Towards constitutive equations for the deep Earth

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Currently a full treatment of both bulk- and shear properties at conditions of high pressure is only available for the Birch-Murnaghan formulation based on power series expansion of the strain energy. This representation is most suitable for extrapolation to mid-mantle conditions. Fits to experimental data for high pressures frequently favour the Vinet or Keane equations of state for bulk-modulus, but in neither case is there any connection to shear.
However, by working with invariants of the stretch tensor suitable isotropic constitutive equations can be found that add-in shear properties in a consistent way via local representations about a pre-stressed state. Such constitutive relations are particularly useful for high-pressure phases in the deep Earth, and make only slight modifications to popular representations for the bulk modulus.

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