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Stability of a porosity wave in mineral replacement

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Coupled dissolution and precipitation reactions are fundamental for understanding of water-mineral systems in geological settings. Whenever – as a result of those reactions – a product rock acquires has a larger porosity than the parent rock, the metasomatic front can become morphologically unstable due to the well-studied reactive-infiltration instability [1]. Here, however, we consider a different situation, where the parent and product rock are of a similar porosity, but there is a thin zone of high porosity right at the front, analogously to what was reported in the case of terra rossa formation [2]. Combining linear stability analysis and Darcy-scale simulations we study the stability of such a porosity wave and show that even though the total porosity in the system remains constant, the front becomes unstable, leading to the emergence of finger-like mineralization patterns.

[1] D. Chadam et al., 1986., J. Appl. Math. 36, 207-221.
[2] E. Meriono and A. Banjerjee, 2008, J. Geol., 116, 62-75