BEDROCK GEOLOGY OF RENVILLE COUNTY
SUPPLEMENTARY MATERIAL
Regional Geology and Geophysical Models

Mark Jirsa, Val Chandler, and Dale Setterholm

Figure S1

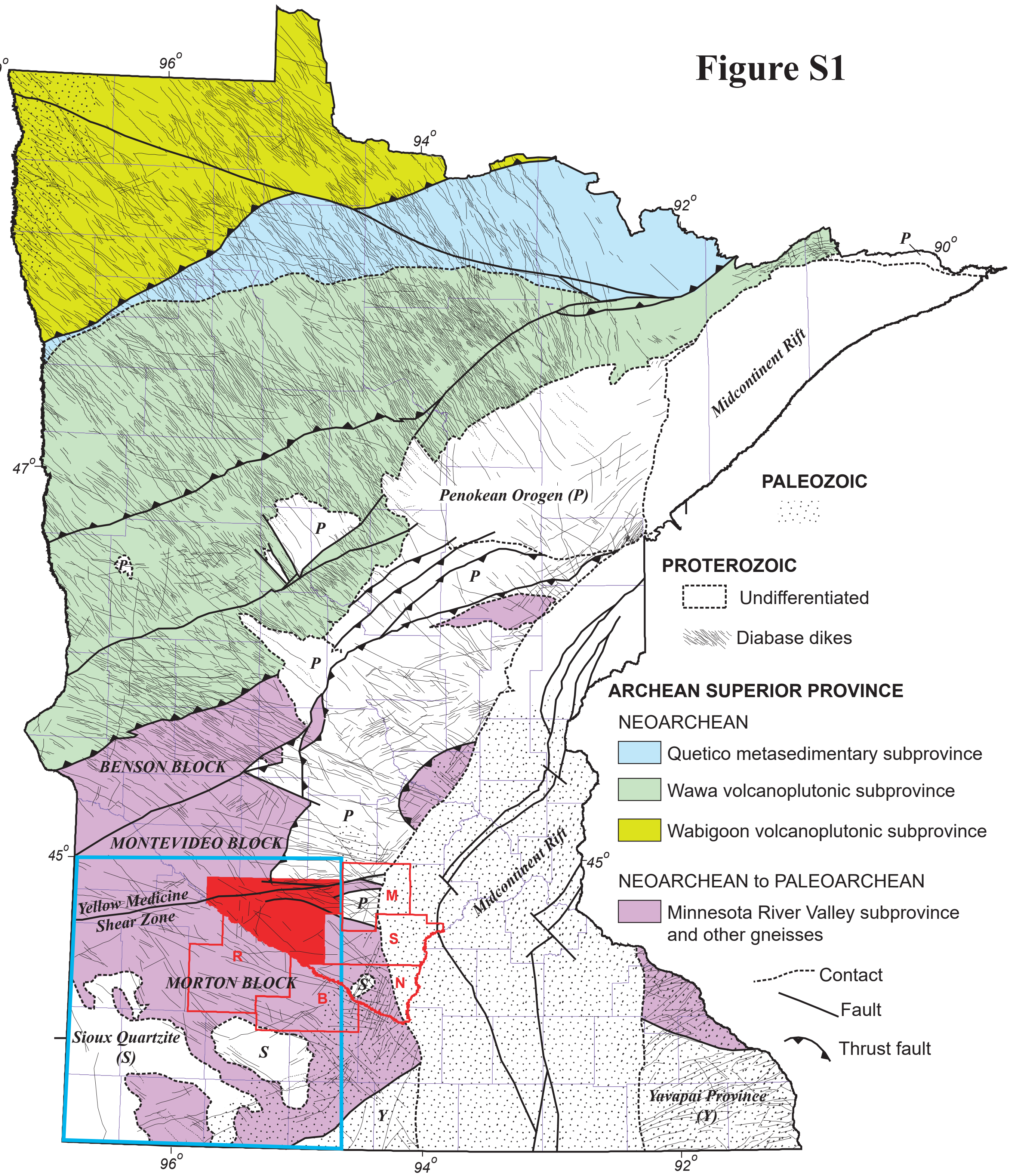

Figure S1. Generalized geologic map of Minnesota showing Precambrian (Archean and Proterozoic) and Paleozoic geology in and near Renville County (solid red). The Precambrian bedrock is subdivided by age and geographic entities such as Province, subprovince, orogen, and block. These entities represent regions of similar characteristics that typically are separated from one another by faulted, unconformable, or intrusive contacts. Geology modified from Jirsa and others, 2012. Paleozoic bedrock strata are shown by dot pattern; Cretaceous strata are omitted. Red outlines and letters indicate adjacent counties for which geologic atlases are published or in progress; B-Brown, M-McLeod, Mk-Meeker, N-Nicollet, R-Redwood, and S-Sibley. Blue outline delineates geologic map of southwestern Minnesota by Southwick (2002).

Figure S2

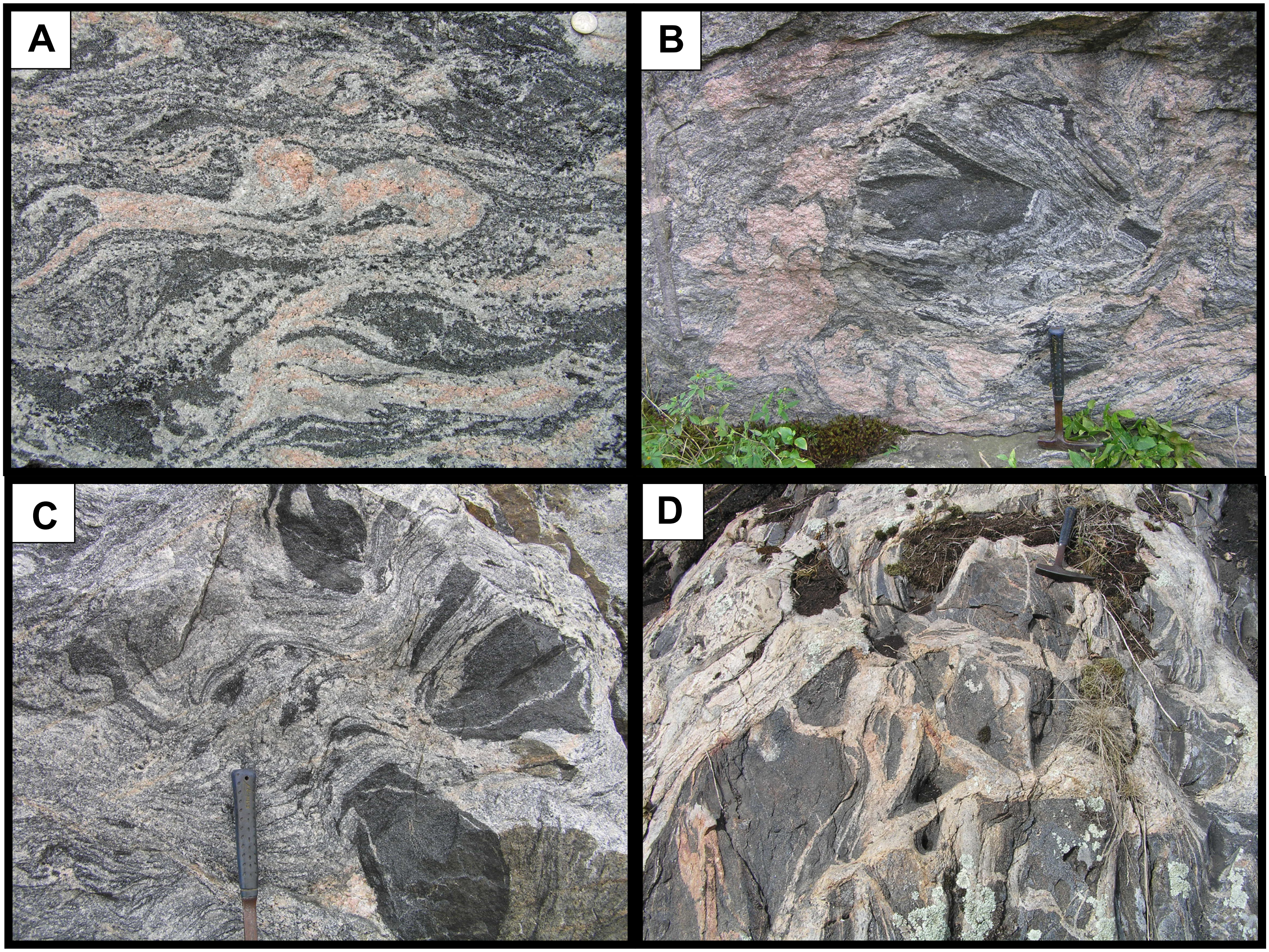

Figure S2. Outcrop photographs showing the complexity of interdigitate lithologic components typical of the Morton Gneiss—an overall pattern that is mimicked by the geologic map. A. Irregular foliation and folding of both granitic and darker granodioritic compositions; coin for scale approximately 1 inch in diameter. B. Gneiss containing "rafts' of amphibolite from quarry in village of Morton; hammer for scale. C. Amphibolite in gray gneiss from road cut near Morton. D. Gray paragneiss cut by multiple dikes of granitic composition.

Figure S3

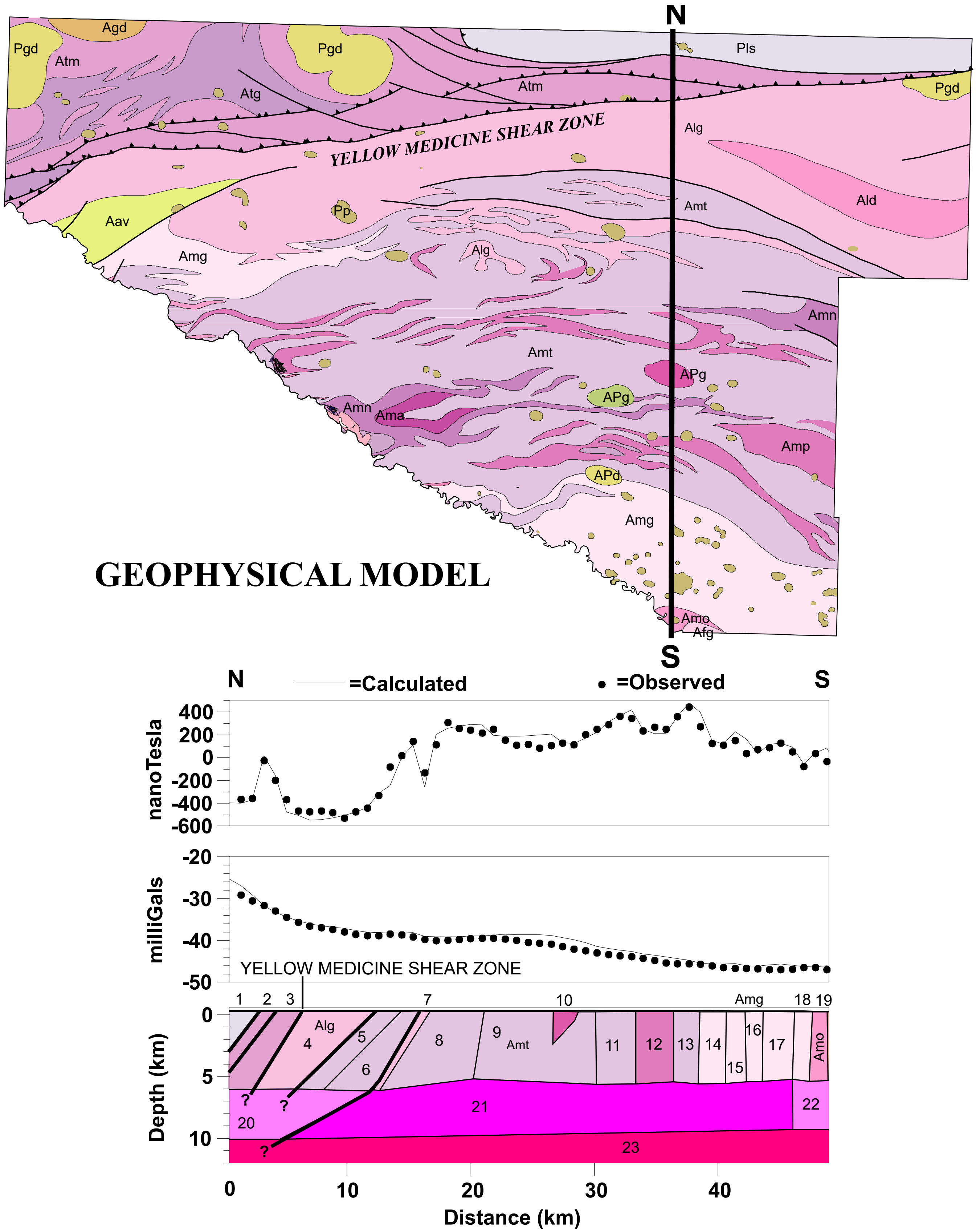

Figure S3. Generalized geologic map and geophysical block model of Renville County. Density and magnetic susceptibility values for individual blocks are number coded to Table 1. Colors of model sources are selected to match those of geologic units shown on geologic map. Minor bodies, such as some thin layers within the gneissic rocks and dikes, are not included in the model. Sources below 5-6 km do not match the colors of any mapped unit, but could represent generalized extensions of some units recognized at the bedrock surface. Heavy lines demark body contacts in the model that correspond to major faults mapped at the bedrock surface, and the Yellow Medicine shear zone is labeled. Modeling was conducted using the GM-SYS module of the Montaj software system by Geosoft Inc.

Table 1

Body No	DEN_SI	MS_SI	MAP UNITS
1	2810	0.0126	Pls
2	2740	0.0390	Atm
3	2740	0.0119	Atm
4	2730	0.0094	Alg
5	2720	0.0151	Amt
6	2740	0.0352	Amt
7	2700	0.0101	Alg
8	2730	0.0402	Amt
9	2740	0.0352	Amt
10	2740	0.0314	Apg
11	2720	0.0402	Amt
12	2710	0.0302	Amp
13	2710	0.0377	Amt
14	2700	0.0201	Amg
15	2710	0.0251	Amg
16	2690	0.0163	Amg
17	2710	0.0226	Amg
18	2710	0.0176	Amg
19	2690	0.0278	Amo
20	2770	0.0000	subsurface
21	2750	0.0754	subsurface
22	2750	0.0000	subsurface
23	2750	0.0377	subsurface

Source: Minnesota Geological Survey

Table 1
Density and magnetic susceptibility values (in SI units) and map unit designations for numbered blocks that comprise the geophysical cross-section depicted in Figure S3.

Discussion of Geophysical Models

In order to investigate geologic structure at depth, gravity and magnetic modeling was conducted along a single north-south profile that transects most major bedrock structures in the county at nearly right angles (Fig. S3). Anomaly values for the profile were interpolated at a 1 km interval from grids of the total field magnetic and Bouguer gravity anomaly data that are described on Plate 2. The modeling assumed two-dimensional (strike-infinite) sources, although end corrections were applied for sources with a limited strike-extent. To assure reliable modeling up to the margins up to the margins of Renville County, the modeling extended several kilometers beyond the ends of the cross-section. Induced magnetization was assumed, and all modeling was based on a geomagnetic field with an intensity of 58,500 nT, and inclination of 75 degrees and a declination of 0 degrees, which is consistent with geomagnetic parameters existing in the area at the approximate time of surveying (ca. 1989; National Oceanic and Atmospheric Administration, 1995). The model included multiple bodies and numerous iterations were applied, varying the geometries and properties of the bodies until their model signatures suitably matched the observed gravity and magnetic anomaly signatures. Interpretation was constrained during this process by geologic control at the bedrock surface and by rock property data (Chandler and Lively, 2011).

The selected model is presented in Figure S3 and the interpreted rock properties for the model sources are given in Table 1.This model indicates that much of the gravity and magnetic signature can be accounted for by geologically reasonable sources that lie within the upper 5-6 km of the crust, although the magnetic modeling implies that some sources may extend as deep as 10 km. South of the Yellow Medicine Shear Zone, the model has densities ranging from 2690 to 2740 kg/m^3 and magnetic susceptibilities ranging from 0.01-0.04, implying that the Morton Gneiss along this profile has a gross composition that is felsic to intermediate. Dip interpretation is best constrained along the Yellow Medicine Shear Zone, where the lower flanks of magnetic anomalies are discernible. Here most contacts are inferred to dip between 45 and 55 degrees to the north, which is consistent with observations from drill core acquired from near the shear zone. Further south, where only the upper peaks of magnetic anomalies are discernible, dip interpretation is much more speculative, and contacts are, by default, assigned vertical dips. This interpretation of vertical dips conflicts with field observations that indicate many contacts within the gneissic bedrock are shallowly dipping. One explanation for this apparent discrepancy may stem from the fact that modeling creates blocks representing “averages” of the geophysical properties of rock units at the bedrock surface with those of units below. The result, therefore, does not adequately reflect the contacts of these interlayered, shallowly dipping, and indistinctly bounded units.

Reference Cited (Note: all other reverences cited are given on Plate 2)

National Oceanic and Atmospheric Administration, 1995. Geomagnetic field models and synthesis software Version 2.1. The National Geophysical Data Center, Boulder, CO.