Implicit 3D geological modelling applied to structurally complex mineral deposits — it's all about geometry

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The accurate definition of the spatial location and orientation of geological structures and ore bodies within a mineral deposit is fundamental for exploration activities, resource evaluation and mining operations. Moreover, it allows the testing of various hypotheses regarding ore forming processes and structural controls on ore deposits. Traditional mining software packages construct 3D models by manually linking hand-digitised 2D sections; therefore, a bias is inherited from the outset. In structurally complex environments (i.e. folding, multiple deformation events), such "explicit models" are difficult to generate and revise. Furthermore, they are disconnected from structural field and subsurface measurements which are processed separately. The alternative, termed "implicit modelling", is capable of generating internally consistent 3D models directly from borehole intersections, numerical data and structural data using mathematical functions. In this work, we apply implicit modelling to data from several structurally complex mineral deposits using the software package Leapfrog. Results show that structural controls that are unrecognizable in explicit models become apparent during implicit modelling. Furthermore, we show that ore body geometries obtained from implicit models can be accurately linked to local and regional structural patterns. Our results suggest that implicit modelling is helping a skilled geologist to identify and evaluate structural controls on deposit geometries.