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Reflection seismic studies of mineral deposits and their host-rock structures: two case studies from Sweden and Canada

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Significantly contrasting seismic wave velocity and density of major mineral deposits with their host-rocks suggests that reflection seismic methods are ideal for targeting deep-seated mineralized bodies. Pioneer seismic reflection investigations in major mining camps in Canada, Australia and South Africa already demonstrated that the methodology could successfully be used for exploration at depth. Today, there are numerous 2D and 3D reflection seismic projects around the world aiming at directly targeting mineral deposits at depth (> 1000 m) or unraveling geological structures hosting mineral deposits for mining and exploration purposes. Such projects often integrate other verified geological and geophysical data for 3D/4D geologic model construction. We present two case studies related to the direct detection of mineral deposits and their host-rock structures from the Bathurst Mining Camp, New Brunswick, Canada and the Bergslagen Region, central Sweden. Both case studies are located in highly deformed and geologically complex mineral belts where deep geological structures cannot be inferred from surface mapping. Both surveys were preceded by petrophysical measurements comprising compressional wave velocity and density carried out to assess seismic signals from potential mineral deposits. In the Canadian case study, 2D and 3D seismic surveys successfully allowed the detection of a hidden 6.5 Mt massive sulphide deposit at a depth of about 1200 m. The massive sulphide lens is located on the southern flank of an over-turned antiformal structure. The southern flank also hosts smaller and shallower mineralized deposits. In the Swedish case study, a crooked-line 2D seismic survey allowed the detection of an iron orebody and its extension down to a minimum depth of 2 km. Results from both case studies demonstrate the potential of the seismic reflection methods to detect mineral deposits at depth and structures controlling mineralization in complex and deformed crystalline environments.