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Microhardness, toughness, and modulus of Mohs scale minerals

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ABSTRACT

We report new results of microhardness and depth-sensing indentation (DSI) experiments for the first nine minerals in the Mohs scale: talc, gypsum, calcite, fluorite, apatite, orthoclase, quartz, topaz, and corundum. The Mohs scale is based on a relative measure of scratch resistance, but because scratching involves both loading and shearing, scratch resistance is not equivalent to hardness as measured by modern loading (indentation) methods; scratch resistance is also related to other material properties (fracture toughness, elastic modulus). To better understand the relationship of hardness to scratch resistance, we systematically determined hardness, fracture toughness, and elastic modulus for Mohs minerals. We measured hardness and toughness using microindentation, and modulus and hardness with DSI ("nanoindentation") experiments. None of the measured properties increases consistently or linearly with Mohs number for the entire scale.

Keywords: Mechanical properties, hardness, fracture toughness, elastic modulus, Mohs minerals, new technique, nanoindentation