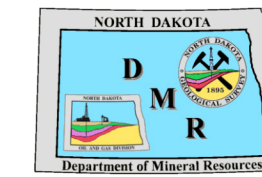# Depth of the Earth's Crust in North Dakota

Fred J. Anderson

2016

INTRODUCTION

The estimated thickness of the Earth's crust in North Dakota is depicted on this map at a scale of 1:1,000,000. The crust of the Earth is the outer-most layer of rock and sediments covering the planet. In North Dakota, the crust includes the rocks of the Williston Basin and Precambrian basement on down to the depth of the Mohorovicic (Moho) seismic discontinuity, which commonly delineates the boundary between the Earth's crust and mantle. The Moho is the layer where a marked increase of rock density, and subsequent increase in seismic wave velocity, is found. This relative rapid change in density versus depth creates a boundary where deeply penetrating seismic waves can reflect and refract off of. The estimated depths to the Moho were determined by geophysical modeling at the Center for Imaging the Earth's Interior (CIEI) at the University of Colorado Boulder by using methods that incorporate ambient noise tomography and the record of global seismologic data collected from the EarthScope project's transportable seismic array that was in operation across North Dakota from 2008 to 2012.

DESCRIPTION OF CRUSTAL THICKNESS

Estimated crustal thickness contours are mapped with a contour interval of one-half mile. Crustal thickness is highest in the northwestern and central portions of the state and thinnest in the southeast. Cross section A-A' depicts the estimated thickness of the crust from the northwest to the southeast corners of the state. An apparent thinning of the crust, of approximately ten miles, is found in the southeastern part of the state.

MAP ANALYSIS METHODOLOGY

Estimated crustal thickness values or Moho depths, were determined at the locations of transportable array seismic stations in the upper-Midwest, which were gathered from geophysical modeling studies of crustal thickness recently completed by the Center for Imaging of the Earth's Interior (CIEI) at the University of Colorado Boulder. Moho depths provided by the CIEI were geostatistically interpolated using an ordinary kriging algorithim coupled with interpretive smoothing during grid construction by the author.

### EARTHSCOPE SEISMIC STATION LOCATIONS
(ca., 2008-2012)
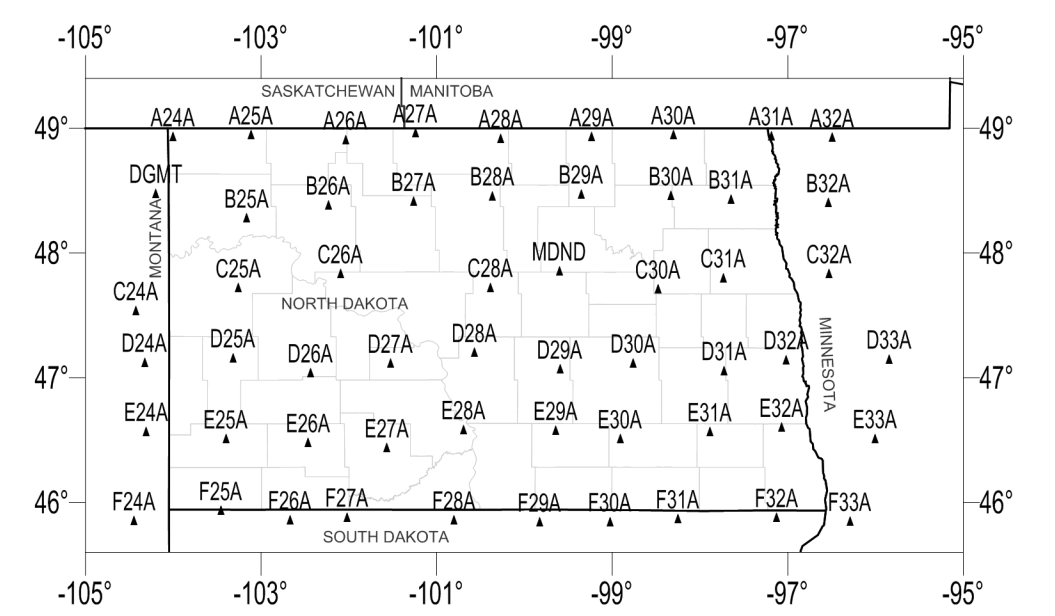
EXPLANATION

Depth contour (approximate) of the Earth's crust.
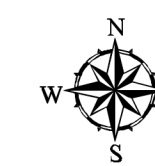
— — 28 — —

Depth (miles)

REFERENCES

Fowler, C.M.R., 2005, The Solid Earth, An Introduction to Global Geophysics, 2nd Ed., Cambridge University Press, 685 p.

Lowrie, W., 2007, Fundamentals of Geophysics, 2nd Edition, Cambridge University Press, 374 p.

Shen, W., M.H. Ritzwoller, and V. Schulte-Pelkum, 2013, A 3-D model of the crust and uppermost mantle beneath the central and western US by joint inversion of receiver functions and surface wave dispersion, J. Geophys. Res., doi:10.1029/2012JB009602, 118, 1-15, 2013.
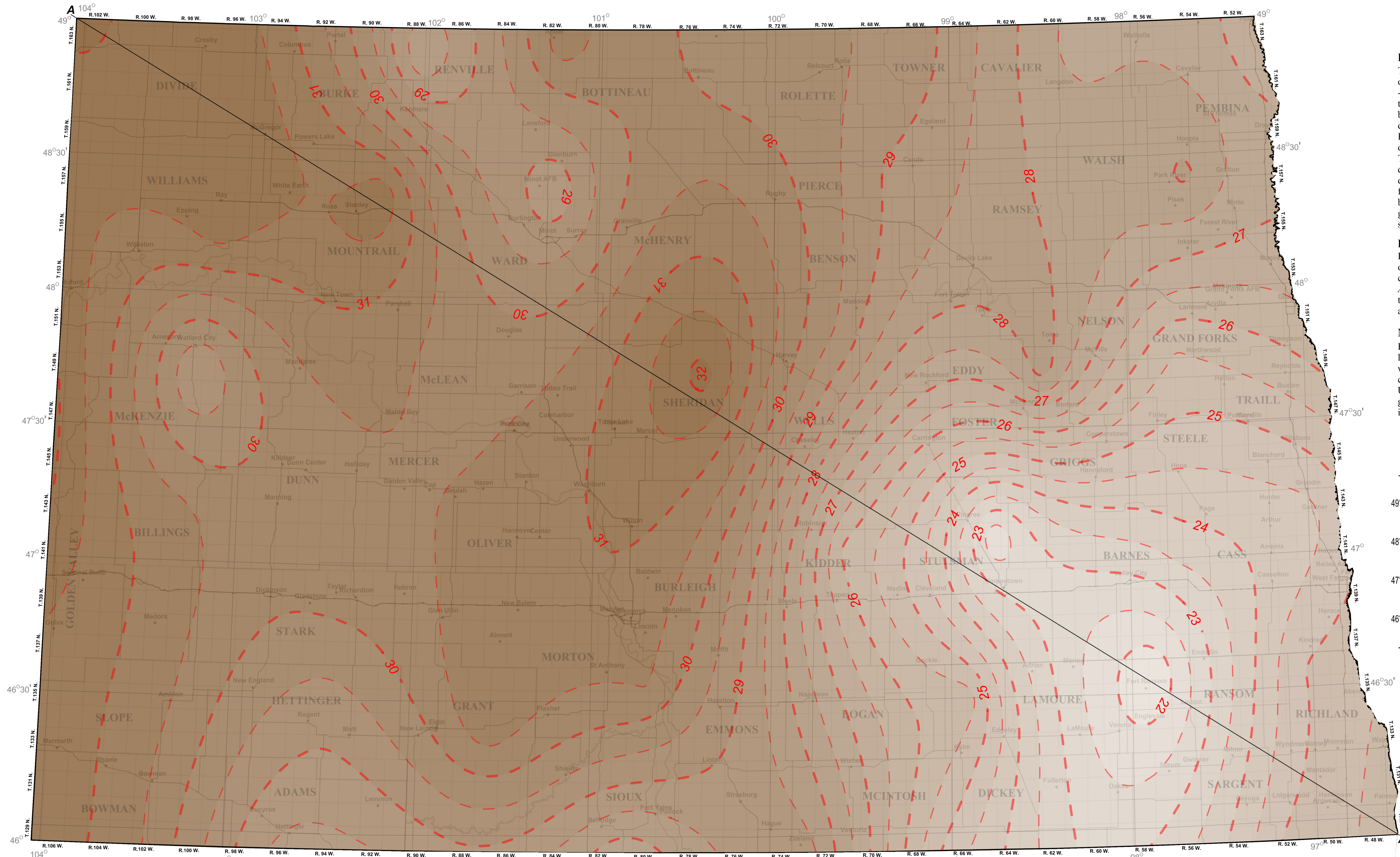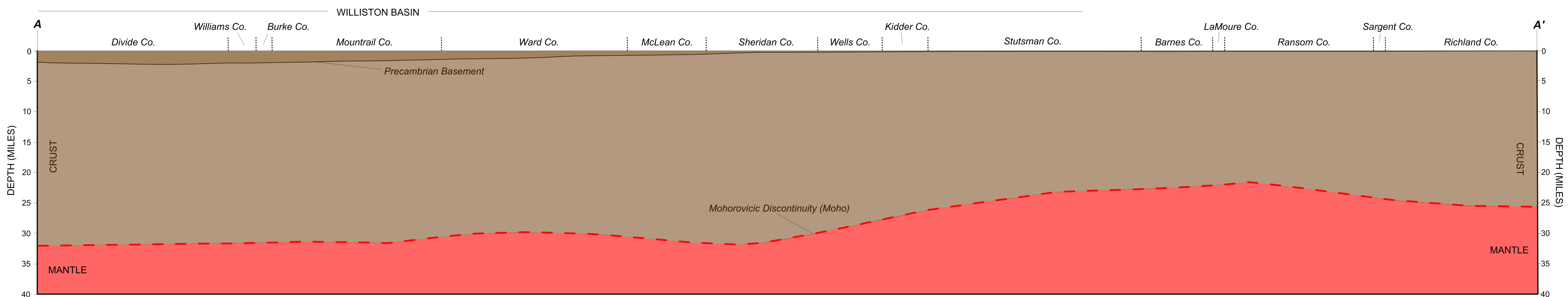
Lambert Conformal Conic Projection
North American Datum 1927

SCALE 1:1,000,000

Data Source: CIEI-University of Colorado-Boulder

MILES

DEPTH OF CRUST

21 22 23 24 25 26 27 28 29 30 31 32 33 34
CONTOUR INTERVAL 0.5 MILES

WILLISTON BASIN

A — Divide Co. — Williams Co. — Burke Co. — Mountrail Co. — Ward Co. — McLean Co. — Sheridan Co. — Wells Co. — Kidder Co. — Stutsman Co. — Barnes Co. — LaMoure Co. — Ransom Co. — Sargent Co. — Richland Co. — A'

Precambrian Basement

DEPTH (MILES)

CRUST

Mohorovicic Discontinuity (Moho)

MANTLE

VERTICAL EXAGGERATION = 1.6X