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Single-crystal elastic properties of minerals and related materials with cubic symmetry

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Abstract

The single-crystal elastic moduli of minerals and related materials with cubic symmetry have been collected and evaluated. The compiled data set covers measurements made over an approximately 70 year period and consists of 206 compositions. More than 80% of the database is comprised of silicates, oxides, and halides, and approximately 90% of the entries correspond to one of six crystal structures (garnet, rocksalt, spinel, perovskite, sphalerite, and fluorite). Primary data recorded are the composition of each material, its crystal structure, density, and the three independent nonzero adiabatic elastic moduli (C_{11}, C_{12}, and C_{44}). From these, a variety of additional elastic and acoustic properties are calculated and compiled, including polycrystalline aggregate elastic properties, sound velocities, and anisotropy factors. The database is used to evaluate trends in cubic mineral elasticity through consideration of normalized elastic moduli (Blackman diagrams) and the Cauchy pressure. The elastic anisotropy and auxetic behavior of these materials are also examined. Compilations of single-crystal elastic moduli provide a useful tool for investigation structure-property relationships of minerals.

Keywords: Elasticity, sound velocities, cubic symmetry, elastic anisotropy