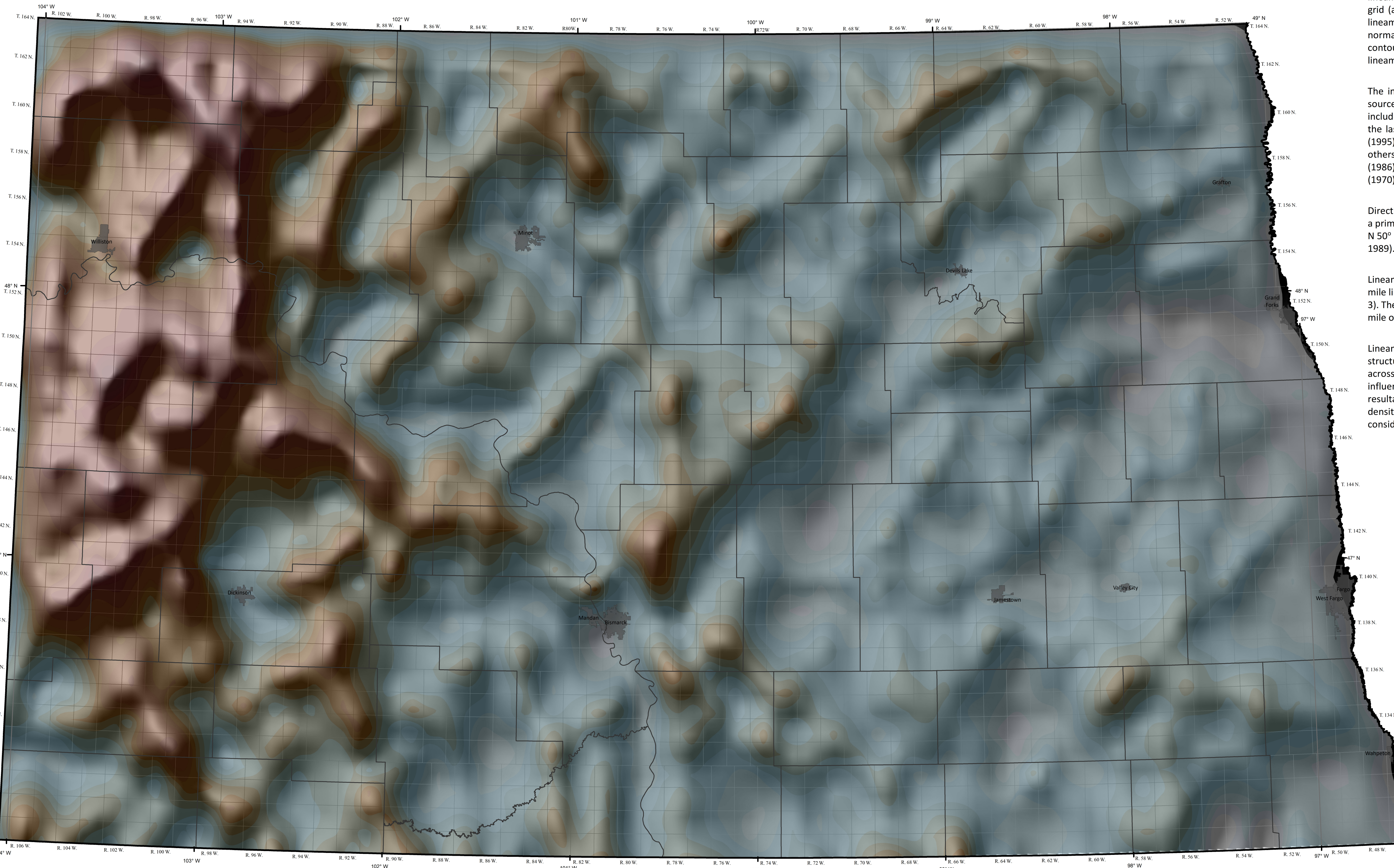


Lineament Density Map of North Dakota

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INTRODUCTION

This map depicts the density of lineaments mapped in North Dakota, including the linear traces of known or suspected faults. A lineament is an extensive linear surface feature that can be identified from aerial imagery and remote sensing data. Lineaments are commonly topographic features of regional extent that are believed to reflect subsurface geological structure. Lineament density in miles per township is presented on this shaded relief lineament density map at a scale of 1:1,000,000. Lineament density is computed as the length of all lineaments within a unit area, and is coincident with the standard Public Land Survey System (PLSS) township grid (approx. 36 square miles) that covers the state. The resulting x,y,z data file was contoured across the lineament density data range in five-mile intervals ranging from 0 to 105 miles per township (mi/twsp) using a normal kriging algorithm as a standard geostatistical baseline and for ease of reproducibility. Lineament density contours are depicted as ranging from areas of lower lineament density (cooler colors) to areas of higher lineament density (warmer colors) on a shaded relief background of 3D lineament density.

PREVIOUS LINEAMENT WORKS

The individual lineaments in this analysis were digitally extracted from a compilation of original published sources (Heinle, 2007), compiled, and merged into a single historical lineament coverage for the state. This map includes lineaments from several previous studies (i.e., historical lineaments) identified by several authors over the last four decades. These include: Penner and Cosford (2006), Kreis-Kent (2000), Freisatz (1995), Gibson (1995), Inden-Burke (1995), Shurr (1995), Brown and Brown (1987), Downey and others (1987), Gerhard and others (1987), Mollard (1987), Oglesby (1987), Peterson and MacCray (1987), Anna (1986), Maughan and Perry (1986), Hayes (1984), Hindman (1984), Cooley (1983), Haman (1975), Kent (1974), Thomas (1974), and Erickson (1970) (Figure 1).

ORIENTATION ANALYSIS

Directional analysis of the strike of 13,785 individual lineaments in this compilation reveals two distinct trends; a primary (1°) orientation of approximately N 45° W (S 45° E) and a secondary (2°) orientation of approximately N 50° E (S 50° W) (Figure 2) consistent with the regional tectonic framework of the conterminous U.S. (Zoback, 1989).

LINEAMENT LENGTH DISTRIBUTION

Lineament lengths follow a general log-normal distribution with the majority (86%) falling within the zero to six-mile lineament length range. Just over 94% of the lineaments mapped were less than 18 miles in length (Figure 3). The overall density of lineaments in ND (i.e. lineaments mapped per unit area) is 0.19 lineaments per square mile or approximately seven lineaments per township.

LINEAMENT DENSITY

Lineament density is generally greater in the western part of the state, owing to the presence of larger known structural features, such as the Nesson Anticline. Overall, lineament density is relatively uniform in character across the central and eastern parts of the state, particularly for shorter mapped lineaments. This suggests an influence from both subsurface geological (i.e., basement faulting) and surface geomorphological conditions resultant from Pleistocene glaciation (Fullerton and others, 2004). The topographic expression of lineament density crest traces may be suggestive of a coarse interpretation of regional tectonic fabric, which could be considered as a first pass at the mapping of deeper structural features such as folds and faults (Figure 4).

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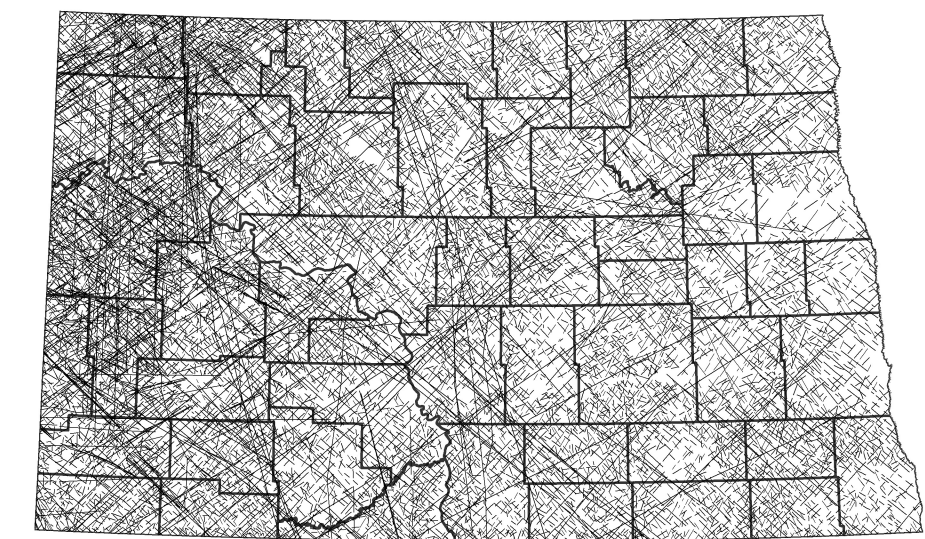


Figure 1. Index map of historical (i.e. previously published) lineaments mapped in North Dakota.

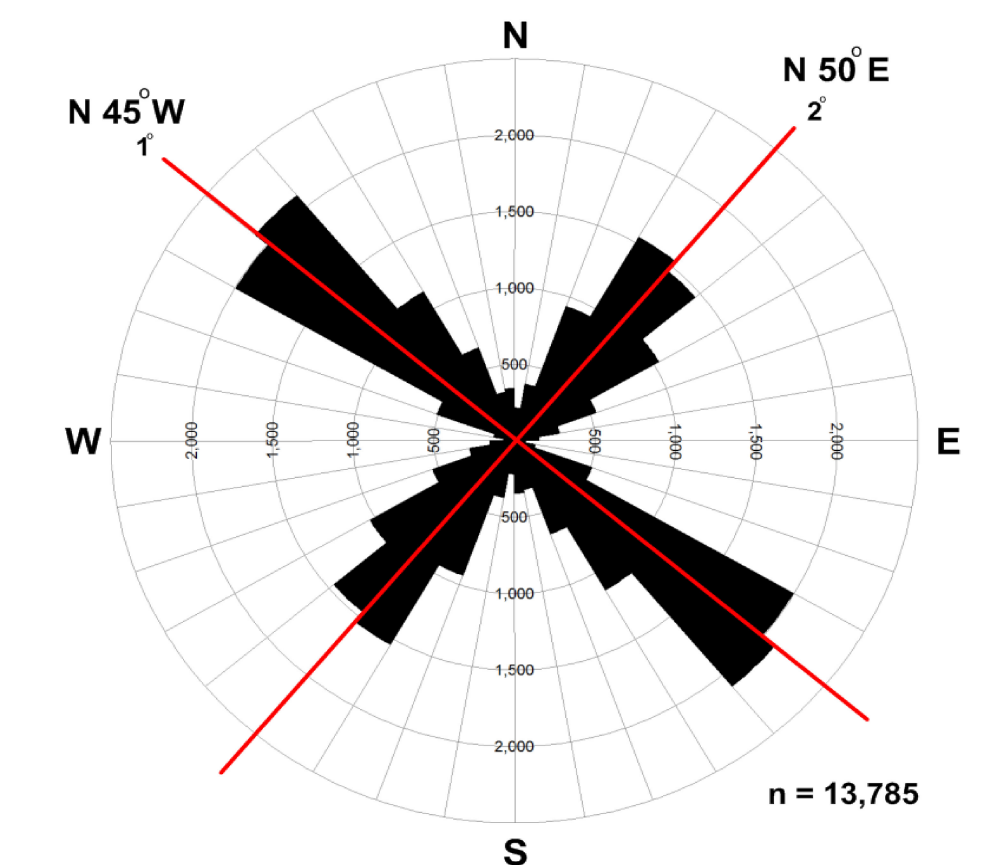


Figure 2. Rose diagram of 13,785 individual lineament orientations mapped from previous lineament studies across North Dakota. Two dominant trends are found: A primary (1°) trend of N 45° W (S 45° E) and a secondary (2°) orientation of approximately N 50° E (S 50° W).

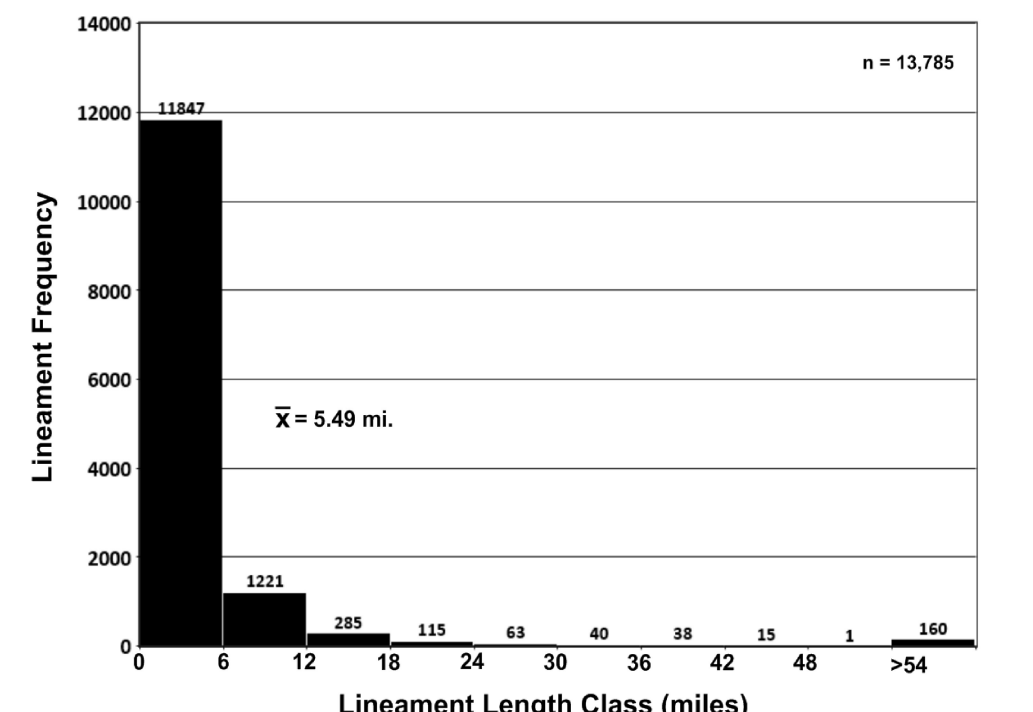


Figure 3. Frequency distribution of 13,785 individual lineament lengths from previously mapped lineament studies across North Dakota. This distribution is heavily influenced by the inclusion of the Cooley (1983) LANDSAT derived lineaments as the majority of these lineaments were less than 20 miles in length.

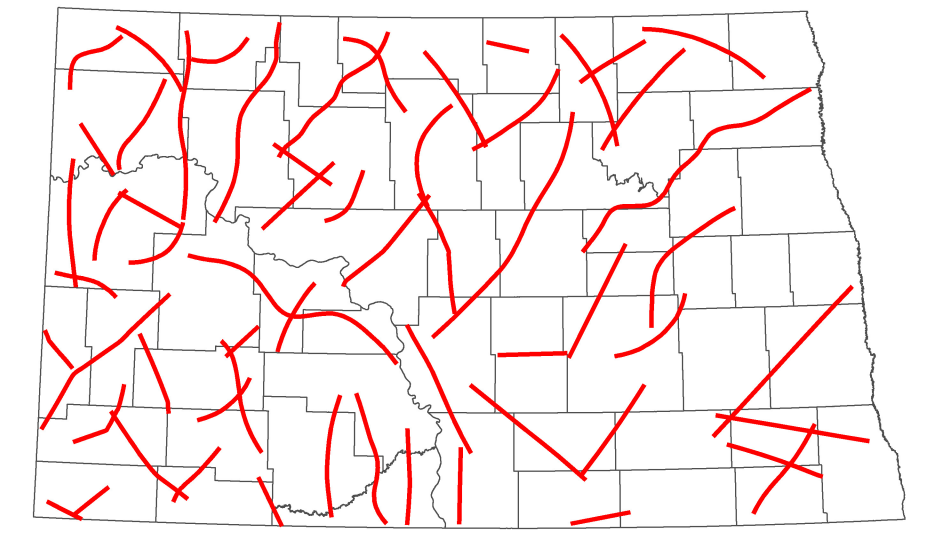
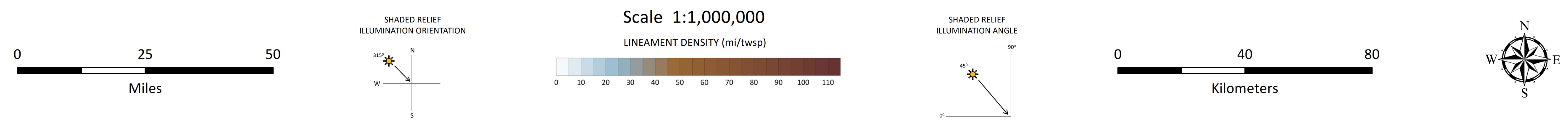


Figure 4. Lineament density crest traces mapped along lineament density highs. These crest traces may be suggestive of regional tectonic boundaries which may provide clues to the identification of deeper basement-rooted faults.



Lambert Conformal Conic Projection
North American 1983 Datum