DEPARTMENT OF THE INTERIOR

U.S. Geological Survey

PRELIMINARY GEOLOGIC MAP OF THE WINCHESTER 30 X 60 MINUTE QUADRANGLE, WEST VIRGINIA, VIRGINIA, AND MARYLAND

compiled by

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This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature

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PURPOSE AND METHODS

Compilation of the Winchester quadrangle was undertaken to identify areas in which detailed mapping, including topical structural and stratigraphic studies, might yield new information on Appalachian geology. A final version of the geologic map, based on this new work, is planned for future publication.

The quadrangle was selected largely because it spans the Appalachian foreland from the Blue Ridge to the Allegheny Plateau, and together with the Washington West, Fredericksburg, and Leonardtown 30 by 60 minute quadrangles, now under study by the U.S. Geological Survey, it will provide a continuous transect across the entire orogen to the Atlantic coastal plain. (fig. 1).

The quadrangle lies across the central Appalachian Valley and Ridge province, and includes rocks that range in age from Late Proterozoic to Pennsylvanian. It is characterized at the surface by broad synclinoria and anticlinoria with asymmetrical first-order folds and a near total absence of the emergent regional thrust faults that are typical of the southern Appalachians (fig.2). Subsurface studies have suggested that a system of blind thrusts, in conjunction with a duplex of Cambrian-Ordovician carbonate rocks, underlies a relatively passive cover of post-Ordovician rocks (Gwinn, 1964; Perry, 1978) Mitra, 1986; Evans, 1989). These cover rocks, called a "blind autochthonous roof" by Geiser (1988), form the bulk of the rocks exposed in the Winchester quadrangle. Cambrian-Ordovician carbonate rocks and Late Ordovician flysch, exposed east of the North Mountain thrust (fig. 2) in the Great Valley subprovince, underlie most of the remainder of the area.

The map was compiled from published maps and reports; the primary sources are shown in fig. 3. Additional sources include Butts (1933), Cardwell and others (1968), Ferrill and Dunne (1989), and the author's unpublished field data. This preliminary geologic map shows that some areas contain unresolved mapping problems, such as mismatches between units shown on published reports or inconsistencies between the geology as shown and that suggested by the topography. A number of such areas are indicated on fig. 4.

Descriptions of the rocks were also compiled from the literature, predominantly the areal reports cited in fig. 3. Also consulted were Butts (1940), deWitt and Colton (1964), Woodward (1941, 1943, 1949, 1951), and Young and Rader (1974).

Current problems of geological interest in the Winchester quadrangle include the nature of the deformation of the post-Ordovician cover rocks, specifically the style, extent, and mechanism of Alleghanian shortening; regional stratigraphic variations and their implications for depositional regimes; the structural relationship between rocks of the Blue Ridge province and the Valley and Ridge province; and the nature and distribution of the surficial deposits. Insight into these problems may be provided by comparison of the geology of the Winchester quadrangle with that of the Radford quadrangle (Bartholomew, Schultz, and McDowell, in press; Schultz, in press; see also McDowell and Schultz, 1990), which spans the foreland in the southern Appalachians (fig. 1).

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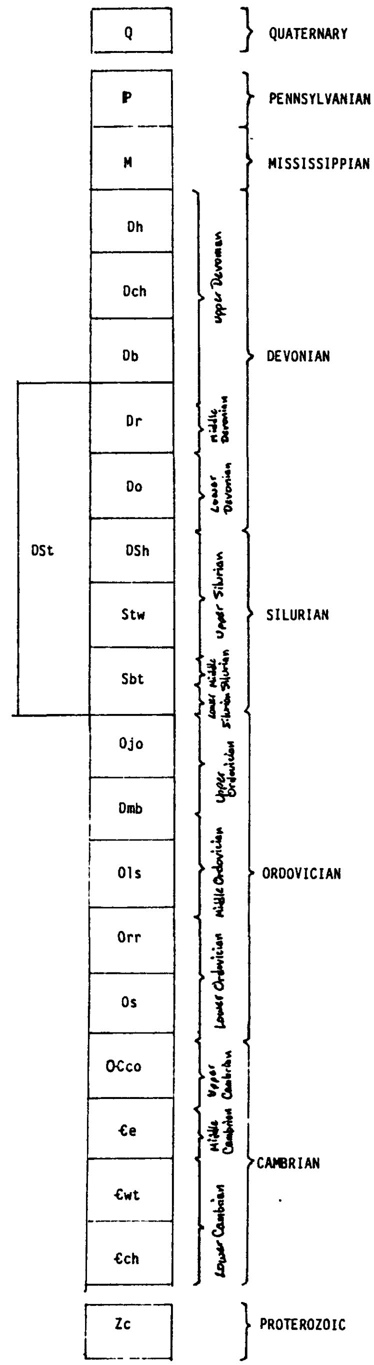
CORRELATION OF MAP UNITS



EXPLANATION OF MAP SYMBOLS

Fault

Thrust fault- sawteeth on upper plate

Quarry

DESCRIPTION OF MAP UNITS

Q Alluvium (Quaternary)-- Silt,clay, sand, and gravel, forming floodplain and terrace deposits; shown only along larger streams and rivers. Probably ranges from 20 to 50 ft (6 to 15 m) thick in most areas, reported to total as much as 120 ft (37 m) thick along the Shenandoah River in the southeast corner of the quadrangle (Edmundson and Nunan, 1973, p. 53-54).

IP Conemaugh and Alleghany Formations and Pottsville Sandstone (Middle and Lower Pennsylvanian)-- Sandstone and shale, with minor siltstone, limestone, and coal. Sandstone, quartzose, locally conglomeratic; at base of unit. Shale, dark-gray, with lesser siltstone and sandstone and very sparse limestone; includes about 14 commercial coal beds, some as thick as 7 ft (2 m); reddish-gray shale and siltstone in upper part. Unit about 1,120 ft (342 m) thick (Dennison, 1963); exposed only in northwestern corner of quadrangle.

M Mauch Chunk Group, Greenbrier Limestone, and Pocono Formation (Mississippian)-- Sandstone, siltstone, shale, and limestone. Crossbedded, micaceous olive-gray sandstone at base (Pocono Formation) overlain by medim-gray, fossiliferous limestone and limy shale (Greenbrier Limestone) and grayish-red to medium-gray shale, siltstone, and sandstone (Mauch Chunk Group). Unit about 1,950 ft (594 m) thick (Dennison, 1963); full thickness present only in northwest corner of quadrangle. Lower part of unit (Pocono Formation) preserved elsewhere in troughs of synclines, mainly in the Broadtop synclinorium, where it has been mapped by previous workers as the Rockwell Formation (at the base), Purslane Sandstone, and Hedges Shale (at the top). Forms high ridges.

Dh Hampshire Formation (Upper Devonian)-- Shale, mudstone, siltstone, and minor sandstone, grayish-red to brownish-gray, medium- to thick-bedded, in part micaceous or arkosic. Thickness ranges from about 1,250 ft (381 m) to about 4,750 ft (1,448 m) (Tilton and Prouty, 1926); exposed throughout the quadrangle west of the North Mountain thrust, generally on mountain slopes or low ridges.

Dch Chemung Formation (Upper Devonian)-- Sandstone, siltstone, and minor shale; sandstone, brownish-gray, medium- to coarse-grained, thick-bedded, in part crossbedded, some beds conglomeratic; most abundant in upper part of unit; many beds very fossiliferous. Siltstone, medium- to thick-bedded, dominant in lower part of unit. Shale is thinly interbedded throughout section. Thickness ranges from 1,200 ft (366 m) to 3,800 ft (1,154 m) (Woodward, 1943; Dennison, 1963); exposed throughout the quadrangle west of the North Mountain thrust; forms low ridges.

Db Brallier Formation (Upper Devonian)-- Shale, siltstone, and sandstone, dark-gray to greenish-gray, weathers light brownish gray; grain size increases irregularly upward in section, sandstones occur in upper part; thin- to medium-bedded. Thickness ranges from 1,250 to 2,400 ft (381 to 762 m) (Butts and Edmundson, 1966; deWitt and Colton, 1964); exposed throughout quadrangle west of the North

Mountain thrust; forms low, rolling hills.

DSt Upper Devonian to Lower Silurian rocks, undivided-- Fault slices along the North Mountain thrust. Generally consists of tectonically attenuated and overturned sequence in footwall; some stratigraphic units locally absent.

Dr Romney Shale (Upper and Middle Devonian)-- Shale, greenish-gray to black, grading upward to dark-gray siltstone and sandstone at top. Some beds very fossiliferous. Generally mapped as Needmore Shale (at base), Marcellus Shale, and Mahantango Formation (at top). Includes Harrell Shale (dark-gray shale) in western part of quadrangle. Ranges from 1,000 to 1,900 ft (305 to 579 m) in thickness (Dean and others, 1985; Tilton and Prouty, 1926); exposed throughout the quadrangle west of the North Mountain thrust. Unit underlies topography of low relief.

Do Oriskany Sandstone (Lower Devonian)-- Sandstone, light-yellowish-gray, coarse-grained, thick-bedded, locally crossbedded, conglomeratic; generally calcareous, friable when weathered; commonly contains molds of shells. Ranges from about 60 ft (18 m) to nearly 300 ft (91 m) thick (Butts and Edmundson, 1966; Dean and others, 1985); forms low but conspicuous, persistent ridges where homoclinal, larger ridges where anticlinal. Occurs throughout quadrangle west of the North Mountain thrust.

DSh Helderberg Group (Lower Devonian and Upper Silurian)-- Limestone, gray, fine- to coarse-grained, very fossiliferous; lower part is nodular-bedded; uppermost part contains white chert beds and nodules that form a conspicous lag deposit in soil. Commonly subdivided and mapped as Keyser Limestone (at base), Coeymans Limestone, New Scotland Limestone, and Licking Creek Limestone or Shriver Chert (at top). Ranges from about 200 ft (61 m) to slightly more than 500 ft (152 m) in thickness (Woodward, 1943; deWitt and Colton, 1964); forms low topography. Exposed throughout quadrangle west of the North Mountain thrust.

Stw Tonoloway Limestone and Wills Creek Formation (Upper Silurian)-- Shale and limestone. Wills Creek: shale, greenish-gray, reddish-gray, or dark-gray, calcareous, interbedded with limestone, dark-gray, fine-grained, argillaceous, and minor sandstone. Tonoloway: limestone, medium-gray, fine-grained, thin-bedded to laminated; some beds very fossiliferous. Unit ranges from 300 to 1,100 ft (91 to 336 m) in thickness (Tilton and Prouty, 1926); exposed in topographically low areas west of the North Mountain thrust.

Sbt Silurian clastic formations (Upper, Middle, and Lower Silurian)-- Quartzite, sandstone, and shale. Unit consists of Tuscarora Quartzite (at base), Clinton Group (Rose Hill and Keefer Sandstones and Rochester Shale), McKenzie Formation, and Bloomsburg (or Williamsport) Formation (at top). Tuscarora: quartzite, very light gray, medium- to coarse-grained, thick-bedded, some beds conglomeratic; about 300 ft (91 m) thick. Rose Hill: sandstone, red and gray, fine-grained, thin-bedded, with thin shale interbeds; about 400 ft (122 m) thick. Keefer: quartzite, light gray, similar to that of Tuscarora; about 10-50 ft (3-15 m) thick. Rochester: shale, calcitic; about 0-30 ft (0-9 m) thick. McKenzie: shale, yellowish-gray, calcitic, and minor argillaceous limestone; about

200 ft (61 m) thick. Bloomsburg: interbedded sandstone and shale, reddish-gray, about 100 ft (31 m) thick, grades westward into Williamsport: gray sandstone, about 20 ft (6 m) thick. Unit totals 900 to 1,200 ft (274 to 366 m) in thickness (Dean and others, 1985; Young and Rader, 1974); Tuscarora forms high ridges, Keefer forms low secondary ridge or flatirons. Exposed along North Mountain thrust and on larger anticlines to the west.

Ojo Juniata and Oswego Sandstones (Upper Ordovician)--Sandstone, shale, and conglomerate. Oswego: sandstone, greenish-gray, coarse-grained, thick-bedded, conglomeratic. Juniata: sandstone, reddish-gray, fine-grained, thin-bedded, crossbedded, interbedded with red shale. Unit ranges from 200 to 900 ft (61 to 274 m) in thickness (Butts and Edmundson, 1966; Tilton and Prouty, 1926); exposed in slices along the North Mountain thrust and in the core of the North Mountain anticline in the south-central part of the quadrangle.

Omb Martinsburg Formation (Upper and Middle Ordovician)--Shale, siltstone, and sandstone. Shale, black to medium-gray, graptolitic, weathers yellowish to brownish gray; thin-bedded, interbedded with silty shale and siltstone. Sandstone, dark-gray, fine-grained, thin- to medium-bedded, most abundant in uppermost part of unit. Thickness difficult to determine because of poor exposure and complex folding and faulting; probably ranges from 1,500 to 4,000 ft (460 to 1,220 m) (Butts and Edmundson, 1966). Forms low topography; exposed in trough of Massanutten syncline in eastern part of map and in core of breached North Mountain anticline in south-central part of map.

Ols Limestones of Middle Ordovician age-- Limestone with minor shale and siltstone. Includes the New Market Limestone (at base), Lincolnshire Limestone, Edinburg Formation, and Oranda Formation (at top). New Market: bluish-gray, very fine grained to cryptograined, thick-bedded, high-calcium limestone. Lincolnshire: dark-gray, fine- to medium-gray limestone with black chert nodules. Edinburg: dark-gray, nodular limestone locally with thin black shale interbeds. Oranda: dark-gray, argillaceous limestone with interbeds of calcareous siltstone. The unit totals about 600 to 950 ft (183 to 290 m) in thickness (Edmunson and Nunan, 1973; Young and Rader, 1974). The limestones form low topography with karst topography, exposed in two narrow belts in the Massanutten syncline.

Orr Rockdale Run Formation (Middle and Lower Ordovician)-- Limestone and dolomite, interbedded. Limestone, medium- to dark-gray, fine-grained. Dolomite, light- to brownish-gray, fine- to medium-grained, massive. White chert nodules and algal structures abundant locally. Unit includes Pinesburg Station Dolomite in northern part of outcrop area; has commonly been mapped as Beekmantown Formation. Ranges from 2,000 to 3,500 ft (610 to 1,070 m) in thickness (Young and Rader, 1974; Butts and Edmundson, 1966); forms low topography in Great Valley province in eastern part of map area.

Os Stonehenge Limestone (Lower Ordovician)-- Limestone, light- to dark-gray, fine- to medium-grained, thick-bedded, locally laminated; minor amounts of black chert in middle of unit. Has been mapped as Chepultepec Formation. Ranges in thickness from 300 to 800 ft (91 to 244 m) (Butts and Edmundson, 1966; Edmundson and Nunan, 1973); exposed in Great Valley subprovince.

O€co Conococheague Formation (Lower Ordovician and Upper Cambrian)-- Limestone and lesser dolomite and sandstone. Limestone, medium- to dark-gray, fine-grained, laminated in part, ribbon-banded in part; locally magnesian; some beds sandy, especially near top. Dolomite, medium-gray, medium-grained, massive, locally cherty, sandy. Sandstone, medium-gray, fine- to medium-grained, in a few thin beds. Silicified algal structures and intraformational limestone conglomerates are also present in unit, which is about 2,500 ft (760 m) thick (Butts and Edmundson, 1966). Forms gentle topography, with low sandstone ridges, in Great Valley province.

€e Elbrook Formation (Upper and Middle Cambrian)-- Limestone and dolomite with minor amounts of siltstone, shale, and sandstone. Limestone, bluish-gray, fine-grained, thin- to thick-bedded, in part ribbon-banded; some beds argillaceous or silty. Dolomite, light-gray to brownish-gray, fine-grained, shaly; in lesser amounts than limestone. Red and green shale and gray siltstone and sandstone are present in minor amounts. Unit about 2,000 ft (610 m) thick (Edmundson and Nunan, 1973), exposed on the hanging wall of the North Mountain thrust and in the southeast corner of the quadrangle.

€wt Waynesboro Formation and Tomstown Dolomite (Lower Cambrian)-- Dolomite, limestone, siltstone, shale, and sandstone. Tomstown: dolomite, very light gray to medium-gray, fine- to medium-grained, and much lesser amounts of limestone, argillaceous or magnesian, medium-gray, fine-grained, interbedded with dolomite. Waynesboro: limestone, bluish-gray, in part argillaceous; dolomite, light-brownish-gray, argillaceous or silty; red, yellowish-gray, or green shale; and red to gray sandy siltstone. Sparse chert nodules in carbonate rocks. Mapped locally as Rome and Shady Formations. Unit exposed only in southeasternmost corner of quadrangle; about 3,400 ft (1,032 m) thick (Edmundson and Nunan, 1973).

€ch Chilhowee Group (Lower Cambrian)-- quartzite, phyllite, siltstone, sandstone, and conglomerate. Unit includes Loudoun Formation (at base), Weverton Quartzite, Harpers Formation, and Antietam Quartzite (at top). Loudoun: phyllite, light-to dark-gray or purple. Weverton: quartzite, light- to dark-gray, coarse-grained, conglomeratic; thick-bedded, crossbedded; and minor phyllite interbeds. Harpers: phyllite, gray to greenish-gray, bedding obscure but with prominent cleavage; siltstone, in part sandy, greenish-gray to brownish-gray; and sandstone, fine- to coarse-grained, thin-bedded, forms one or more thin units. Antietam: quartzite, light-gray to pinkish-gray, coarse-grained, thin- to medium-bedded, crossbedded. Unit about 2,850 ft (869 m) thick (Edmundson and Nunan, 1973), forms high, rugged topography in southeastern corner of quadrangle.

Zc Catoctin Formation (Upper Proterozoic)-- Metabasalt: dark-gray to greenish-gray, fine-grained, massive to schistose, some beds amygdaloidal. Base not present in quadrangle; about 500 ft (152 m) exposed in southeasternmost corner (Edmundson and Nunan, 1973). Forms high ridge.

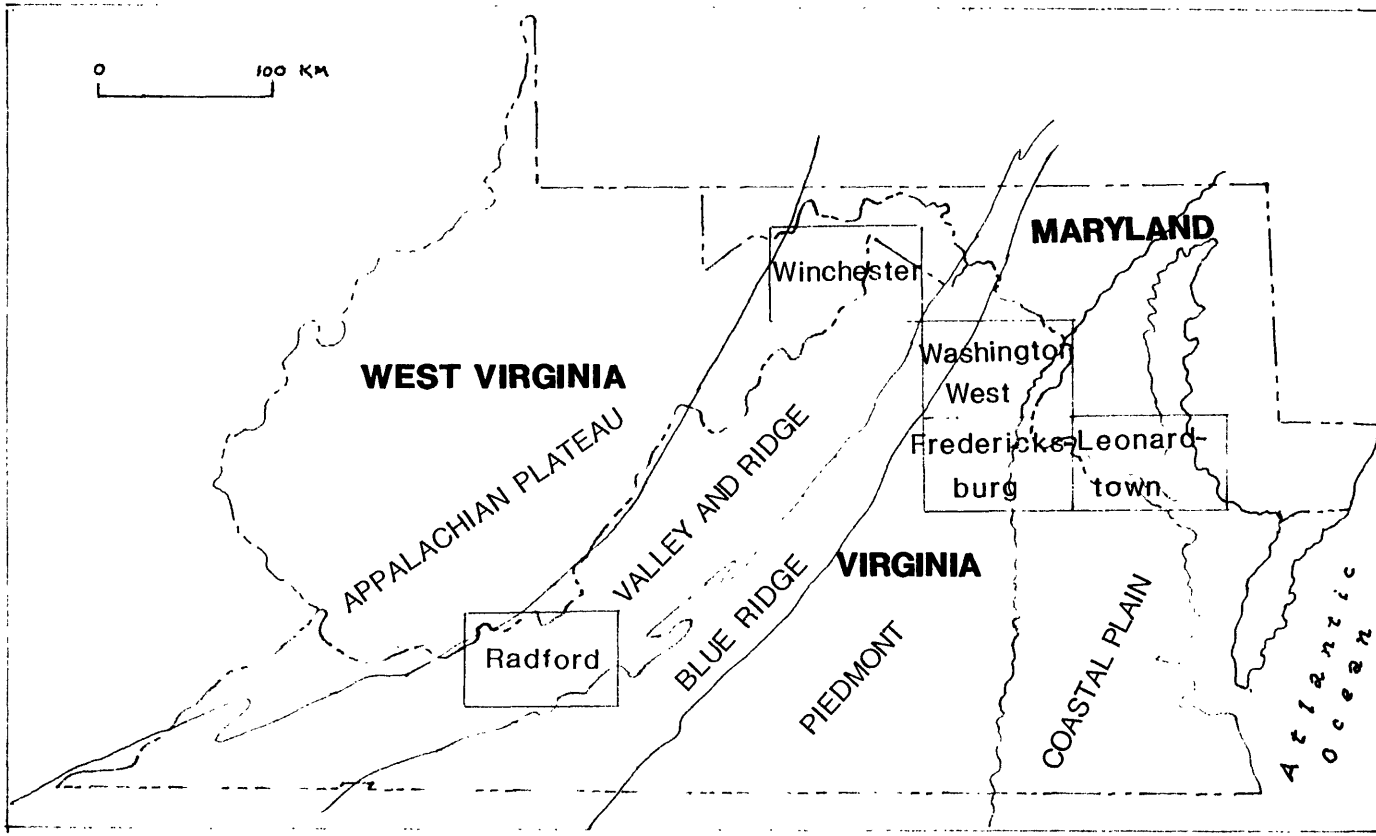


Fig. 1. Index map to the Winchester and other quadrangles under study.

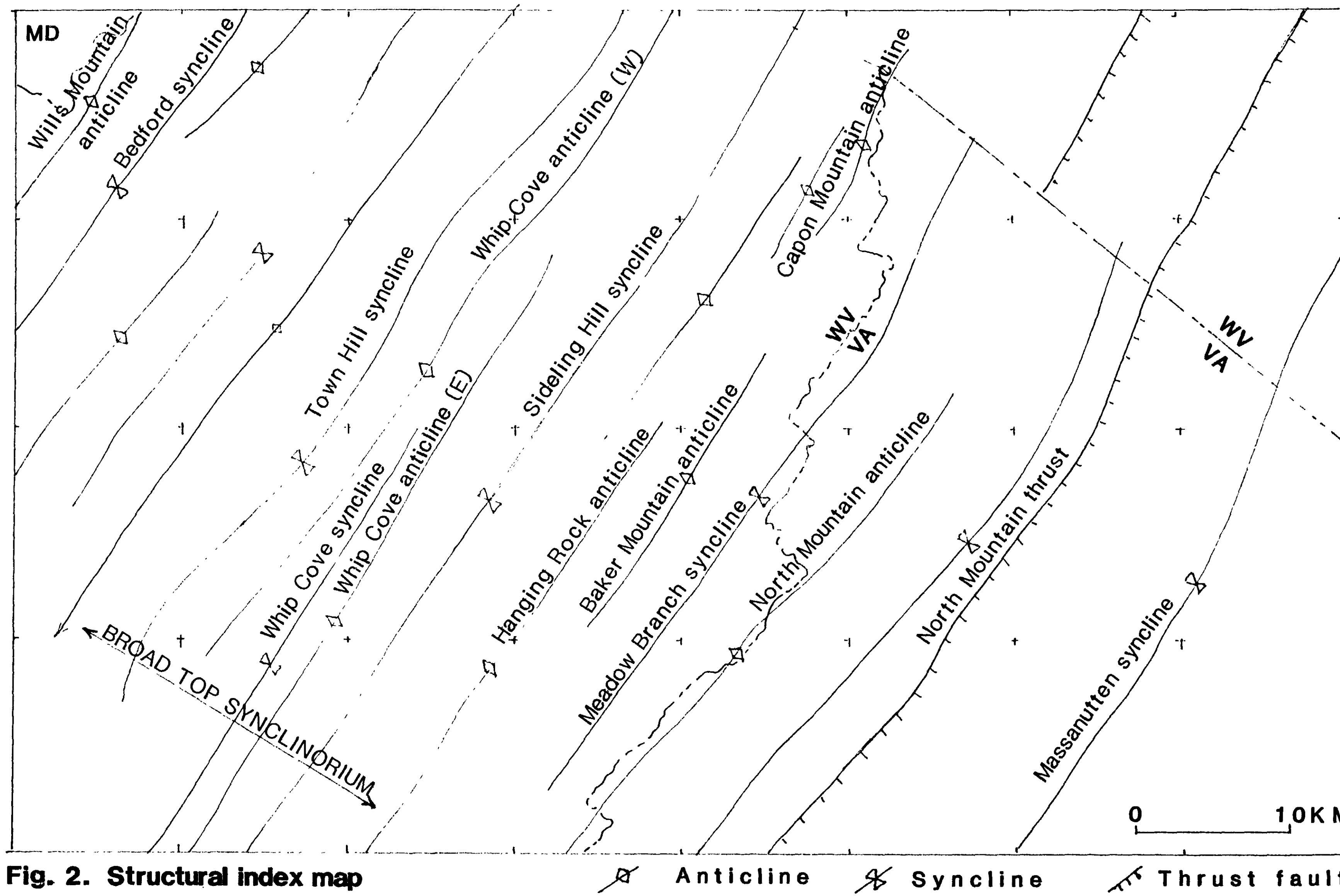


Fig. 2. Structural index map

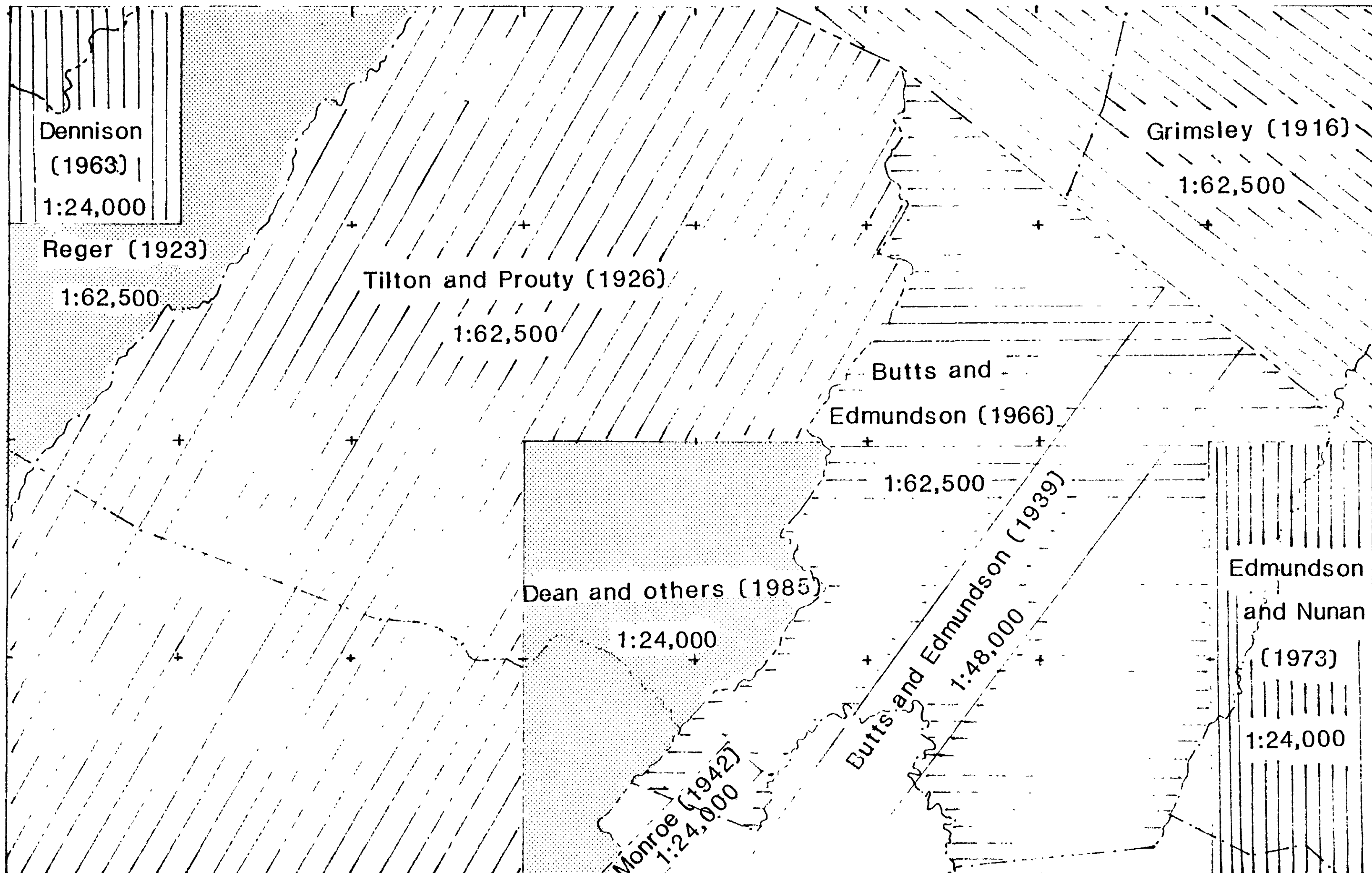


Fig. 3. Index to mapping sources

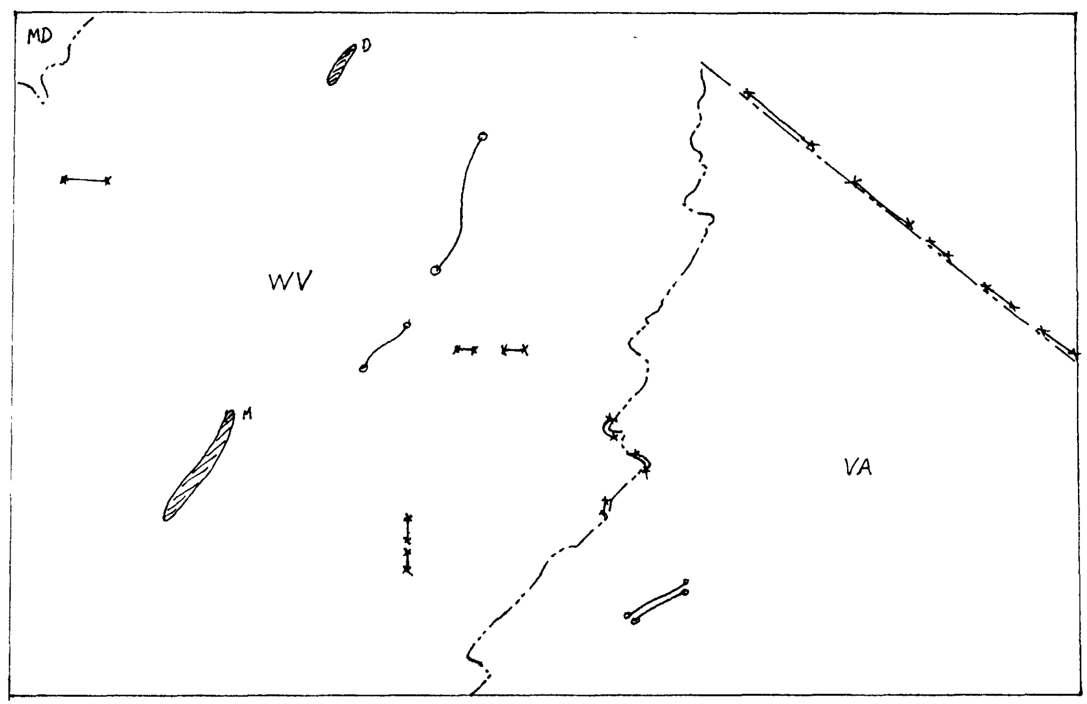


Fig. 4. Mapping problems identified on the preliminary map.