EXECUTIVE SUMMARY

Exploring in the Harris Greenstone Belt (HGB) region is complicated by a regolith cover produced by a long and complex history of landscape evolution. The present surface of the HGB indicates little of the complex palaeochannel architectures beneath. Drilling reveals Quaternary sediments concealing a complex pattern of Tertiary palaeochannels commonly incising and overlying weathered bedrock, with channel sediments ranging in thickness from a few meters to 144 m. Complex relationships between the Quaternary sediments, Tertiary channel fills, and older (e.g., Mesozoic) sediments and deeply weathered basement make palaeochannel identification difficult.

The Kingoonya Palaeochannel System (KPS) is one of several incised-valley systems that contain Tertiary marine-influenced fluvial sediments in the Gawler Craton of South Australia. Palaeochannel mapping and sampling with test drilling has indicated that the KPS drained across the HGB region from east to west; significant mineralisation (e.g., Tarcoola and Glenloth) and possible channel mineralisation (e.g. gold, uranium, groundwater) occur. The vast blankets of surficial cover have masked much of the geology of the region, including the history of palaeochannels. Older suites of rocks, in particular those more prone to weathering, such as regolith derived from various basement rocks, are similarly largely hidden.

The data sets integrated in an investigation of the palaeochannels have significance for mineral exploration. The principal objective of the study was the investigation of the palaeochannel architecture and evolution to assist exploration in these palaeodrainage terrains. This was achieved through the combination of results from several geological and geophysical methods. Comprehensive dimensional palaeodrainage landscape models were created based on interpretations from field exposures, a compendium of geological and drilling data, evaluated digital elevation models, remote sensing imagery, magnetics, seismic, gravity and airborne electromagnetics — all of which (where available) have contributed to a systematic investigation of the palaeochannel architecture in GIS. Detailed KPS mapping in the HGB region has provided a Cainozoic lithostratigraphic framework and has outlined the landscape evolution as an aid for mineral exploration. Delineation of the palaeochannels has been successfully demonstrated by test drilling targeting the poorly known, but key spots of the interpreted palaeochannels. The gold and uranium distributions derived from both this and previous works were used to predict the potential and make recommendations for further work. All results, together with the geological and dynamic nature of the palaeochannels, provide a framework for understanding the controls on mineralisation.

Evidence from sedimentology is combined with that of the architectural characteristics to arrive at a general reconstruction of palaeochannel evolution. The palaeochannels were originally incised into the pre-Middle Eocene landscape, mostly weathered basement, and became the sites where Tertiary fluvial, lacustrine and even estuarine sediments accumulated during the Middle to Late Eocene and Middle to Late Miocene. The application of detailed sequence stratigraphy and facies analysis over the palaeodrainage network has established the changes experienced