GIS and GPS Utility in the Geologic Mapping of Complex Geologic Terrane on the Mascot, Tennessee 7.5' Quadrangle

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INTRODUCTION

The bedrock geology of the Mascot, Tennessee 7.5' Quadrangle was mapped in 2003 under a STATEMAP cooperative agreement between the U.S. Geological Survey and the Tennessee Division of Geology. The Mascot Quadrangle is located in the Valley and Ridge Province of east Tennessee; the bedrock consists of folded and faulted Cambrian and Ordovician strata (Figure 1). The Tennessee Division of Geology purchased two Trimble GeoExplorer 3 Global Positioning Systems (GPS), which were used in conjunction with ESRI ArcView 3.2 Geographic Information System (GIS) software to record the geologic field data and present the results of the geologic mapping.

The decision to utilize GPS technology for this mapping project was initially based on the geologic complexity of the Mascot Quadrangle and the need to improve the accuracy of geologic station location. The Division of Geology had previously used GPS units to locate oil and gas wells in a well inventory study, but the majority of well data was input into a field book or datasheet. The Mascot project would help determine how the utility of GPS and, specifically, the ability to input data directly into the GPS unit would affect the geologic mapping process.

METHODOLOGY AND RESULTS

Utilizing the Trimble GeoExplorer 3 GPS and Data Dictionary for Geologic Field Data Collection

A GPS data dictionary contains a catalog of the features and attributes pertinent to an endeavor or project. It is used in the field to control the data collection of a feature (e.g., an object, geologic station, rock outcrop, etc.) and its attributes (e.g., object information, soil type, rock lithology, etc.). Using the Trimble GPS data dictionary, a geologic data spreadsheet was created to record the important geologic aspects and their values relevant to the mapping of the Mascot Quadrangle (Figure 2). Recording geologic observations involved scrolling through attribute windows (e.g., lithology) and choosing their values (e.g., shale, limestone, sandstone) from a predefined drop-down

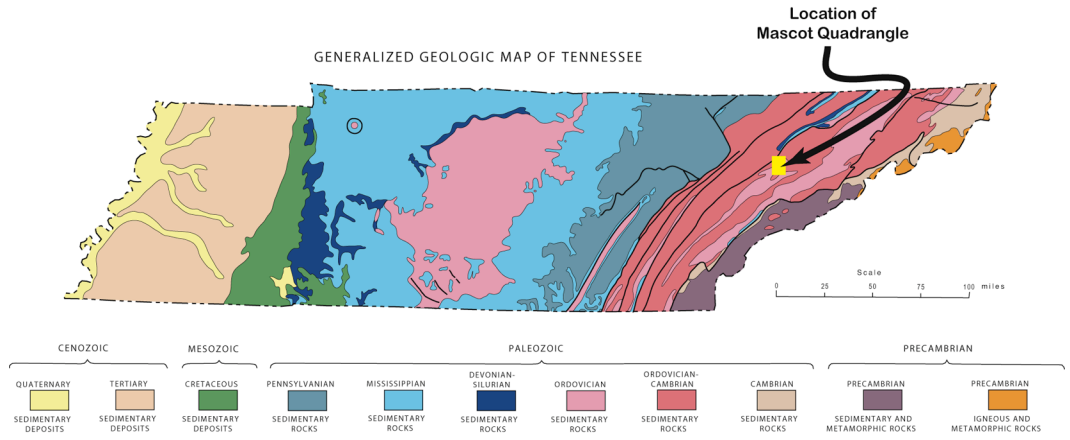
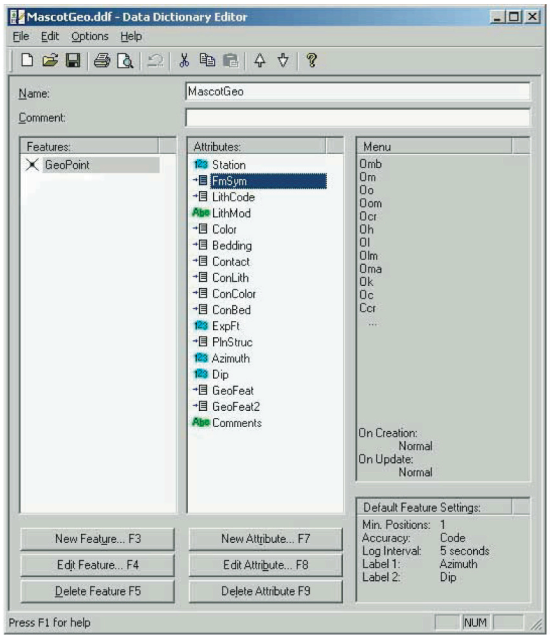


Figure 1. Location of the Mascot 7.5' Quadrangle.

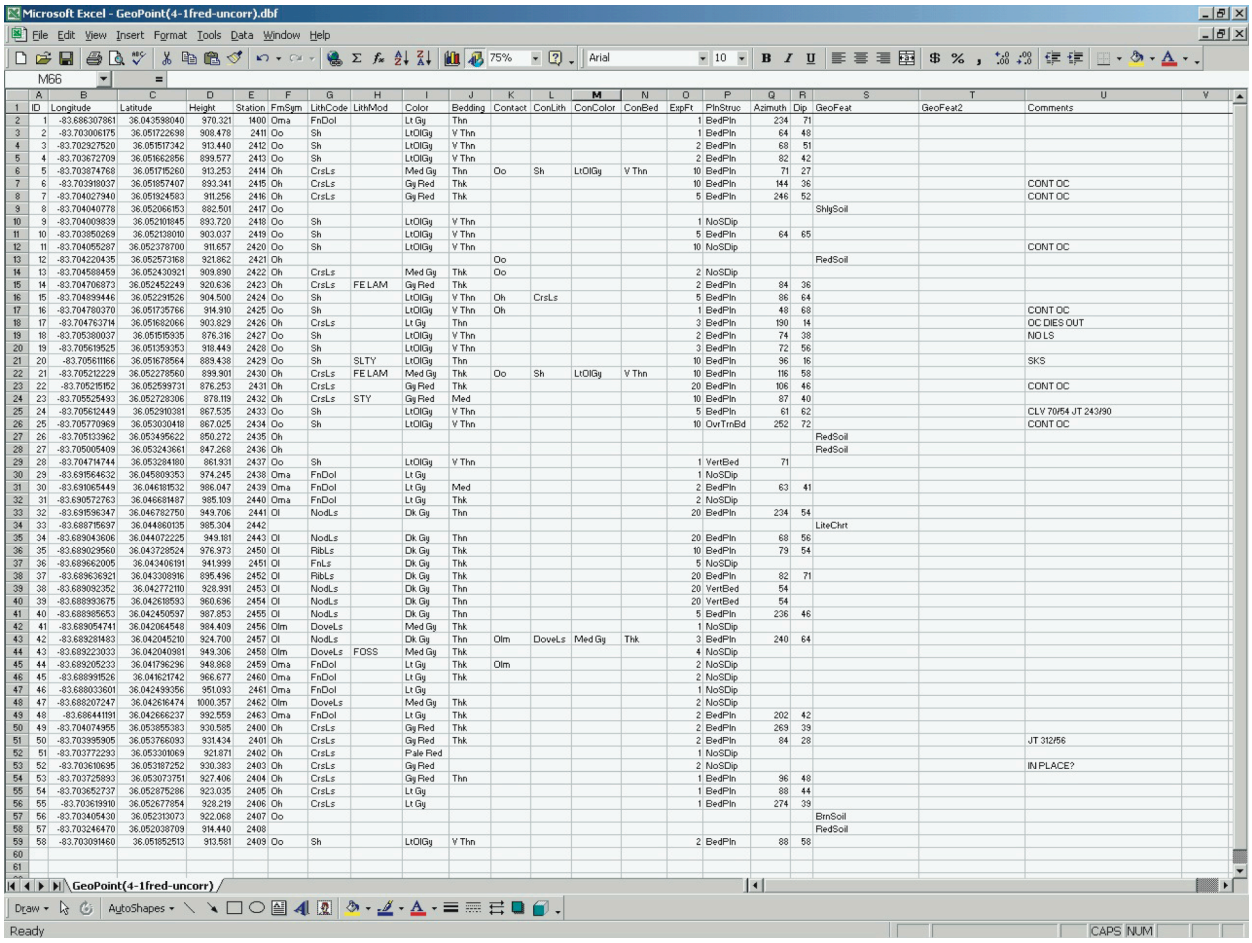


Numeric imput Field station number 1-9000	Drop-down menu Standard abbreviations of Formation names	Drop-down menu Abbreviations of diagnostic rock lithology	Text input Lithology modifiers	Drop-down menu Commonly observed lithologic colors	Drop-down menu Bedding thickness description	Drop-down menu Formation contact. Standard abbreviations of Formation names	Drop-down menu Contact lithology. Abbreviations of diagnostic rock lithology	Drop-down menu Contact color. Commonly observed lithologic colors	Drop-down menu Contact bedding. Bedding thickness description	Numeric input Top bed to bottom bed 0-300	Drop-down menu Planar structural features	Numeric input Strike in azimuth degrees 0-360	Numeric input Dip measurement 0-90	Drop-down menu Various geologic features	Drop-down menu Various geologic features repeated	Text input Other comments
Station	**FmSym**	**LithCode**	**LithMod**	**Color**	**Bedding**	**Contact**	**ConLith**	**ConColor**	**ConBed**	**ExpFt**	**PlnStruc**	**Azimuth**	**Dip**	**GeoFeat**	**GeoFeat2**	**Comments**
	Omb	Sh		Lt Gy	V Thk	Omb	Sh	Lt Gy	V Thk		BedPln			CrypChrt	CrypChrt	
	Om	SltySh		Med Gy	Thk	Om	SltySh	Med Gy	Thk		NoSDip			OoChrt	OoChrt	
	Oo	Slst		Dk Gy	Med	Oo	Slst	Dk Gy	Med		BedPln?			AlglChrt	AlglChrt	
	Oom	SdySh		LtOlGy	Thn	Oom	SdySh	LtOlGy	Thn		HorzBed			VugChrt	VugChrt	
	Ocr	Ss		Olgy	V Thn	Ocr	Ss	Olgy	V Thn		VertBed			BlkChrt	BlkChrt	
	Oho	FnLs		Grn Gy	Thk Lam	Oho	FnLs	Grn Gy	Thk Lam		OverTrnBed			LiteChrt	LiteChrt	
	Ole	CrsLs		Brn Gy	Thn Lam	Ole	CrsLs	Brn Gy	Thn Lam		Joint			RedChrt	RedChrt	
	Olm	RlbLs		Rd Gy	Cross	Olm	RlbLs	Rd Gy	Cross		VertJnt			PoroChrt	PoroChrt	
	Oma	NodLs		Red	? - Default	Oma	NodLs	Red	? - Default		Cleavage			MoldChrt	MoldChrt	
	Ok	DoveLs		Gy Red		Ok	DoveLs	Gy Red			VertClvg			OvalChrt	OvalChrt	
	Oc	FnDol		Pale Red		Oc	FnDol	Pale Red			Fault			AlgalBall	AlgalBall	
	Ccr	CrsDol		Gy Pink		Ccr	CrsDol	Gy Pink			Fault?			Cottonball	Cottonball	
	Cmnc	PetDol		Ylw		Cmnc	PetDol	Ylw			MnrAnt			BlkyChrt	BlkyChrt	
	Cmnl	RdClst		Ylw Gy		Cmnl	RdClst	Ylw Gy			MnrSyn			SltFloat	SltFloat	
	Cn	YlClst		Brn Gy		Cn	YlClst	Brn Gy			CrumpBed			SsFloat	SsFloat	
	Cm	Other		Red Brn		Cm	Other	Red Brn			? - Default			SsCobbls	SsCobbls	
	Crg	? - Default		Other		Crg	? - Default	Other						ChtMtxSs	ChtMtxSs	
	Crgo			? - Default		Crgo		? - Default						Breccia	Breccia	
	Crt					Crt								Hematite	Hematite	
	Cpv					Cpv								Limonite	Limonite	
	Cr					Cr								RedSoil	RedSoil	
	Crc					Crc								ShlySoil	ShlySoil	
	? - Default					? - Default								BrnSoil	BrnSoil	
														Spring	Spring	
														Depress	Depress	
														Collapse	Collapse	
														Cave	Cave	
														Opening	Opening	
														Swallet	Swallet	
														Quarry	Quarry	
														? - Default	? - Default	

Figure 2. The GPS data dictionary (top) for the Mascot 7.5’ Quadrangle with expanded menu selections for the geologic attributes (bottom).

menu. Attribute menu nomenclature was abbreviated to fit the constraints of the drop-down menu screen on the GPS unit. Numerical fields for strike and dip of planar features such as bedding, joints, and cleavage required direct user input. Strikes were measured in azimuth degrees (using the right hand rule) to facilitate the proper rotation of geologic symbols when compiling the data in ArcView. Two general geologic attribute fields containing drop-down menus of additional pertinent geologic information acquired during mapping include soil character, chert type, karst features, and mining activities. A final comment field allows the mapper to input directly any other observations using a menu keypad. The data dictionary and accompanying spreadsheet were updated as needed when new useful mapping criteria were observed.

The geologic data generally were input via the data dictionary, while the GPS unit collected the satellite-based coordinate information. The latitude and longitude coordinates were collected by the GPS unit in a decimal degree format so that, later, field station locations could be plotted in ArcView (Figure 3). After returning to the office, the data files were downloaded to a computer, and the coordinates were differentially corrected to a local base station over the Internet to improve accuracy.



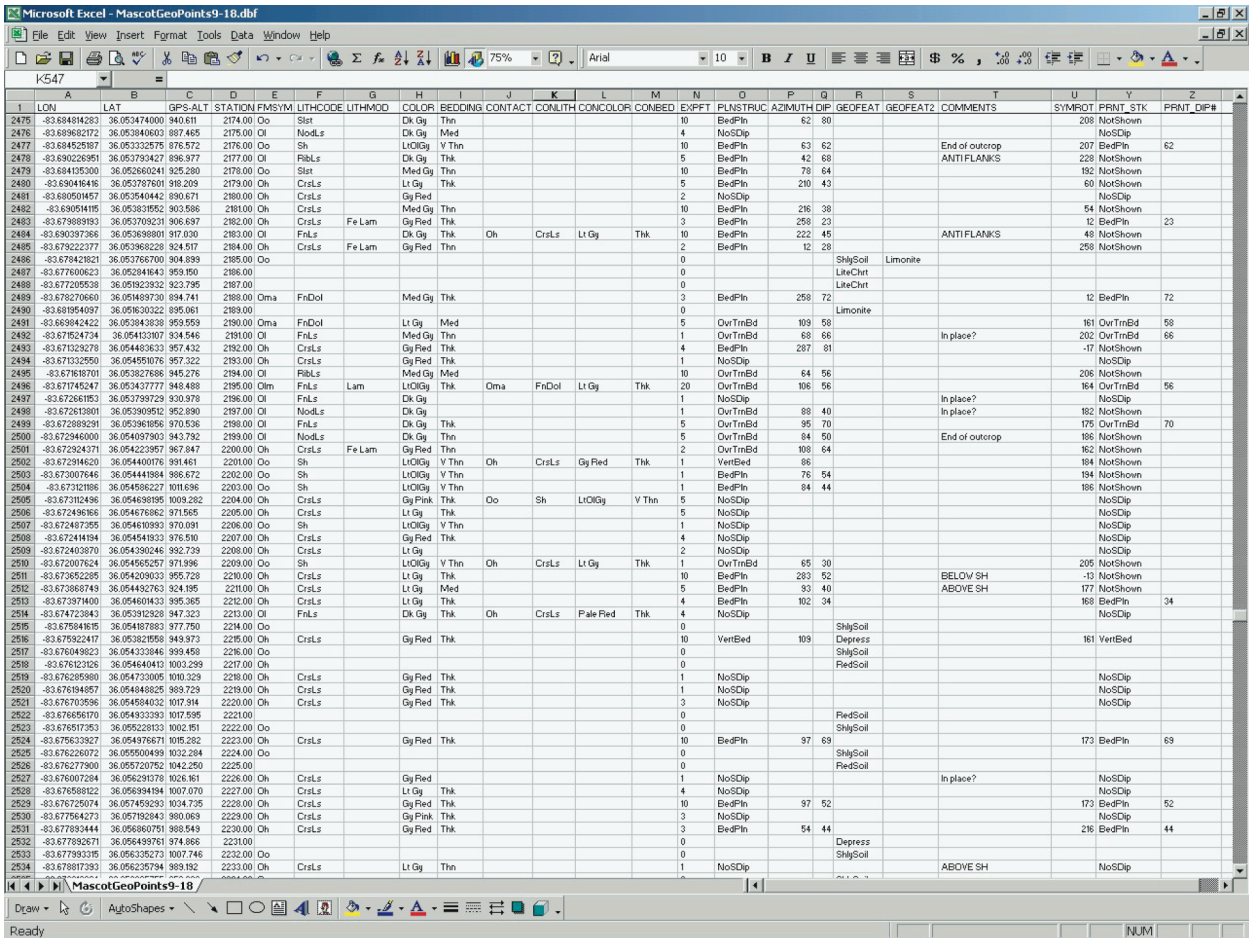
ID	Longitude	Latitude	Height	Station	FmSym	LithCode	LithMod	Color	Bedding	Contact	ConLith	ConColor	ConBed	EspFt	PlnStruc	Azimuth	Dip	GeoFeat	GeoFeat2	Comments
1	-83.686307861	36.042598040	970.321	1400	Oma	FnDol		Lt Gy	Thn					1	BedPln	234	71			
2	-83.703006175	36.051722698	908.478	2411	Oo	Sh		LtOlGy	V Thn					1	BedPln	64	48			
3	-83.702927520	36.051517342	913.440	2412	Oo	Sh		LtOlGy	V Thn					2	BedPln	68	51			
4	-83.703672709	36.051662856	899.577	2413	Oo	Sh		LtOlGy	V Thn					2	BedPln	82	42			
5	-83.703874768	36.051715260	913.253	2414	Oh	CrsLs		Med Gy	Thn	Oo	Sh	LtOlGy	V Thn	10	BedPln	71	27			
6	-83.703918037	36.051857407	893.341	2415	Oh	CrsLs		Gy Red	Thk					10	BedPln	144	36			CONT OC
7	-83.704027940	36.051924583	911.256	2416	Oh	CrsLs		Gy Red	Thk					5	BedPln	246	52			CONT OC
8	-83.704040778	36.052066153	882.501	2417	Oo													ShlySoil		
9	-83.704009839	36.052101845	893.720	2418	Oo	Sh		LtOlGy	V Thn					1	NoSDip					
10	-83.703850269	36.052138010	903.037	2419	Oo	Sh		LtOlGy	V Thn					5	BedPln	64	65			
11	-83.704055287	36.052378700	911.657	2420	Oo	Sh		LtOlGy	V Thn					10	NoSDip					CONT OC
12	-83.704229435	36.052573168	921.862	2421	Oh					Oo								RedSoil		
13	-83.704588459	36.052430921	909.890	2422	Oh	CrsLs		Med Gy	Thk	Oo				2	NoSDip					
14	-83.704706873	36.052452249	920.636	2423	Oh	CrsLs	FE LAM	Gy Red	Thk					2	BedPln	84	36			
15	-83.704899446	36.052291526	904.500	2424	Oo	Sh		LtOlGy	V Thn	Oh	CrsLs			5	BedPln	86	64			
16	-83.704780370	36.051735766	914.910	2425	Oo	Sh		LtOlGy	V Thn	Oh				1	BedPln	48	68			CONT OC
17	-83.704763714	36.051682066	903.829	2426	Oh	CrsLs		Lt Gy	Thn					3	BedPln	190	14			OC DIES OUT
18	-83.705380037	36.051515935	876.316	2427	Oo	Sh		LtOlGy	V Thn					2	BedPln	74	38			NO LS
19	-83.705619525	36.051353053	918.449	2428	Oo	Sh		LtOlGy	V Thn					3	BedPln	72	56			
20	-83.705611166	36.051678564	889.438	2429	Oo	Sh	SLTY	LtOlGy	Thn					10	BedPln	96	16			SKS
21	-83.705212229	36.052278560	899.901	2430	Oh	CrsLs	FE LAM	Med Gy	Thk	Oo	Sh	LtOlGy	V Thn	10	BedPln	116	58			
22	-83.705215152	36.052589731	876.253	2431	Oh	CrsLs		Gy Red	Thk					20	BedPln	106	46			CONT OC
23	-83.705525493	36.052728306	878.119	2432	Oh	CrsLs	STY	Gy Red	Med					10	BedPln	87	40			
24	-83.705612449	36.052910381	867.535	2433	Oo	Sh		LtOlGy	V Thn					5	BedPln	61	62			CLV 70/54 JT 243/90
25	-83.705770969	36.053030418	867.025	2434	Oo	Sh		LtOlGy	V Thn					10	OvrTrnBd	252	72			CONT OC
26	-83.705133962	36.053495622	850.272	2435	Oh													RedSoil		
27	-83.705005409	36.053243661	847.268	2436	Oh													RedSoil		
28	-83.704714744	36.053284180	861.931	2437	Oo	Sh		LtOlGy	V Thn					1	VertBed	71				
29	-83.691564632	36.045809353	974.245	2438	Oma	FnDol		Lt Gy						1	NoSDip					
30	-83.691065449	36.046181532	986.047	2439	Oma	FnDol		Lt Gy	Med					2	BedPln	63	41			
31	-83.690572763	36.046681487	985.109	2440	Oma	FnDol		Lt Gy	Thk					2	NoSDip					
32	-83.691596347	36.046782750	949.706	2441	Ol	NodLs		Dk Gy	Thn					20	BedPln	234	54			
33	-83.688775297	36.044860105	985.304	2442														LiteChrt		
34	-83.689043606	36.044072225	949.181	2443	Ol	NodLs		Dk Gy	Thn					20	BedPln	68	56			
35	-83.689029560	36.043728524	976.973	2450	Ol	RibLs		Dk Gy	Thk					10	BedPln	79	54			
36	-83.689662005	36.043406191	941.999	2451	Ol	FnLs		Dk Gy	Thk					5	NoSDip					
37	-83.689636921	36.043308916	895.496	2452	Ol	RibLs		Dk Gy	Thk					20	BedPln	82	71			
38	-83.689092352	36.042772110	928.991	2453	Ol	NodLs		Dk Gy	Thn					20	VertBed	54				
39	-83.688993675	36.042618593	960.696	2454	Ol	NodLs		Dk Gy	Thn					20	VertBed	54				
40	-83.688985653	36.042450597	987.853	2455	Ol	NodLs		Dk Gy	Thn					5	BedPln	236	46			
41	-83.689054741	36.042064548	984.409	2456	Olm	DoveLs		Med Gy	Thk					1	NoSDip					
42	-83.689281483	36.042045210	924.700	2457	Ol	NodLs		Dk Gy	Thn	Olm	DoveLs	Med Gy	Thk	3	BedPln	240	64			
43	-83.689223033	36.042040981	949.306	2458	Olm	DoveLs	FOSS	Med Gy	Thk					4	NoSDip					
44	-83.689205233	36.041796296	948.868	2459	Oma	FnDol		Lt Gy	Thk	Olm				2	NoSDip					
45	-83.688991526	36.041621742	968.677	2460	Oma	FnDol		Lt Gy	Thk					2	NoSDip					
46	-83.688033601	36.042499356	951.093	2461	Oma	FnDol		Lt Gy						1	NoSDip					
47	-83.688207247	36.042616474	1000.357	2462	Olm	DoveLs		Med Gy	Thk					2	NoSDip					
48	-83.686441191	36.042666237	992.559	2463	Oma	FnDol		Lt Gy	Thk					2	BedPln	202	42			
49	-83.704074955	36.053855383	930.585	2400	Oh	CrsLs		Gy Red	Thk					2	BedPln	269	39			
50	-83.703995905	36.053766093	931.434	2401	Oh	CrsLs		Gy Red	Thk					2	BedPln	84	28			JT 312/56
51	-83.703772293	36.053301069	921.871	2402	Oh	CrsLs		Pale Red						1	NoSDip					
52	-83.703610695	36.053187252	930.383	2403	Oh	CrsLs		Gy Red						2	NoSDip					IN PLACE?
53	-83.703725993	36.053073751	927.406	2404	Oh	CrsLs		Gy Red	Thn					1	BedPln	96	48			
54	-83.703852737	36.052975206	923.035	2405	Oh	CrsLs		Lt Gy						1	BedPln	88	44			
55	-83.703619910	36.052677854	928.219	2406	Oh	CrsLs		Lt Gy						1	BedPln	274	39			
56	-83.703405430	36.052313073	922.068	2407	Oo													BrnSoil		
57	-83.703246470	36.052038709	914.440	2408														RedSoil		
58	-83.703091460	36.051852513	913.581	2409	Oo	Sh		LtOlGy	V Thn					2	BedPln	88	58			

Figure 3. Example of part of the fieldwork database for the Mascot 7.5' Quadrangle.

Utilizing ESRI ArcView 3.2 GIS Software and the GPS Database to Produce the Mascot Quadrangle Geologic Map

The differentially corrected GPS data file (.cor) was exported in dBase format and transferred into a compilation database that was used in ArcView to compile a preliminary geologic map. Additional fields in the compilation database are included to plot the symbol orientation for planar features (SYMROT) and print selected geologic symbols (PRNT_STK) and dip numbers (PRNT_DIP#) in ArcView (Figure 4). The SYMROT field was used to rotate the geologic symbols by using the formula "270° minus the azimuth strike." The compilation map included point themes for lithology, bedding attitudes, formation contact points, and other geologic features recorded in the database, all of which are shown as unique points or symbols on the map (Figure 5 and 6). Dip value labels were added to the bedding attitude symbols. These point themes were used to interpret the location of stratigraphic contacts and the surface trace of axial planes and faults, which are each separate line themes on the geologic compilation map (Figure 7).

To produce the "final" version of the geologic map in ArcView, stratigraphic contacts and fault lines were divided into solid (exactlocation), dashed (approximatelocation), and dotted (coveredlocation) line segments based on contact location certainty. These contact line themes were converted to formation polygon themes. The formation polygons were colored and displayed beneath a partially transparent raster topographic base map. The color pallet of the raster map was adjusted such that the underlying polygons could be displayed while important features such as roads, streams, and contour lines also were visible. Formation labels then were added to the geologic map. To avoid clutter, the lithologic and geologic feature point themes were not displayed in the final version of the geologic map (Figure 8). A geologic cross-section location line was placed on the map. In the ArcView layout view, titles, labels, and a geologic symbol explanation were added as well as a written scale, bar scales, and a north arrow (Figure 9). The geologic cross-section, stratigraphic column, and geologic descriptions were drafted separately using Adobe Illustrator 8.0 software.



LON	LAT	GPS-ALT	STATION	FMSYM	LITHCODE	LITHMOD	COLOR	BEDDING	CONTACT	CONLITH	CONCOLOR	CONBED	EXPFT	PLNSTRUC	AZIMUTH	DIP	GEOFEAT	GEOFEAT2	COMMENTS	SYMROT	PRNT_STK	PRNT_DIP#
-83.684814283	36.053474000	940.611	2174.00	Oo	Slst		Dk Gy	Thn					10	BedPln	62	80					NotShown	
-83.688968172	36.053840603	887.465	2175.00	Ol	NodLs		Dk Gy	Med					4	NoSDip							NoSDip	
-83.684525187	36.053332575	876.572	2176.00	Oo	Sh		LtOlGy	V Thn					10	BedPln	63	62			End of outcrop	207	BedPln	62
-83.690226951	36.053793427	896.977	2177.00	Ol	FibLs		Dk Gy	Thk					5	BedPln	42	68			ANTI FLANKS	228	NotShown	
-83.684135300	36.052660241	925.280	2178.00	Oo	Slst		Med Gy	Thn					10	BedPln	78	64				192	NotShown	
-83.690416416	36.053787601	918.209	2179.00	Oh	CrsLs		Lt Gy	Thk					5	BedPln	210	43				60	NotShown	
-83.680501457	36.053540442	890.671	2180.00	Oh	CrsLs		Gy Red						2	NoSDip							NoSDip	
-83.690514115	36.053831552	903.586	2181.00	Oh	CrsLs		Med Gy	Thn					10	BedPln	216	38				54	NotShown	
-83.679889193	36.053709231	906.697	2182.00	Oh	CrsLs	Fe Lam	Gy Red	Thk					3	BedPln	258	23				12	BedPln	23
-83.690397366	36.053698801	917.030	2183.00	Ol	FnLs		Dk Gy	Thk	Oh	CrsLs	Lt Gy	Thk	10	BedPln	222	45			ANTI FLANKS	48	NotShown	
-83.679222377	36.053968228	924.517	2184.00	Oh	CrsLs	Fe Lam	Gy Red	Thn					2	BedPln	12	28				258	NotShown	
-83.678423821	36.053766700	904.899	2185.00	Oo									0				ShlySoil	Limonite				
-83.677600623	36.052841643	959.150	2186.00										0				LiteChrt					
-83.677205538	36.051923332	923.795	2187.00										0				LiteChrt					
-83.678270660	36.051489730	894.741	2188.00	Oma	FnDol		Med Gy	Thk					3	BedPln	258	72				12	BedPln	72
-83.681954097	36.051630322	895.061	2189.00										0				Limonite					
-83.669842422	36.053843838	959.559	2190.00	Oma	FnDol		Lt Gy	Med					5	OvrTrnBd	109	58				161	OvrTrnBd	58
-83.671524734	36.054133107	934.546	2191.00	Ol	FnLs		Med Gy	Thn					1	OvrTrnBd	68	66			In place?	202	OvrTrnBd	66
-83.671329278	36.054493633	957.432	2192.00	Oh	CrsLs		Gy Red	Thk					4	BedPln	287	81				-17	NotShown	
-83.671332550	36.054551076	957.322	2193.00	Oh	CrsLs		Gy Red	Thk					1	NoSDip							NoSDip	
-83.671618701	36.053827686	945.276	2194.00	Ol	FibLs		Med Gy	Med					10	OvrTrnBd	64	56				206	NotShown	
-83.671745247	36.053437777	949.489	2195.00	Olm	FnLs	Lam	LtOlGy	Thk	Oma	FnDol	Lt Gy	Thk	20	OvrTrnBd	106	56				164	OvrTrnBd	56
-83.672661153	36.053799729	930.978	2196.00	Ol	FnLs		Dk Gy						1	NoSDip					In place?		NoSDip	
-83.672613801	36.053909512	952.890	2197.00	Ol	NodLs		Dk Gy						1	OvrTrnBd	88	40			In place?	182	NotShown	
-83.672889291	36.053961656	970.536	2198.00	Ol	FnLs		Dk Gy	Thk					5	OvrTrnBd	95	70				175	OvrTrnBd	70
-83.672946000	36.054097903	943.792	2199.00	Ol	NodLs		Dk Gy	Thn					5	OvrTrnBd	84	50			End of outcrop	186	NotShown	
-83.672924371	36.054223957	967.847	2200.00	Oh	CrsLs	Fe Lam	Gy Red	Thn					2	OvrTrnBd	108	64				162	NotShown	
-83.672914620	36.054400176	991.461	2201.00	Oo	Sh		LtOlGy	V Thn	Oh	CrsLs	Gy Red	Thk	1	VertBed	86					184	NotShown	
-83.673007646	36.054441984	986.672	2202.00	Oo	Sh		LtOlGy	V Thn					1	BedPln	76	54				194	NotShown	
-83.673121186	36.054586227	1011.696	2203.00	Oo	Sh		LtOlGy	V Thn					1	BedPln	84	44				186	NotShown	
-83.673112496	36.054698195	1009.282	2204.00	Oh	CrsLs		Gy Pink	Thk	Oo	Sh	LtOlGy	V Thn	5	NoSDip							NoSDip	
-83.672496166	36.054676862	971.565	2205.00	Oh	CrsLs		Lt Gy	Thk					5	NoSDip							NoSDip	
-83.672487255	36.054610993	970.091	2206.00	Oo	Sh		LtOlGy	V Thn					1	NoSDip							NoSDip	
-83.672414194	36.054541933	976.510	2207.00	Oh	CrsLs		Gy Red	Thk					4	NoSDip							NoSDip	
-83.672403870	36.054390246	992.739	2208.00	Oh	CrsLs		Lt Gy						2	NoSDip							NoSDip	
-83.672007624	36.054565257	971.996	2209.00	Oo	Sh		LtOlGy	V Thn	Oh	CrsLs	Lt Gy	Thk	1	OvrTrnBd	65	30				205	NotShown	
-83.673652285	36.054209033	955.728	2210.00	Oh	CrsLs		Lt Gy	Thk					10	BedPln	283	52			BELOW SH	-13	NotShown	
-83.673868749	36.054492763	924.195	2211.00	Oh	CrsLs		Lt Gy	Med					5	BedPln	93	40			ABOVE SH	177	NotShown	
-83.673971400	36.054601433	995.365	2212.00	Oh	CrsLs		Lt Gy	Thk					4	BedPln	102	34				168	BedPln	34
-83.674723843	36.053912928	947.323	2213.00	Ol	FnLs		Dk Gy	Thk	Oh	CrsLs	Pale Red	Thk	4	NoSDip							NoSDip	
-83.675841615	36.054187883	977.750	2214.00	Oo									0				ShlySoil					
-83.675922417	36.053821558	949.973	2215.00	Oh	CrsLs		Gy Red	Thk					10	VertBed	109		Depress			161	VertBed	
-83.676049823	36.054233846	999.459	2216.00	Oo									0				ShlySoil					
-83.676123126	36.054640413	1003.299	2217.00	Oh									0				RedSoil					
-83.676285980	36.054733005	1010.329	2218.00	Oh	CrsLs		Gy Red	Thk					1	NoSDip							NoSDip	
-83.676194857	36.054848825	989.729	2219.00	Oh	CrsLs		Gy Red	Thk					1	NoSDip							NoSDip	
-83.676703596	36.054584032	1017.914	2220.00	Oh	CrsLs		Gy Red	Thk					3	NoSDip							NoSDip	
-83.676656170	36.054933393	1017.595	2221.00										0				FledSoil					
-83.676517353	36.055228133	1002.151	2222.00	Oo									0				ShlySoil					
-83.675633927	36.054976671	1015.282	2223.00	Oh	CrsLs		Gy Red	Thk					10	BedPln	97	69				173	BedPln	69
-83.676226072	36.055500499	1032.284	2224.00	Oo									0				ShlySoil					
-83.676277900	36.055720752	1042.250	2225.00										0				RedSoil					
-83.676007284	36.056291078	1026.161	2226.00	Oh	CrsLs		Gy Red						1	NoSDip					In place?		NoSDip	
-83.676598122	36.056994194	1007.070	2227.00	Oh	CrsLs		Lt Gy	Thk					4	NoSDip							NoSDip	
-83.676725074	36.057459293	1034.735	2228.00	Oh	CrsLs		Gy Red	Thk					10	BedPln	97	52				173	BedPln	52
-83.677564273	36.057192843	980.069	2229.00	Oh	CrsLs		Gy Pink	Thk					3	NoSDip							NoSDip	
-83.677693444	36.056860751	988.549	2230.00	Oh	CrsLs		Gy Red	Thk					3	BedPln	54	44				216	BedPln	44
-83.677892671	36.056493761	974.866	2231.00										0				Depress					
-83.677993315	36.056335273	1007.746	2232.00	Oo									0				ShlySoil					
-83.678817393	36.056235794	989.192	2233.00	Oh	CrsLs		Lt Gy	Thn					1	NoSDip					ABOVE SH		NoSDip	

Figure 4. Example of part of the compilation database for the Mascot 7.5’ Quadrangle. Note SYMROT, PRNT_STK, and PRNT_DIP columns near the right side of figure.

ADVANTAGES AND DISADVANTAGES ENCOUNTERED

Advantages of using GIS and GPS technology during the geologic mapping process included the drastic reduction of office time to input field data into a spreadsheet format that can be used in ArcView. Prior to using GPS, office time was required to determine field point coordinates and enter field book data into a spreadsheet. Also, the GPS data dictionary facilitated the compilation of data from two mappers in that it listed basic attributes to record and constrained how the attributes were described. The GPS dictionary also provided a framework by which to set up a consistent GIS compilation database between separate mappers, and share data between mappers on a daily basis.

Disadvantages included the need for a paper copy of the topographic map in the field for navigation, station point location, and plotting contact lines. The paper map was also needed to plot the data in the field to determine where the geologic traverse needed to proceed. Areas that contained observable geologic characteristics, but were deemed inaccessible, were also plotted on the paper map. Field books were used for lengthy geologic descriptions, sketches, or other information. GPS satellite acquisition was occasionally hampered under heavy forest canopy or when satellites were not in proper array. On these occasions, station locations were plotted directly on the paper map, and the correct coordinates were added later to the compilation database. There were no independent checks and balances in place designed to detect GPS user input errors. The ArcView compilation map was also printed on a periodic basis to guide future traverses and provide a map for the geologists to use in the field.

This methodology may not be suitable when geologic mapping involves long stays in the wilderness away from the office and electricity. In this study, data files needed to be downloaded every day or two because of GPS memory limitations and the GPS batteries had to be recharged every day.

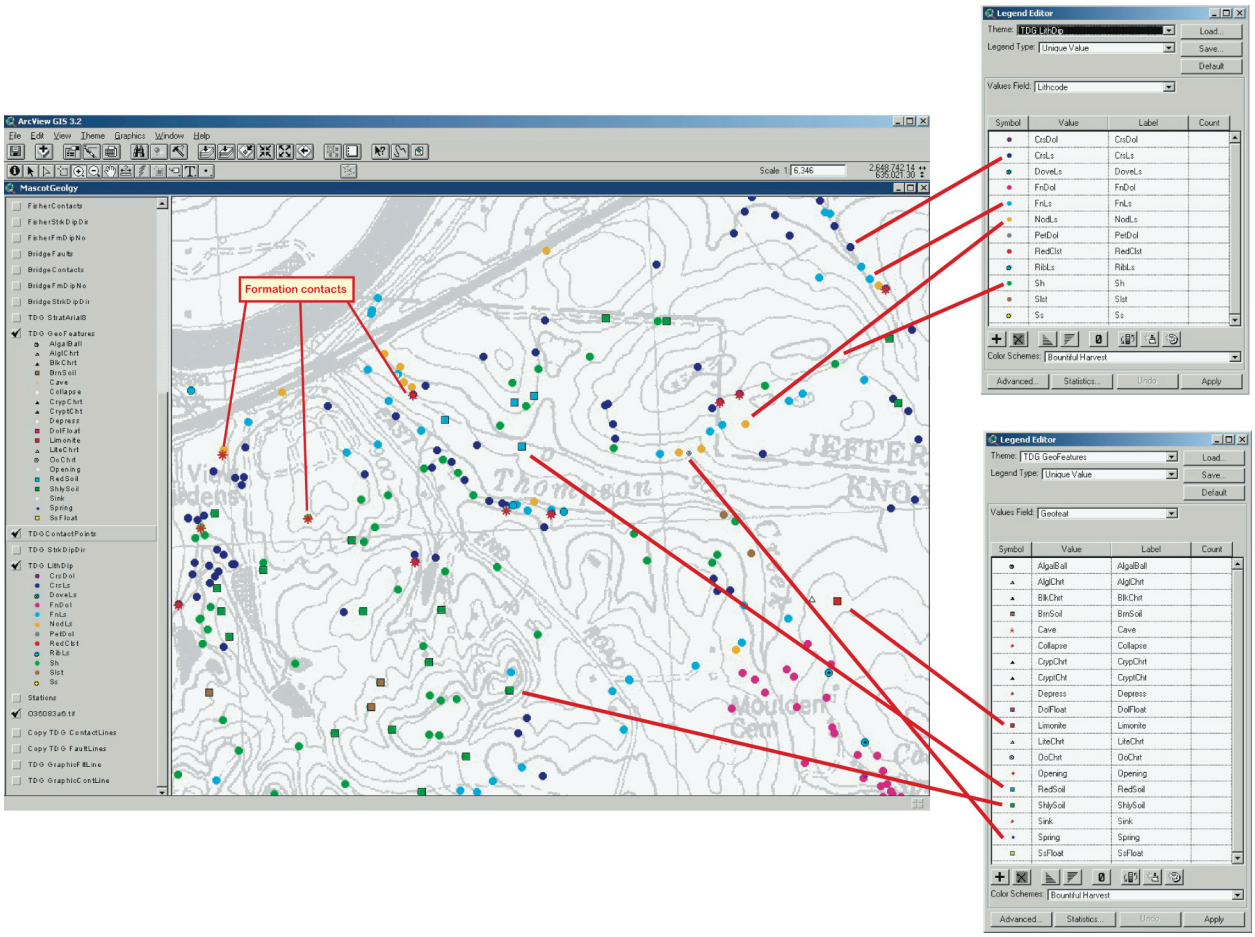


Figure 5. Part of the Mascot 7.5' Quadrangle compilation map with lithologies, geologic contacts, and other geologic features shown as discrete points or symbols.

CONCLUSIONS

Despite minor problems in the field and office, the Trimble GeoExplorer 3 Global Positioning System and the ESRI ArcView 3.2 Geographic Information System worked well in unison to assist in the completion of the geologic map of the Mascot Quadrangle. The GPS unit was used to locate station points in geologically complex areas where accurate plotting was crucial for constraining the geologic interpretation. The GPS data dictionary permitted relatively rapid data entry into the database, while the GPS unit collected coordinate information. The GIS software had the versatility to import the GPS data files directly for rapid compilation of the geologic data into a useable map. The Mascot 7.5' Geologic Quadrangle map can be printed on demand and is currently available from the Tennessee Division of Geology as an open file map.

VENDOR CONTACT INFORMATION

Adobe Illustrator—Adobe Systems, Inc., 345 Park Ave., San Jose, CA 95110-2704 USA, (800) 833-6687, <http://www.adobe.com>.

ArcGIS, ArcPad, ArcView—Environmental Systems Research Institute (ESRI), Inc., 380 New York St., Redlands, CA, 92373-8100 USA, (909) 793-2853, <http://www.esri.com>.

dBase—dataBased Intelligence, Inc., 2548 Vestal Parkway, East Vestal, NY 13850, (877) 322-7340, <http://www.dbase.com>.

Microsoft Excel—Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399 USA, (425) 882-8080, <http://www.microsoft.com/office/excel>.

Trimble GeoExplorer—Trimble Navigation Limited, 645 N. Mary Avenue, Sunnyvale, CA, 94088-3642, (408) 481-8000, <http://www.trimble.com>.

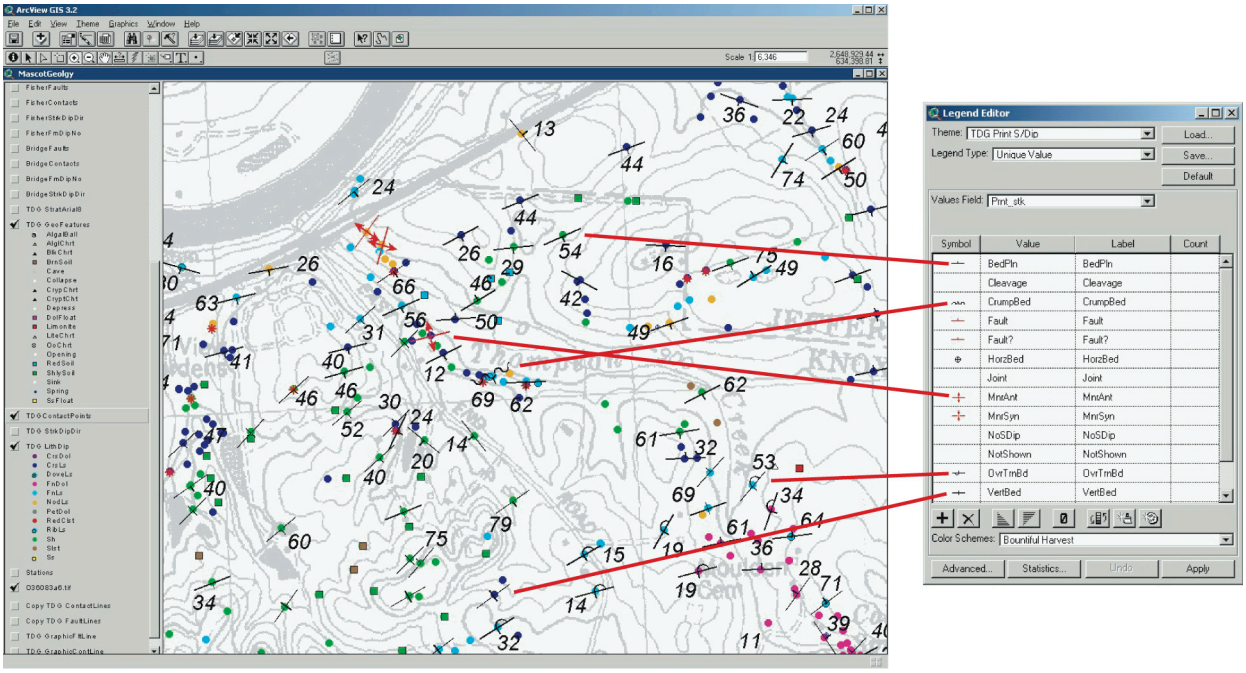


Figure 6. Part of the Mascot 7.5’ Quadrangle compilation map with bedding strike and dip symbols for the point features shown in Figure 5.

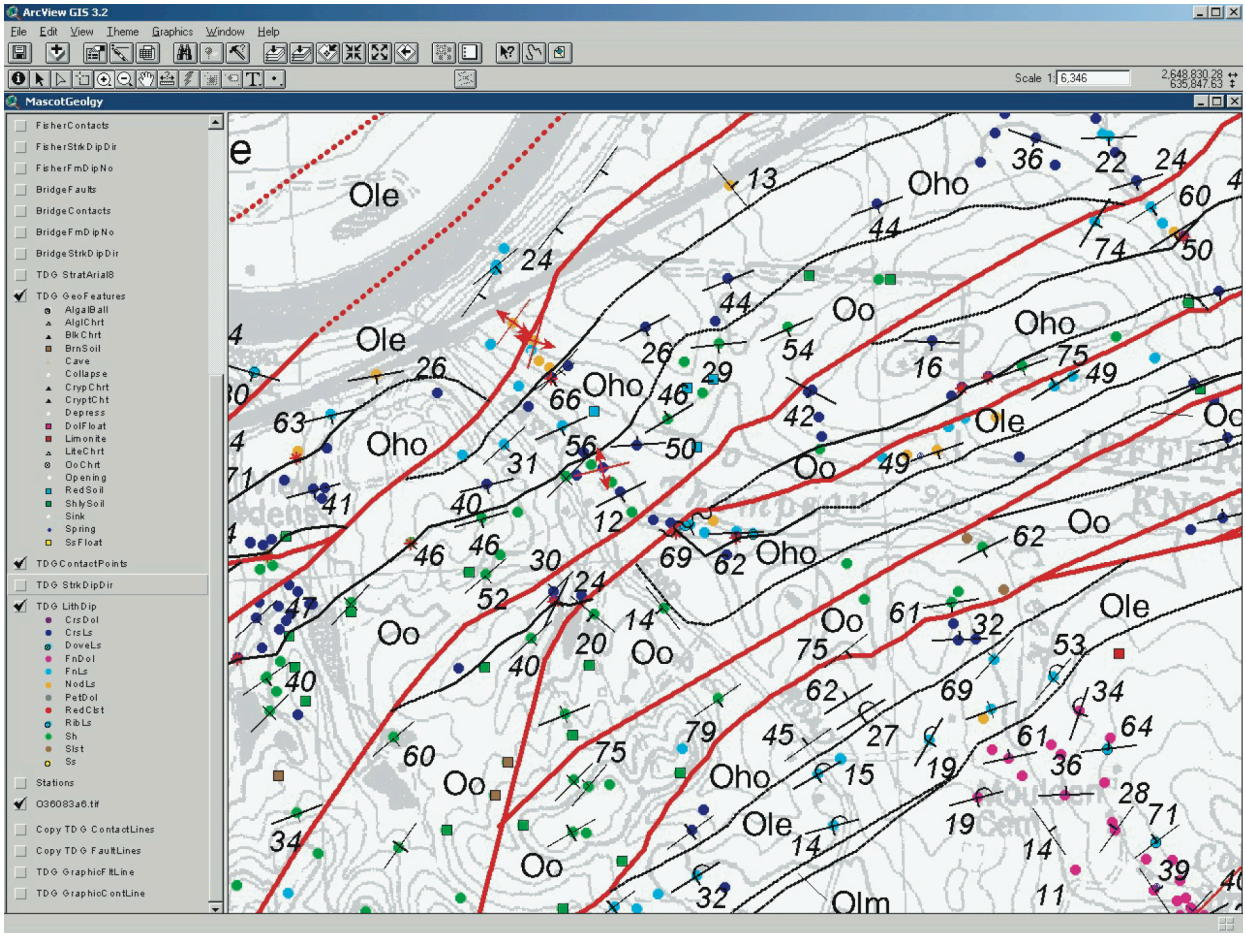


Figure 7. Part of the Mascot 7.5' Quadrangle compilation map with geologic contact lines (black), fault lines (red), and formation abbreviations. In the printed version, the fault lines appear as thick black lines. Map includes geologic point features (see Figure 5) and bedding attitude symbology (see Figure 6).

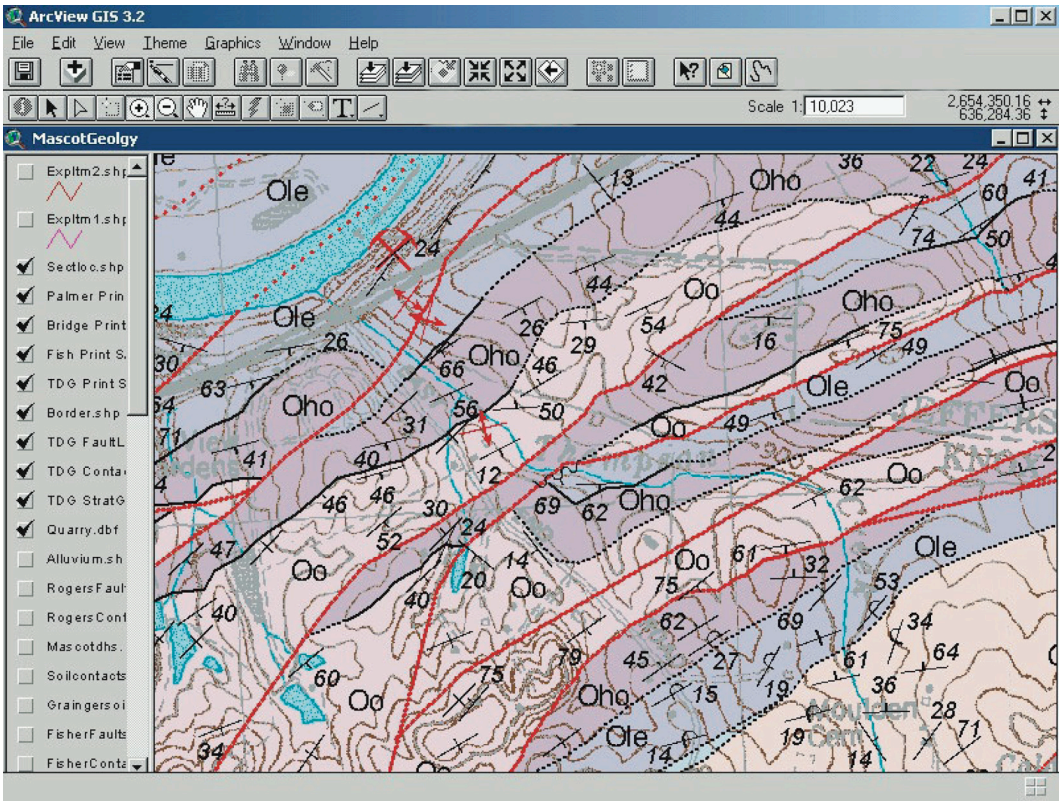


Figure 8. Part of the Mascot 7.5’ Quadrangle compilation map with polygons filled with appropriate geologic formation colors. Geologic point features are not shown. Bedding attitude symbology shown.

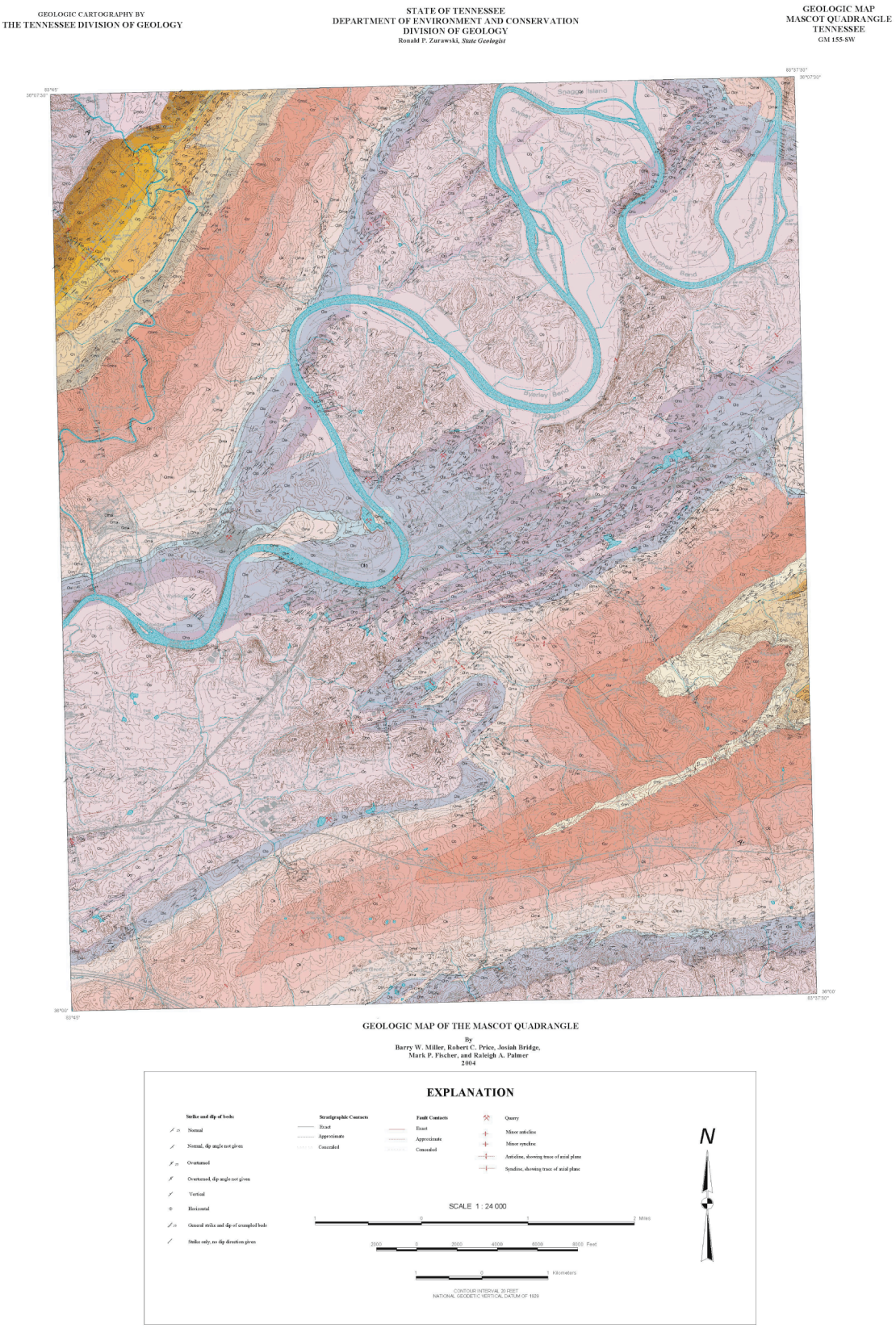


Figure 9. Open file version of the Mascot Geologic Quadrangle Map.