PRELIMINARY SERIES

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

PART OF SHEET 74

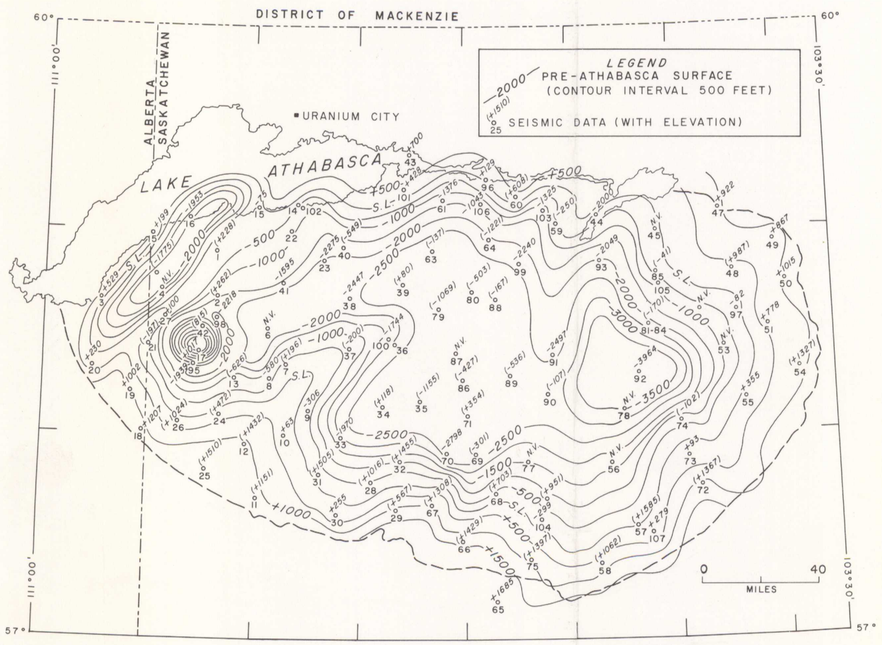


Figure 1. Pre-Athabascan topography, contour interval 500 feet, showing seismic locations and elevation of pre-Athabascan surface relative to sea level. Bracketed values of elevation are minimal values – the pre-Athabascan surface is probably deeper.

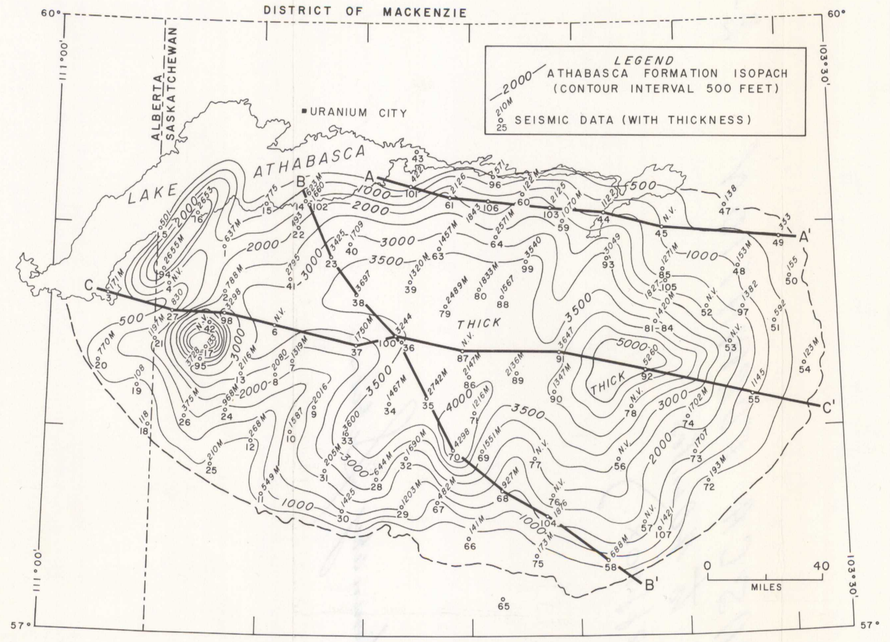


Figure 3. Thickness of Athabasca Formation, contour interval 500 feet, showing seismic locations and thickness of sandstone. M indicates computation of a minimum thickness.

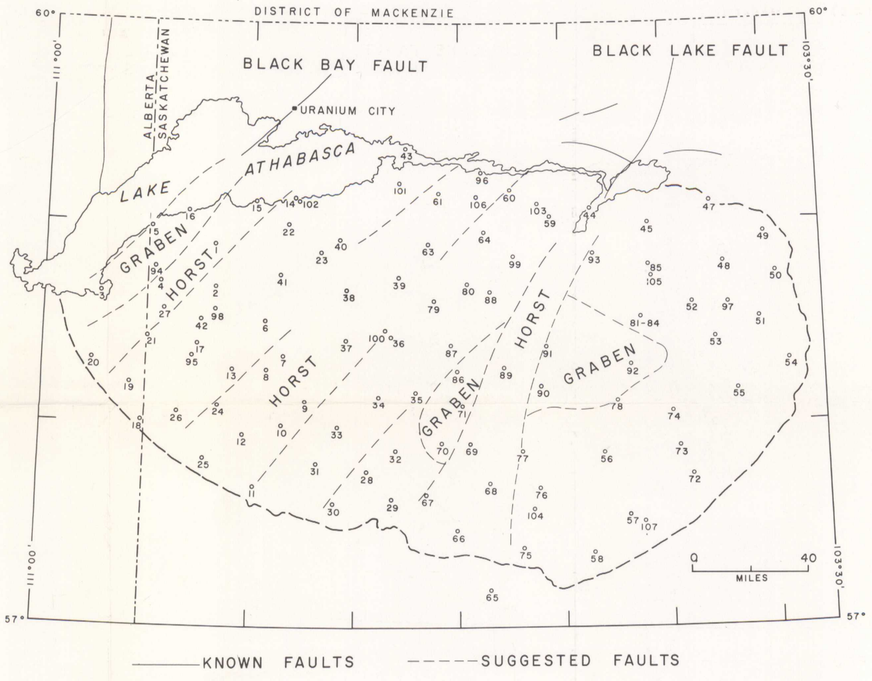


Figure 2. Geological implications of the seismic data, Athabasca Formation area.

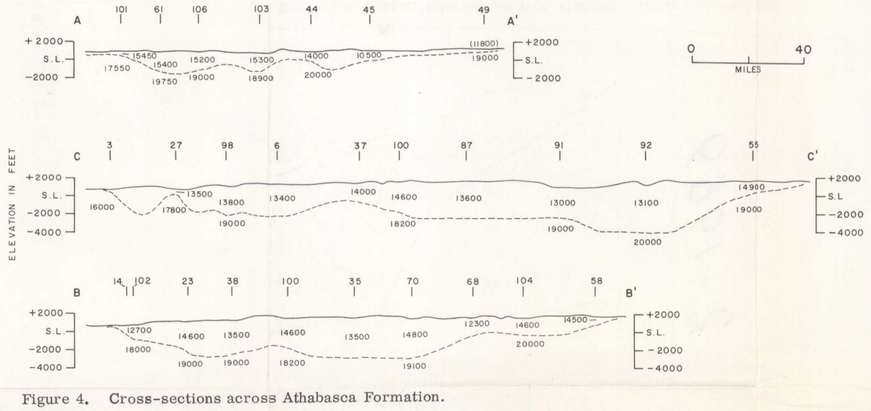
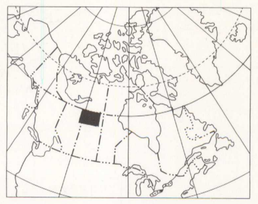


Figure 4. Cross-sections across Athabasca Formation.



MAP 2-1969

A SEISMIC RECONNAISSANCE SURVEY OF THE ATHABASCA FORMATION, SASKATCHEWAN

Copies of this map may be obtained
from the Geological Survey of Canada

Published 1969

DESCRIPTIVE NOTES

A seismic team of the Geological Survey of Canada was sent into the Athabasca Formation area first during the summer of 1962, again in 1963 and more recently in 1968 to explore the subsurface composition of the Athabasca Formation, the thickness of the formation, the nature of the Carswell Lake structure and the topography of the pre-Athabascan surface. The program in 1968 was carried out as a cooperative venture with the Saskatchewan Department of Mineral Resources,

The seismic refraction technique was generally used throughout these investigations in a modified reversed profile manner. Seismic lines were extended until an interface was detected that transmitted seismic compressional wave energy at approximately 19,000 feet per second.

Seismic velocities through drift range from 1,200 to 8,100 feet per second. The sandstones of the Athabasca Formation display a wide velocity range, from 8,600 to possibly 16,500 feet per second with an average value of 13,300 feet per second. Velocities in the range 16,000 to 21,000 feet per second are assigned to the rocks of the pre-Athabascan basement complex.

Pre-Athabascan topography

Figure 1 shows the general configuration of the pre-Athabascan surface topography referred to sea level. The lowest calculated elevation, 3,964 feet below sea level, is located beneath profile 92 at Pasfield Lake. A surface elevation at this profile of 1,347 feet above sea level indicates a total thickness of 5,260 feet of Athabasca Formation.

The geological implications of the seismic data are suggested in figure 2. Lineaments, suggested by sharp changes in direction of contour lines on figure 1, may be faults in the pre-Athabascan basement complex. A graben may be present to the southeast of an extension of the Black Bay fault which is coincident with the Black Bay shoreline of the Crackingstone Peninsula on the north shore of Lake Athabasca. An extension of the Black Lake fault in the northeastern portion of the area appears to coincide with a nosing feature on the pre-Athabascan surface and is suggested to indicate a horst. These fault extensions cannot be traced in detail with the seismic control available. These grabens may be infilled with Martin Formation.

Athabasca Formation

Figure 3 is an isopach map of the Athabasca sedimentary basin. The isopach indicates the thickness of the Athabasca Formation along with the possible underlying formations (Martin ?) and local drift cover. The cross-sections of figure 4 indicate the thickness of the Athabasca Formation and, in a regional sense, the relief of the pre-Athabascan surface.

Martin Formation

The Martin Formation may underlie the Athabasca Formation in some parts of the sedimentary basin south of Lake Athabasca. If the Martin Formation does exist south of the lake it most likely will be found in the basement lows. No seismic velocity data have been obtained over Martin Formation outcrops. Some of the observed velocities that are intermediate to those confidently assigned to either the Athabasca Formation or the basement complex may be associated with Martin rocks.

Drift

Drift thickness at most locations investigated is generally less than 60 feet. Drift thicknesses greater than 100 feet were calculated at nine locations with two of these in excess of 200 feet.

Conventional reflection surveys

Events with normal but small moveouts were recorded at profiles 93 and 99. These events were recorded only from long offset shots and have two-way travel times in excess of three seconds. If these events are primary events they must originate from within the basement complex. They may also be multiples of primary reflections from the pre-Athabascan surface, the primary events not being recognized on these long offsets because they might be obscured by the arrival of refracted energy at the detectors at the same time. In short, the survey was not successful in recording reflections from the pre-Athabascan surface although efforts were made at 10 locations during April 1968.

Conclusions

Seismic methods have been used to determine the thickness of the Athabasca Formation; if applied in detail, the topography of the pre-Athabascan surface could probably be defined. The seismic method should be considered in exploration programs in this area because of the good velocity contrast between the Athabasca Formation and the pre-Athabasca group of rocks.

Interpretation by George D. Hobson and H. A. MacAulay