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A new method to rapidly and accurately assess the mechanical properties of geologically relevant materials

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Abstract

A new indentation-based method was developed that will impact and facilitate the elastic property measurements of rocks and minerals, especially those possessing unusual deformation behavior, including brittle materials and those with complex architectures. The novel feature employed is a metallic film that uniformly transfers the load from the indenter tip to the sample. The film also absorbs the damage caused by the penetrating indenter, shielding the material from highly localized deformation that can impact its response to loading. Many geologically relevant materials have resisted traditional indentation testing because they are either brittle in nature or possess highly anisotropic architectures, such as layered or lamellar structures. In both cases, the highly localized deformation from direct indentation significantly affects the indenter unloading stiffness, from which the elastic properties are determined. The indirect indentation method developed here has demonstrated accurate determination of the elastic properties of many common geological materials as well as materials that have resisted elastic characterization such as galena and talc.

Keywords: Indentation, elastic properties, lamellar structure, highly localized deformation