

Ore Geology Reviews

A review of reflection seismic investigations in three major metallogenic regions: The Kevitsa Ni–Cu–PGE district (Finland), Witwatersrand goldfields (South Africa), and the Bathurst Mining Camp (Canada)

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Abstract

Effective exploration for mineral deposits depends on a sound understanding of the processes and geological structures that contributed to their formation. The reflection seismic method has proven to be a powerful tool that provides a high-resolution image of the subsurface and information about structural and lithological relationships that control mineral deposits. The method has also become an attractive geophysical tool for deep exploration and mine planning. In this paper, we review the use of reflection seismic methods to obtain a better understanding of the architecture and ore-forming processes of three diverse mineral regions: the Kevitsa Ni–Cu–PGE district in Finland, the goldfields of the Witwatersrand Basin South Africa, and the Bathurst Mining Camp, Canada. Seismic data, both 2D and 3D, from the Kevitsa deposit clearly image the 3D geometry of the ore-bearing intrusion and provide information about its relationship to the host rock units and nearby intrusions within a larger tectonic framework. 3D seismic data from the Witwatersrand Basin not only provide clear images of major structures, including a distinct reflection that acts as a marker horizon for the gold-bearing reef, but also provide information that may be useful in resolving a longstanding controversy regarding the origin of the gold in the Basin. For example, it might be possible to show that dykes formed impermeable barriers, thereby falsifying the epigenetic hydrothermal models. 2D and 3D seismic data from the Brunswick No. 6 area in the Bathurst Mining Camp suggest that the Brunswick horizon (which contains the bulk of the massive sulfide and associated iron deposits) occurs within a reflective package that extends down to at least 6–7 km depth.