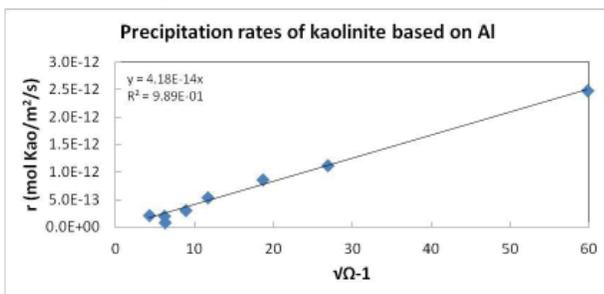


KAOLINITE PRECIPITATION RATES AT PH 4 AND 25 °C.

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This study focuses on the precipitation rates of kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$), a common low temperature secondary clay mineral forming during silicate rocks weathering. To date a number of studies have reported kaolinite dissolution rates (1, 2, 3, 4) but far fewer precipitation rates have been reported (1, 2, and 4). Rates were measured at pH 4 and 25 °C as a function of saturation state using low defect Georgia kaolinite, KGa-1b, as seeds in constant volume mixed flow reactors. Precipitation was induced by injecting into the reactor at similar rates two separate aqueous solutions, one Al-rich and one Si-rich. All fluids were fixed to ionic strength of 10 mM using NaCl. Reactive fluids were sampled daily, keeping the volume in the reactor constant. Sampled fluids were filtered and analyzed for Si and Al concentration. Solids recovered after all experiments exhibit identical X-ray diffraction patterns compared to those of the initial seed. Similar results were observed for the Al/Si surface ratio of these solids as measured by XPS. These observations demonstrate that the only mineral phase precipitating in our experiments was kaolinite. Furthermore, precipitation rates obtained from aqueous Si concentrations are closely consistent with those obtained from aqueous Al concentrations. Measured rates exhibit a systematic variation, increasing linearly with the square root of the kaolinite saturation index (see Fig.). This behaviour, consistent with TST-derived rate laws, indicates that kaolinite growth is controlled by the simple incorporation of Al and SiO_2 at the numerous growth sites (likely crystal edge sites) present at kaolinite surface.



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1.1 Billion-years-old biomarkers from a microbial mat

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Biomarkers and the Proterozoic

Molecular fossils, or biomarkers, are altered biogenic compounds that can be preserved in the geological record for hundreds of millions of years and assigned to specific precursor molecules. Therefore, biomarker analysis makes it possible to assess major groups of organisms that contributed organic matter to ancient microbial communities. The mid-Proterozoic interval, ~1.8 Ga to 0.8 Ga ago, comprises major steps in the evolution of life and Earth chemistry. However, in a re-appraisal of published biomarkers from this period, we only found indigenous bitumens in 9 geological basins, and only 3 fall into the age bracket 1.4 Ga to 0.9 Ga; the 1.2 Ga Hongshuizhuang Fm. N China [1], the 1.1 Ga Taoudeni Basin, NW Africa [2] and the 1.0 Ga Nonesuch Fm., NE USA [3]. Here, we present a detailed study of biomarkers from microbial mats in the Taoudeni Basin.

Mat biomarkers of the 1.1 Ga Taoudeni Basin, NW Africa

The shales of the Taoudeni Basin belong to an organic-rich mat facies [2]. We found TOC levels as high as 16%, and Rock Eval parameters reveal low thermal maturity. *n*-Alkanes range from C_{12} to C_{37} with a maximum at C_{17} . Pristane and phytane are present but we did not detect any higher acyclic isoprenoids. Hopanes are abundant, including 3 β -methylhopanes, although concentrations of 2 α -methylhopanes were very low. Even though the mats contain simple fossils of eukaryotic origin, diagnostic eukaryotic steranes were not detected. However, we found triaromatic steroids of possible methanotrophic bacterial origin. Most significantly, we detected aryl isoprenoids with distinct substitution patterns. These biomarkers together describe a shallow-water microbial mat community that was presumably inhabited by oxygenic cyanobacteria, anoxygenic phototrophic purple (Chromatiaceae) and green (Chlorobiaceae) sulphur bacteria, as well as methanotrophic bacteria. The biomarker assemblage is very similar to biomarkers from the 1.64 Ga Barney Creek Formation (BCF) in northern Australia [4], which has been described as an euxenic deep water environment. However, this new data suggests that it may instead represent a shallow water habitat harbouring microbial mats.

Our results represent the oldest direct observation of the complexity of Precambrian microbial mat ecosystems.

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