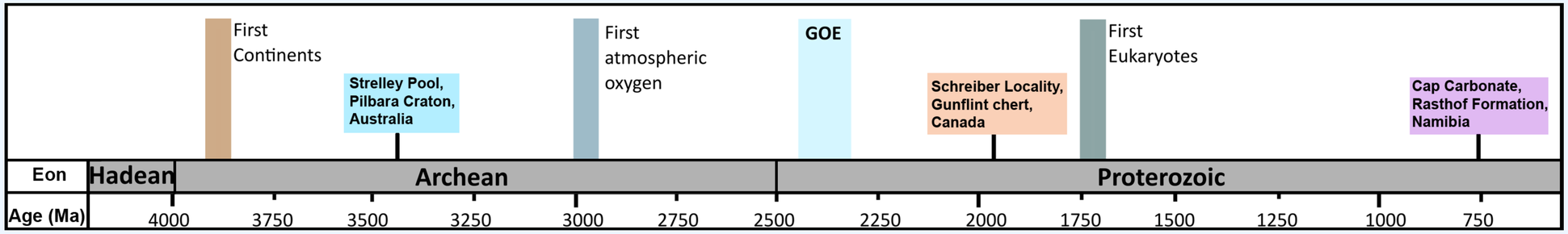
Raman Spectroscopy

Synchrotron Radiation X-ray Tomographic Microscopy (SRXTM)

Biovolume calculations:

Biovolume was calculated using a combination of diameter measurements and abundance counts. The calculations used the following assumptions

1. The shape of a spherical microfossil is that of a perfect sphere
2. A random sampling of 100 diameter measurements accurately represents size distribution
3. 4 abundance counts in 4 separate rock regions accurately represent microfossil abundance



Results

- Cell abundance **decreased** towards the end of the Precambrian
- Biovolume remained relatively **constant** **(0.17% Strelley, 0.17% Gunflint, 0.16% Rasthof)**
- Size and disparity **increased** through time

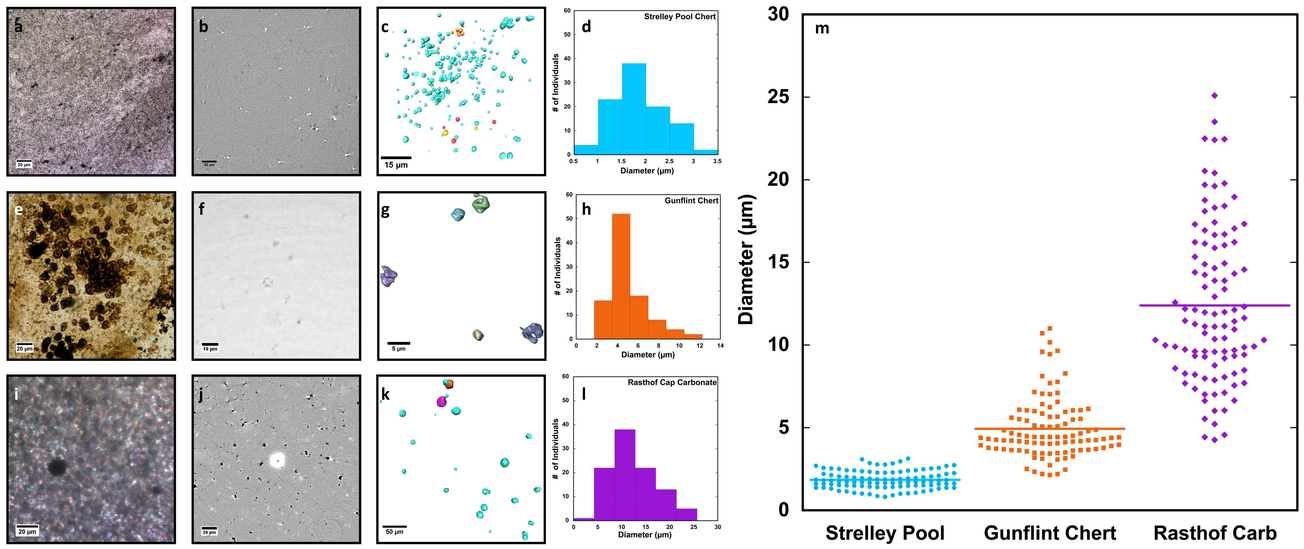


Figure 1: a-d) Strelley Pool Chert, **e-h)** Gunflint Chert, **i-l)** Rasthof Cap Carbonate. **Column 1:** Micrographs from each of the 3 localities. **Column 2:** A single slice from an SRXTM scan of each of the 3 localities: Strelley Pool and Rasthof Cap Carbonate microfossils appear white, Gunflint chert microfossils appear as dark outlines. **Column 3:** 3D reconstructions of microfossils in their original orientations. **Column 4:** Histograms of diameter measurements of each locality.

Discussion and Conclusions

Consistent biovolumes found through time with **negative correlation** between **large cell size** and **abundance** potentially indicates that microfossils grew in a **nutrient limited system**.

The observed **increase** in **cell size** and the corresponding decrease in surface to volume ratio may be attributed to **selective factors** such as **increased motility** in response to predation[2,3].

Size increase may also be linked to **preservational bias**. With **smaller prokaryotes** having been **predated** by **grazers**[3,4].

Literature cited

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