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Joint inversion of gravity and seismic tomography data for modelling magmatic massive sulphide bodies

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Joint inversion of multiple geophysical data sets containing complimentary information about the subsurface has the potential to significantly improve inversion results by reducing the non-uniqueness of the inverse problem. One of the challenges of joint inversion is coupling the multiple physical property models. In this work, we investigate the fuzzy c-means clustering approach to lithologically couple seismic velocity and density in joint inversions of first-arrival traveltimes and gravity data.

We conducted a suite of joint inversion tests on synthetic data generated from a geologically realistic model based on the Voisey's Bay Eastern Deeps magmatic massive sulphide deposit in Labrador, Canada. There is a known relationship between seismic velocity and density for the silicate rocks and sulphide minerals involved; this lithological relationship was used to design a clustered coupling strategy in the joint inversions. The tests clearly demonstrate the benefits of joint inversion using fuzzy c-mean coupling. This work also demonstrates the effects of including inaccurate a priori physical property information and we suggest approaches to assess whether such inaccurate information may have been used.