Integrated imaging of the lithosphere for resource exploration

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Abstract

Resources underpin quality of life and the transition to a low-carbon economy is increasing demand on already scant resource supply necessitating new deposit discoveries. In resource exploration it is generally accepted that the most important decision is the selection of the search space in which more detailed follow-up work will be undertaken. As part of the Exploring for the Future program Geoscience Australia has undertaken an unprecedented variety of pre-competitive data acquisition to enable robust area selection for exploration. Seismic data acquisition is a cornerstone of this program ranging from crustal scale reflection seismic profile to broad passive seismic arrays, which image the whole lithosphere. Here we present the utility of passive seismic in reducing the exploration search space. We start by outlining recent advances in the calibration of seismic tomography to temperature using xenoliths and the oceanic plate model in order to map the lithosphere-asthenosphere boundary (LAB). We then show that steps along this boundary have been shown to control the distribution of global sediment-hosted mineral deposits. We then use results of deep reflection seismic profiles to infer the mechanistic control exerted by the LAB on basin architecture and the mineral system. Last, we demonstrate the utility of combining seismic datasets with other geophysical and geological observables to map crustal architecture and assessments of mineral potential undercover.