Abstract Submitted
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Stomatal design principles for gas exchange in synthetic and real leaves[1] KAARE H. JENSEN, KATRINE HAANING, Department of Physics, Technical University of Denmark, C. KEVIN BOYCE, Department of Geological Sciences, Stanford University, MACIEJ ZWIENIECKI, Department of Plant Sciences, University of California, Davis — Stomata are portals in plant leaves that control gas exchange for photosynthesis, a process fundamental to life on Earth. Gas fluxes and plant productivity depend on external factors such as light, water, and CO_2 availability and on geometric properties of the stomata pores. The link between stomata geometry and environmental factors have informed a wide range of scientific fields – from agriculture to climate science, where observed variations in stomata size and density is used to infer prehistoric atmospheric CO_2 content. However, the physical mechanisms and design principles responsible for major trends in stomatal patterning, are not well understood. Here we use a combination of biomimetic experiments and theory to rationalize the observed changes in stomatal geometry. We show that the observed correlations between stomatal size and density are consistent with the hypothesis that plants favor efficient use of space and maximum control of dynamic gas conductivity, and – surprisingly – that the capacity for gas exchange in plants has remained constant over at least the last 325 million years. Our analysis provides a new measure to gauge the relative performance of species based on their stomatal characteristics.

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