# *Exploring for the Future*: Discovering the Barkly region with new regional seismic data

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## Introduction

*Exploring for the Future* (*EFTF*) program is a four-year $100.5 million Australian Government initiative conducted by Geoscience Australia (GA) in partnership with state and Northern Territory government agencies, CSIRO and universities. This program aims to boost northern Australia's attractiveness for investment in resource exploration. As part of this program, GA will use innovative techniques to gather new precompetitive data and information on an unprecedented scale about the energy, mineral and groundwater resource potential concealed beneath the surface.

The Barkly 2D seismic survey was acquired from September to November 2019 (**Figure 1**). This project is a collaboration between GA and the Northern Territory Geological Survey (NTGS), and is funded by the Australian Government's *EFTF* program and the Northern Territory Geological Survey under its *Resourcing the Territory* initiative.

## Barkly Seismic

Acquisition of the Barkly 2D seismic survey commenced near the town of Camooweal on the Northern Territory–Queensland (NT–Qld) border; it links with the 2017 South Nicholson seismic survey (Henson *et al* 2018) and the existing Beetaloo Sub-basin seismic data. The total length of acquisition was 812.6 km spread over five lines: 19GA-B1 (434.6 km), 19GA-B2 (45.9 km), 19GA-B3 (66.9 km), 19GA-B4 (225.8 km), and 19GA-B5 (39.4 km). The Barkly seismic survey also links to the recently acquired Camooweal 2D seismic survey collected by the Geological Survey of Queensland in 2019.

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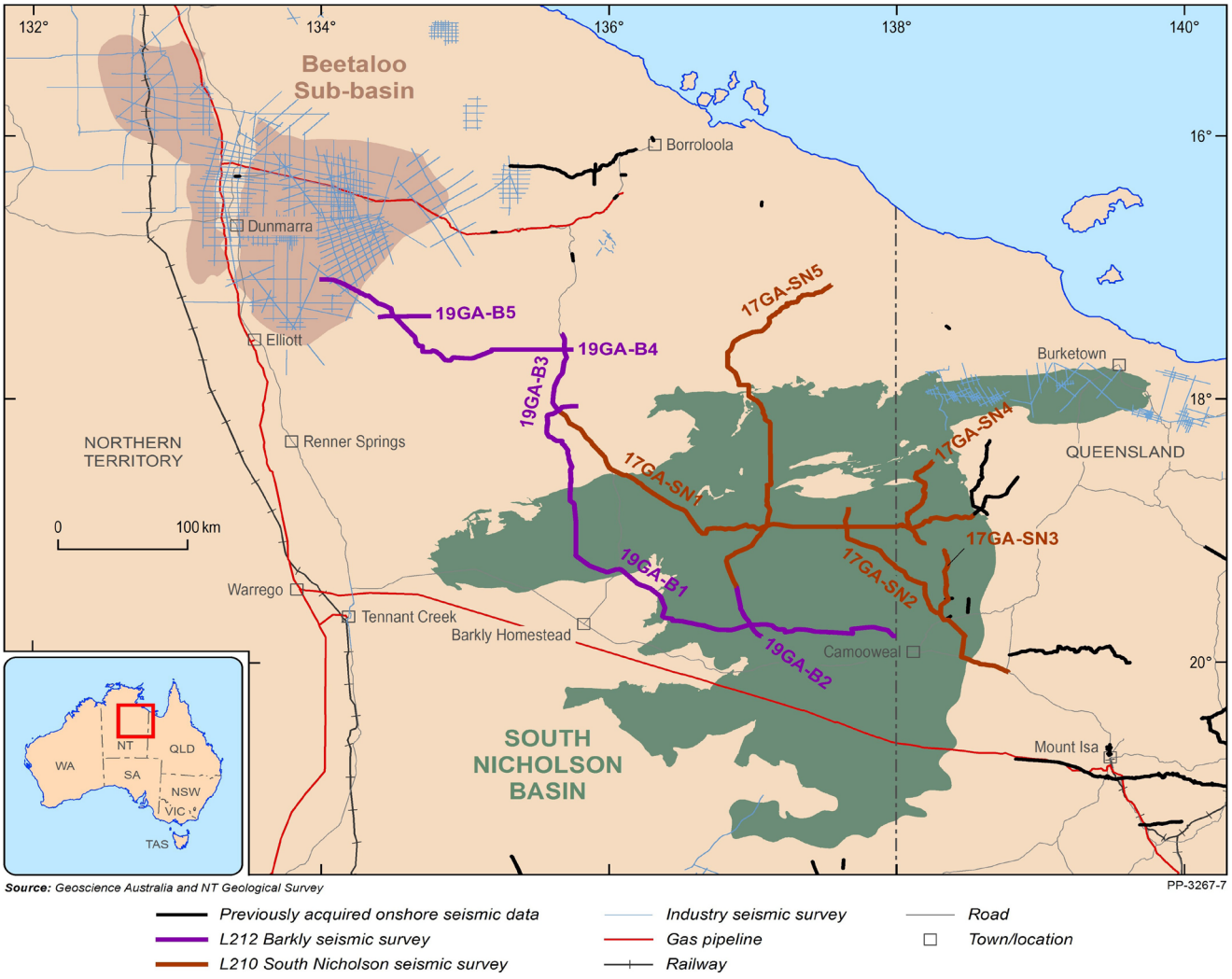



**Figure 1**: Map of the Barkly region showing the new Barkly seismic survey and previous seismic surveys.

The project objective was to obtain better coverage of fundamental geological and geophysical data over the region from the southern McArthur Basin to the northern Mount Isa western succession. The new Barkly seismic has linked the existing Beetaloo Sub-basin seismic grid to the South Nicholson seismic. It has defined the western extent of the new Carrara Sub-basin straddling the NT–Qld border discovered in 2017 (Carr *et al* 2019). The main aim was to investigate the under cover region by targeting large gravity lows indicative of basin sequences with energy potential and with structures critical for mineral resources. Seismic results will be integrating other high-resolution datasets to better predict potential resources at depth, as well as address major information gaps to inform future exploration activities.

Overall the Barkly seismic data are excellent quality, imaging numerous basin sequences and basement structures, and complimenting the knowledge gained from the 2017 South Nicholson seismic survey. The eastern end of line 19GA-B1, starting at the NT–Qld border, images the south-eastern extent of the Carrara Sub-basin broadly defined by the gravity low spanning the NT–Qld border (**Figure 2**). Preliminary interpretation indicates reflectors imaging a flat-lying, relatively undeformed sequence with ~2 s two-way time (TWT), shallowing to the west. The central region of line 19GA-B1 images a series of smaller basin sequences broadly coincident with gravity lows, with most basin-bounding structures trending north-northeast–east-northeast, coincident with linear gravity trends. Line 19GA-B2 intersects with 19GA-B1 and overlaps with 17GA-SN5, enabling interpretation to be linked to the South Nicholson seismic. Continuing to the northwest along line 19GA-B1, directly north of the South Nicholson Basin (**Figure 1**), images a basement high that may represent an under cover western extension of the Paleoproterozoic Murphy Province (~1850 Ma). South of this basement high, linear reflectors deepen (~4 s TWT) to the south terminating at an interpreted structure.

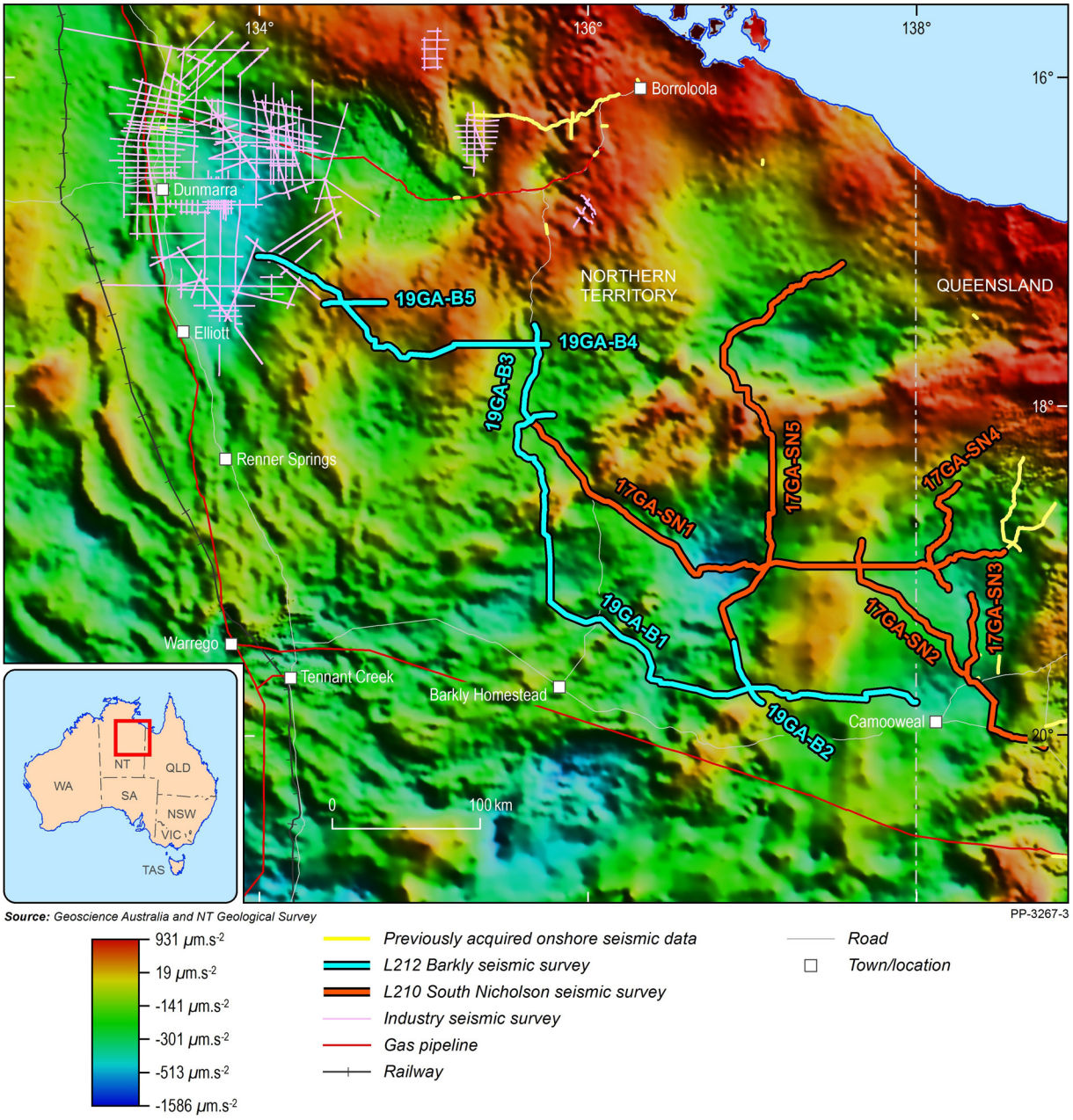
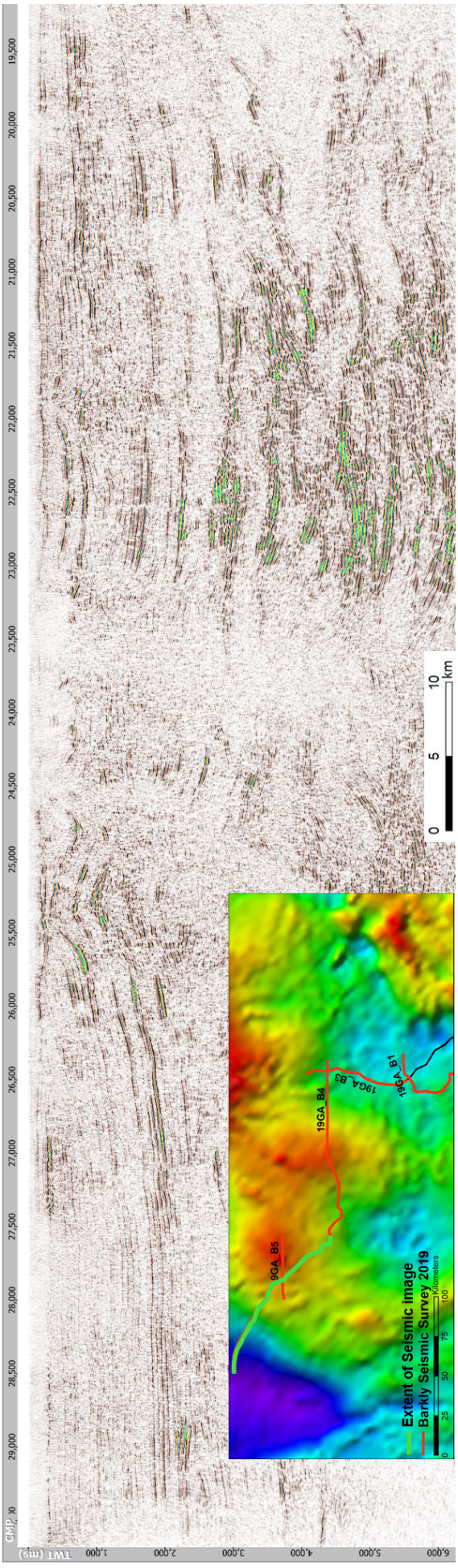



**Figure 2**. Gravity image of the Barkly region overlain with the new Barkly seismic survey and previous seismic surveys.




To the north of the basement high, linear reflectors deepen (to ~7 s TWT) northward into a 'broad gravity low'. The reflectivity within this 'broad gravity low' is divided between an upper high resolution package (~2 s TWT) and an underlying package with strong spaced reflectors. This seismic character continues on lines 19GA-B3 and 19GA-B4 to near the intersection of the defined southeast margin of the Beetaloo Sub-basin. As a comparison, a similar seismic character is imaged on the South Nicholson line 17GA-SN5 (to the east along strike of the east-northeast gravity trend), which also has two distinct packages deepening to the north on the northern margin of the outcropping Murphy Province. At the northwest end of line 19GA-B4, the Beetaloo Sub-basin is clearly imaged as high-resolution, flat-lying reflectors shallowing to the interpreted basin margin, with some major structures imaged close to the intersection with line 19GA-B5 and coincident with a gravity high. To the west and south of this gravity high and extending into the 'broad gravity low' on 19GA-B4, 19GA-B3 and 19GA-B1, the seismic character of the upper high resolution package (~2 s TWT) is similar to the Beetaloo Sub-basin reflectivity, raising the possibility of a new prospective basin directly to the southeast of the Beetaloo Sub-basin (**Figure 3**).

## Conclusion

The new Barkly 2D seismic survey represents a foundation dataset from the *Exploring for the Future* program that links the highly prospective resource-rich areas of the McArthur Basin and Mount Isa Province via a continuous seismic traverse. Decades of scientific research undertaken in both regions will act as a framework to interpret the new data in the Barkly region and as a catalyst to enable transfer of scientific knowledge across the border. This output will be combined with additional *EFTF* data collected over the region (including airborne electromagnetic surveys, magnetotelluric surveys, passive seismic surveys and groundwater acquistion) to greatly improve resource evaluations in northern Australia. The *EFTF* program will de-risk greenfield regions and position Australia for the next wave of exploration investment.

## Acknowledgements

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**Figure 3**. A seismic section (preliminary post-stack Kirchhoff migration with deconvolution and band-pass filter) from the western end of line 19GA-B4 from the Barkly seismic survey. The image shows reflectors in the Beetaloo Sub-basin on the left side of the image, a central zone of structural discontinuities and a new unnamed basin sequence to the southeast of the Beetaloo Sub-basin margin on the right side of the image. **Insert**: seismic section location on a gravity image.

**References**

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