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Structural geophysics: Geological principles applied to geophysical data

Minerals keynote paper

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SUMMARY

The fundamental precept of structural analysis is that descriptions of geometry lead to interpretations of kinematics and the dynamics of geological systems. Controls of the formation of structures at all scales depend on the starting material heterogeneity, and the anisotropy and time dependence mechanical response of the materials. Processes that control mechanical response at the small scale (~1cm) may be quite different to those at the regional scale (>1km), the flow fields and structures that develop can be similar and therefore can be interpreted in similar ways. This approach is second nature in structural geology but is also easily applicable to analysis of regional geophysical datasets such as aeromagnetic and gravity data. Structural geophysics is a discipline defined by Jessell and Valenta, (1996), where structural methodology and interpretation could be applied to regional geophysical datasets to unravel 3D architecture and overprinting relationships. Geophysical datasets are increasingly used in conjunction with structural analysis, and as a stand-alone tool, to resolve regional crustal architecture and geological evolutions, particularly in remote regions and areas of limited outcrop, or where there is some ambiguity in how structure can be determined in the third dimension. Importantly, aeromagnetic data is also effective interpret regional kinematics of major shear zones and high strain zones at different scales. Applying structural kinematic analysis to regional geophysical datasets informs a broad range of disciplines including, but not limited to structural analysis, plate reconstruction, tectonic analysis, and prediction of mineral systems in exploration. In the context of resource exploration 3D and kinematic analysis allows you to predict Earth structuring that controls mineralisation, but more importantly allows prediction of favourable sites of dilation and fluid flow. In this presentation will highlight many of the principles of 3D geometry and kinematic analysis and illustrate how they improve our understanding of geological architecture and dynamic processes of the Earth.