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The basics of stylolite formation: insights from modeling

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Stylolites are commonly occurring sub-planar surfaces upon which localized dissolution takes place in sedimentary porous rocks. Due to their importance in controlling rock dissolution, precipitation, and fluid transport, stylolites have been studied extensively for the past century. Field observations indicate that stylolite formation is related to both pressure induced dissolution and the presence of clays, but since stylolites were never reproduced in the lab and never satisfactorily modeled, their formation process remains mysterious.

We present results from a newly developed two-dimensional elasto-plastic numerical model, which allows us to quantitatively study stylolite formation and evolution. Simulations and analytical results provide the elastic stress distribution around a region that experienced localized dissolution. From this stress distribution we show that it is virtually impossible for stylolites to form by pressure solution alone. Similarly we demonstrate that clay-induced dissolution alone cannot reproduce the observed morphology of stylolites. These were the two formation mechanisms previously suggested in the literature, hotly debated but never before tested. Here, we show that a *combined process*, of clay-enhanced dissolution as well as pressure-solution, results in stylolite growth and propagation, producing a morphology similar to that observed in the field.