Localization of folding and faulting in extreme Cosserat materials

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Folding is a process in which bending localizes into sharp corners separated by almost undeformed elements. This process is rarely encountered in nature, examples are some uncommon layered rock formations (so-called 'chevron') and sea shell patterns (clearly visible for instance in the 'Lopha Cristagalli' marine bivalve). In mechanics, bending of a three-dimensional elastic solid is common (obtained for instance during bulk wave propagation), but folding is usually not achieved. The route leading to folding is shown in the present article for an elastic solid obeying couple-stress theory, when the material possesses an extreme anisotropy. This result is obtained with a perturbation technique, which involves the derivation of new two-dimensional Green's functions for applied concentrated force and moment. The latter perturbation reveals that a material in an extreme anisotropy state is also prone to suffer a faulting instability, in which a displacement step of finite size emerges. Finally, another failure mechanism, namely, the formation of compaction bands is given evidence. Preliminary results have been published in [1] and [2].

Keywords: Cosserat elasticity, strain localization, stress channelling

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References

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