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Possible refugium for surface life on Snowball Earth in a nearly-enclosed sea

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Photosynthetic eukaryotic algae are thought to have survived the global or near-global glaciations of the Neoproterozoic. The conditions during these events do not make it immediately clear where these organisms persisted. With net accumulation of ice at polar regions, and net sublimation at the tropical regions, thick ice called sea glaciers, flowing from the poles toward the equator, would likely have covered the global ocean, prohibiting the transmission of light to the liquid water below the ice.

We have recently shown that, in regions of net sublimation, sea glaciers may have been unable to fully penetrate long narrow embayments, under certain climatic conditions. Our previous work showed that refugia could exist at the landward ends of some idealized seas with uniform width surrounded by desert, if the climatic conditions were otherwise favorable for open water or thin ice.

Here, we use a numerical model to solve for penetration lengths of sea glaciers entering narrow channels with more realistic geometries by solving ice [U+FB02]ow equations using a [U+FB01]nite-element model. Channel geometries containing narrow straits near the entrance (as in the modern Red Sea) restrict the ability of the sea glacier to penetrate the channel. This allows narrow channels to prevent sea-glacier invasion into potential refugia of open water or thin ice under a wider variety of conditions.