DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE DEPARTMENT OF ENERGY
INTERAGENCY AGREEMENT # EX-76-C-01-2287

OPEN-FILE REPORT 81-837
SHEET 2 OF 4

Joint Localities in Limestone and Dolomite

[SY, system; A.B.*, attitude of bedding; T.O., type outcrop; S.S., sample size; PA, Pennsylvanian; MS, Mississippian; DV, Devonian; SI, Silurian; OR, Ordovician; CA, Cambrian; HWC, highway cut; QRR, quarry or strip mine; STG, stream bank, floor, gorge, or gully; CON, construction site; LAK, lake-shore cliff; VAL, valley side]

County	No.	Latitude	Longitude	SY.	Formation	A.B.*	T.O.	S.S.	Miscellaneous
KENTUCKY									
Bath	1	38° 08′ 09"	83° 43′ 19"	OR	Bull Fork	0	HWC	29	
Carter	4	38° 18′ 33"	83° 09′ 09"	MS	Newman	0	HWC	34	
Estill	3	37° 36′ 01"	83° 57′ 54"	MS	Newman	0	HWC	14	Joints poorly developed; none large.
Lewis	3	38° 35′ 24"	83° 29′ 46"	SI	Bisher	0	HWC	14	Joints irregular and sinuous.
Madison	1	37° 34′ 14"	84° 18′ 33"	DV	Boyle	0	HWC	62	Sinuous joints; solution along joints.
Powell	2	37° 47′ 50"	83° 40′ 25"	MS	Newman	0	HWC	45	Joints widely spaced; poorly developed.
Powell	6	37° 52′ 41"	83° 57′ 10"	SI	Boyle	0	HWC	24	
Rowan	4	38° 16′ 34"	83° 22′ 35"	MS	Newman	0	HWC	25	
MARYLAND									
Allegany	4	39° 42′ 15"	78° 33′ 45"	SI	Tonoloway	36SE	HWC	25	
Garrett	4	39° 33′ 27"	79° 23′ 06"	MS	Greenbriar	05SW	QRR	12	
Washington	1	39° 42′ 48"	78° 11′ 36"	SI	Wills Creek	53SE	HWC	16	
NEW YORK									
Erie	2	42° 41′ 42"	78° 56′ 06"	DV	Genesee	0	STG	16	Second orthogonal set absent.
Tompkins	1	42° 32′ 23"	76° 36′ 17"	DV	Tully	0	STG	60	
OHIO									
Adams	1	38° 56′ 47"	83° 22′ 28"	SI	Greenfield	0	QRR	30	
Adams	2	38° 39′ 40"	83° 21′ 20"	SI	Niagara	0	HWC	20	Pattern same as sandstone below.
Athens	2	39° 27′ 24"	81° 53′ 30"	PA	Conemaugh/ Monongahela	0	HWC	6	
Coshocton	1	40° 16′ 15"	82° 06′ 46"	PA	Allegheny	0	HWC	19	Joints well developed.
Delaware	2	40° 08′ 22"	83° 06′ 55"	DV	Columbus/ Delaware	?	?	61	
Delaware	5	40° 17′ 59"	83° 04′ 47"	DV	Delaware	0	QRR	72	Joints poorly developed; complex.
Gallia	2	39° 19′ 15"	82° 58′ 40"	PA	Conemaugh	0	HWC	10	
Lawrence	4	38° 40′ 36"	82° 40′ 41"	PA	Allegheny	0	HWC	23	
Mahoning	1	40° 59′ 36"	80° 43′ 24"	PA	Pottsville/ Allegheny	0	HWC	4	
Morgan	2	39° 44′ 12"	81° 55′ 54"	PA	Conemaugh	0	HWC	3	
Noble	2	39° 45′ 24"	81° 32′ 18"	PA	Conemaugh/ Monongahela	0	HWC	4	
Noble	3	39° 38′ 06"	81° 29′ 42"	PA	Conemaugh	0	QRR	5	
Tuscarawas	5	40° 33′ 38"	81° 24′ 32"	PA	Allegheny	0	HWC	15	
Washington	2	39° 29′ 42"	81° 44′ 54"	PA	Monongahela	0	HWC	2	
PENNSYLVANIA									
Allegheny	1	40° 34′ 00"	79° 47′ 30"	PA	Conemaugh	0	HWC	7	
Bedford	4	40° 00′ 10"	78° 30′ 40"	SI	Tonoloway	35SE	HWC	10	
Bedford	5	40° 01′ 10"	78° 30′ 48"	SI	Tonoloway	55NW	HWC	16	
Bedford	8	40° 00′ 40"	78° 22′ 45"	DV	Keyser	62SE	QRR	4	Very small sample.
Bedford	10	39° 59′ 40"	78° 32′ 20"	SI	Wills Creek	?	HWC	7	
Huntington	4	40° 36′ 30"	78° 10′ 18"	OR	Bellefonte	38SE	?	7	
Lawrence	2	41° 01′ 21"	80° 10′ 17"	PA	Allegheny/ Vanport	0	HWC	8	
Lawrence	5	40° 58′ 00"	80° 21′ 48"	PA	Pottsville	0	HWC	4	
Washington	2	40° 12′ 15"	80° 14′ 51"	PA	Monongahela	0	HWC	7	
VIRGINIA									
Bland	3	37° 04′ 09"	81° 07′ 36"	OR	Knox	15SE	HWC	7	
Giles	1	37° 19′ 56"	80° 45′ 08"	MS	Hinton	0	HWC	60	Complex set.
Giles	2	37° 22′ 12"	80° 48′ 50"	OR	Knox	33SE	HWC	50	Most joints not perpendicular to bedding.
Montgomery	1	37° 09′ 01"	80° 19′ 53"	CA/OR	Knox?	50SE	HWC	10	Beds overturned.
Rockbridge	1	37° 50′ 14"	79° 24′ 32"	OR	Beekmantown	35SE	HWC	30	
Rockbridge	2	37° 42′ 15"	79° 27′ 50"	CA	Elbrook	32SE	HWC	7	
Russell	1	36° 50′ 46"	82° 15′ 42"	CA	Knox	20SE	HWC	53	Complex pattern; some faulting.
Scott	1	36° 40′ 09"	82° 45′ 18"	CA	Conesauga	45SW	HWC	27	Very complex pattern; much faulting.
Tazewell	2	37° 05′ 00"	81° 17′ 56"	OR	Eggleston	15SE	HWC	5	
Washington	1	36° 45′ 20"	82° 03′ 43"	MS	Neuman	23SE	HWC	55	Complex pattern; much mineralization.
WEST VIRGINIA									
Braxton	1	38° 41′ 23"	80° 41′ 20"	PA	Conemaugh	0	HWC	9	Outcrop contains growth faults.
Hampshire	6	39° 19′ 55"	78° 48′ 05"	SI	Tonoloway/ Keyser	44SE	QRR	16	
Marion	1	39° 31′ 02"	80° 03′ 05"	PA	Conemaugh	0	HWC	2	In brachiopod bearing limestone.
Mercer	2	37° 17′ 03"	81° 07′ 35"	OR	Knox	35SE	HWC	7	
Monroe	2	37° 34′ 42"	80° 33′ 06"	MS	Greenbriar	0	HWC	14	Intensive solution weathering.
Ohio	1	40° 02′ 42"	80° 38′ 42"	PA	Dunkard	0	HWC	7	Large fresh exposure.
Pendleton	4	38° 39′ 28"	79° 14′ 19"	DV/SI	Keyser	17SE	HWC	22	Strongly developed joint pattern.
Pleasants	1	39° 23′ 00"	81° 14′ 12"	PA	Monongahela	0	HWC	9	
Pocahontas	1	38° 06′ 54"	80° 15′ 48"	MS	Greenbriar	0	HWC	10	On north flank of Droop Mountain.
Randolph	2	38° 39′ 02"	79° 55′ 11"	MS	Greenbriar	09SE	HWC	47	$CaCO_3$ mineralization; faulting.
Randolph	3	38° 54′ 24"	79° 42′ 21"	MS	Greenbriar	0	HWC	6	
Summers	1	37° 41′ 46"	80° 52′ 45"	MS	Hinton	0	HWC	5	Intensely weathered exposure.
Tucker	3	39° 00′ 18"	79° 27′ 45"	MS	Greenbriar	?	QRR	24	
Tucker	5	39° 03′ 40"	79° 36′ 20"	MS	Greenbriar	0	STG	25	Low relief exposure in stream bed.

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*A.B. (attitude of bedding); 0 if flat or less than 5°; otherwise dip amplitude is given numerically (i.e., 35) in degrees, followed by letters indicating dip direction (i.e., 35NW).

FACTORS AFFECTING JOINT PATTERNS

The joint patterns of the Appalachian region appear to be controlled by four dominant factors:

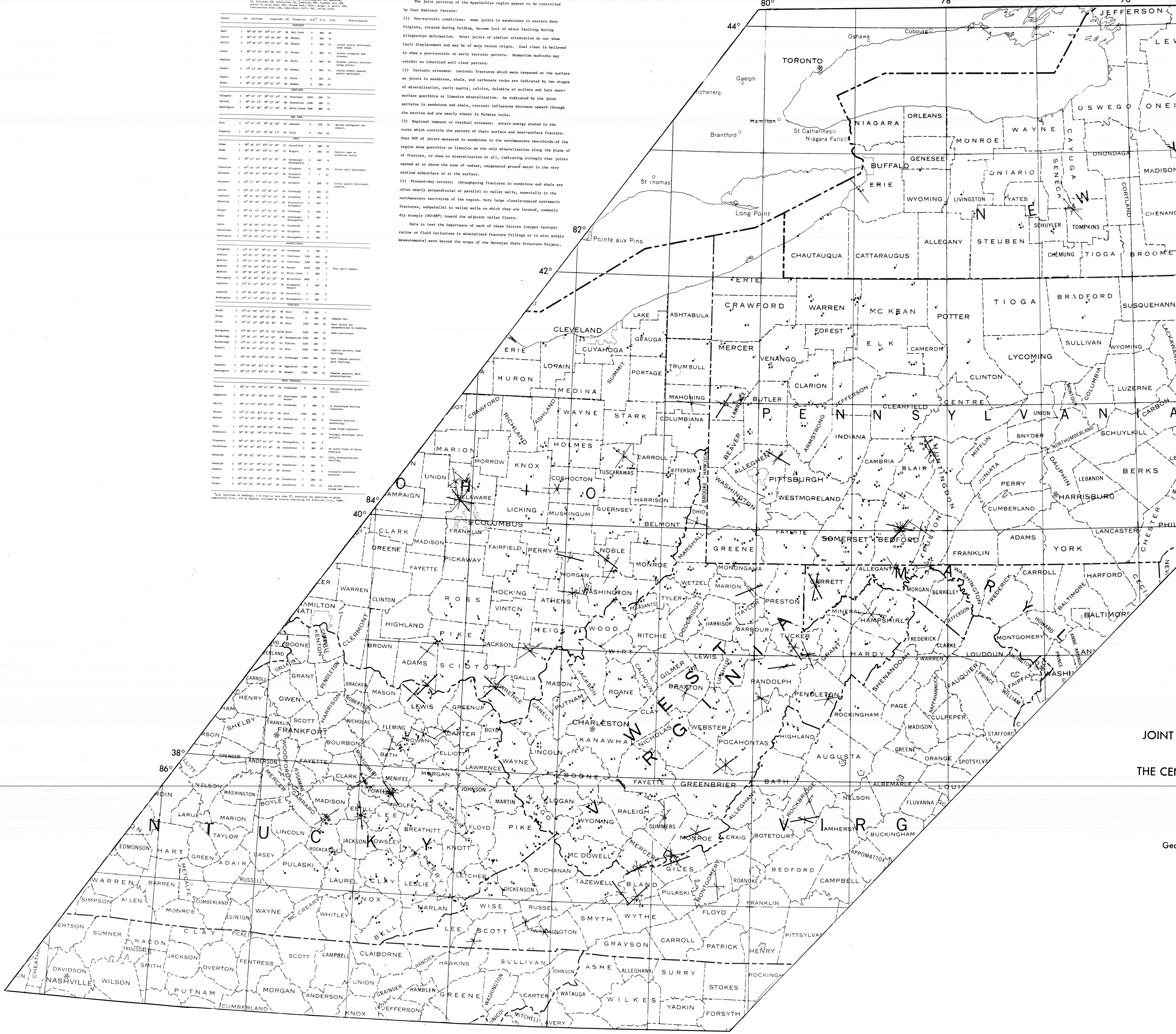
(1) Pre-tectonic conditions: some joints in sandstones in eastern West Virginia, rotated during folding, became loci of minor faulting during Alleghenian deformation. Other joints of similar orientation do not show fault displacement and may be of more recent origin. Coal cleat is believed to show a pre-tectonic or early tectonic pattern. Nonmarine mudrocks may exhibit an inherited soil cleat pattern.

(2) Tectonic stresses: tectonic fractures which were reopened at the surface as joints in sandstone, shale, and carbonate rocks are indicated by two stages of mineralization, early quartz, calcite, dolomite or sulfate and late near-surface goerthite or limonite mineralization. As indicated by the joint patterns in sandstone and shale, tectonic influences decrease upward through the section and are nearly absent in Permian rocks.

(3) Regional remnant or residual stresses: strain energy stored in the rocks which controls the pattern of their surface and near-surface fracture. Over 90% of joints measured in sandstone in the northwestern two-thirds of the region show goerthite or limonite as the only mineralization along the plane of of fracture, or show no mineralization at all, indicating strongly that joints opened at or above the zone of vadose, oxygenated ground water in the very shallow subsurface or at the surface.

(4) Present-day terrain: throughgoing fractures in sandstone and shale are often nearly perpendicular or parallel to valley walls, especially in the northwestern two-thirds of the region. Very large closely-spaced systematic fractures, subparallel to valley walls on which they are located, commonly dip steeply (80-88°) toward the adjacent valley floors.

Data to test the importance of each of these factors (oxygen isotopic ratios or fluid inclusions in mineralized fracture fillings or in situ strain measurements) were beyond the scope of the Devonian Shale Structure Project.

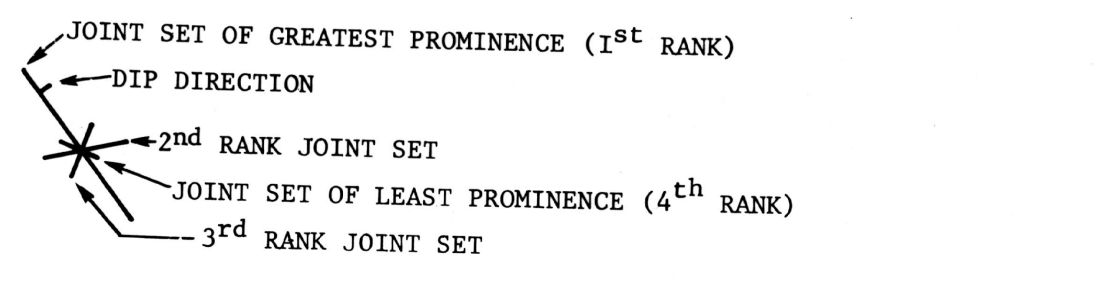

80°
78°
76°
74°
44°
42°
40°
38°
36°
82°
84°
86°
TORONTO
Oshawa
Cobourg
Guelph
Kitchener
Hamilton
Brantford
St Catharines
Niagara Falls
St Thomas
Long Point
Pointe aux Pins
BUFFALO
CLEVELAND
COLUMBUS
PITTSBURGH
HARRISBURG
PHILADELPHIA
TRENTON
BALTIMORE
WASHINGTON D.C.
ALBANY
CHARLESTON
FRANKFORT
NASHVILLE
N E W   Y O R K
P E N N S Y L V A N I A
O H I O
M A R Y L A N D
W E S T   V I R G I N I A
V I R G I N I A
K E N T U C K Y
VERMONT
MAS
CON
N J
JEFFERSON
LEWIS
ESSEX
ADDISON
HAMILTON
WARREN
OSWEGO
ONEIDA
FULTON
SARATOGA
WASHINGTON
RUTLAND
WINDSOR
NIAGARA
ORLEANS
MONROE
WAYNE
CAYUGA
SENECA
ONONDAGA
HERKIMER
MONTGOMERY
SCHENECTADY
RENSSELAER
BENNINGTON
ERIE
GENESEE
WYOMING
LIVINGSTON
ONTARIO
YATES
SCHUYLER
TOMPKINS
CORTLAND
MADISON
CHENANGO
OTSEGO
SCHOHARIE
ALBANY
COLUMBIA
BERKSHIRE
HAMPSHIRE
HAMPDEN
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
CHEMUNG
TIOGA
BROOME
DELAWARE
GREENE
DUTCHESS
LITCHFIELD
HARTFORD
ULSTER
SULLIVAN
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER
FAIRFIELD
CRAWFORD
MC KEAN
POTTER
BRADFORD
SUSQUEHANNA
FOREST
ELK
CAMERON
LYCOMING
WYOMING
LACKAWANNA
PIKE
SUSSEX
PASSAIC
BERGEN
MORRIS
ESSEX
UNION
MERCER
VENANGO
CLARION
CLINTON
CENTRE
CLEARFIELD
JEFFERSON
COLUMBIA
MONTOUR
LUZERNE
CARBON
MONROE
NORTHAMPTON
HUNTERDON
SOMERSET
BUTLER
LAWRENCE
BEAVER
ARMSTRONG
INDIANA
CAMBRIA
BLAIR
HUNTINGDON
MIFFLIN
UNION
SNYDER
NORTHUMBERLAND
SCHUYLKILL
LEHIGH
BUCKS
BERKS
LEBANON
DAUPHIN
JUNIATA
PERRY
CUMBERLAND
LANCASTER
CHESTER
MONTGOMERY
DELAWARE
ADAMS
YORK
FRANKLIN
FULTON
BEDFORD
SOMERSET
FAYETTE
GREENE
WASHINGTON
ALLEGHENY
WESTMORELAND
LAKE
ASHTABULA
GEAUGA
CUYAHOGA
LORAIN
HURON
MEDINA
SUMMIT
PORTAGE
TRUMBULL
MAHONING
COLUMBIANA
STARK
WAYNE
ASHLAND
RICHLAND
HOLMES
CARROLL
TUSCARAWAS
JEFFERSON
HARRISON
BELMONT
GUERNSEY
COSHOCTON
KNOX
MORROW
MARION
UNION
DELAWARE
LICKING
MUSKINGUM
CHAMPAIGN
CLARK
MADISON
FRANKLIN
FAIRFIELD
PERRY
NOBLE
MONROE
MORGAN
WASHINGTON
ATHENS
HOCKING
PICKAWAY
FAYETTE
GREENE
CLINTON
WARREN
ROSS
VINTON
MEIGS
HAMILTON
CINCINNATI
HIGHLAND
PIKE
JACKSON
GALLIA
CLERMONT
BROWN
ADAMS
SCIOTO
LAWRENCE
BROOKE
HANCOCK
OHIO
MARSHALL
WETZEL
MONONGALIA
MARION
TYLER
PLEASANTS
WOOD
RITCHIE
DODDRIDGE
HARRISON
TAYLOR
PRESTON
BARBOUR
TUCKER
GRANT
MINERAL
HAMPSHIRE
MORGAN
BERKELEY
JEFFERSON
HARDY
WIRT
LEWIS
UPSHUR
RANDOLPH
PENDLETON
CALHOUN
GILMER
BRAXTON
ROANE
JACKSON
MASON
PUTNAM
CABELL
KANAWHA
CLAY
NICHOLAS
WEBSTER
POCAHONTAS
HIGHLAND
BOONE
LINCOLN
WAYNE
LOGAN
MINGO
FAYETTE
GREENBRIER
RALEIGH
WYOMING
SUMMERS
MONROE
MC DOWELL
MERCER
ALLEGANY
GARRETT
WASHINGTON
FREDERICK
CARROLL
HARFORD
BALTIMORE
HOWARD
MONTGOMERY
ANNE ARUNDEL
PRINCE GEORGES
CECIL
NEW CASTLE
FREDERICK
CLARKE
LOUDOUN
WARREN
SHENANDOAH
ROCKINGHAM
PAGE
RAPPAHANNOCK
FAUQUIER
PRINCE WILLIAM
FAIRFAX
ARLINGTON
CULPEPER
MADISON
STAFFORD
GREENE
ORANGE
SPOTSYLVANIA
AUGUSTA
ALBEMARLE
LOUISA
FLUVANNA
NELSON
BATH
ALLEGHANY
ROCKBRIDGE
AMHERST
BUCKINGHAM
APPOMATTOX
BOTETOURT
CRAIG
GILES
BEDFORD
CAMPBELL
ROANOKE
MONTGOMERY
PULASKI
BLAND
TAZEWELL
BUCHANAN
DICKENSON
RUSSELL
WISE
SCOTT
LEE
WASHINGTON
SMYTH
WYTHE
FLOYD
FRANKLIN
PITTSYLVANIA
CARROLL
GRAYSON
PATRICK
HENRY
BOONE
KENTON
CAMPBELL
GALLATIN
GRANT
PENDLETON
CARROLL
OWEN
HENRY
BRACKEN
MASON
ROBERTSON
HARRISON
LEWIS
GREENUP
SHELBY
FRANKLIN
SCOTT
NICHOLAS
FLEMING
ROWAN
CARTER
BOYD
BOURBON
BATH
ELLIOTT
SPENCER
ANDERSON
WOODFORD
FAYETTE
MONTGOMERY
CLARK
MENIFEE
MORGAN
LAWRENCE
JESSAMINE
MERCER
NELSON
WASHINGTON
BOYLE
GARRARD
MADISON
ESTILL
POWELL
WOLFE
MAGOFFIN
JOHNSON
MARTIN
LEE
BREATHITT
FLOYD
PIKE
HARDIN
LARUE
MARION
TAYLOR
LINCOLN
JACKSON
OWSLEY
KNOTT
PERRY
LETCHER
EDMONSON
HART
GREEN
ADAIR
CASEY
ROCKCASTLE
PULASKI
LAUREL
CLAY
LESLIE
WARREN
BARREN
METCALFE
RUSSELL
KNOX
HARLAN
SIMPSON
ALLEN
MONROE
CUMBERLAND
CLINTON
WAYNE
MC CREARY
WHITLEY
BELL
ROBERTSON
SUMNER
MACON
CLAY
PICKETT
TROUSDALE
JACKSON
SMITH
OVERTON
FENTRESS
SCOTT
CAMPBELL
CLAIBORNE
HANCOCK
HAWKINS
SULLIVAN
JOHNSON
ASHE
ALLEGHANY
SURRY
STOKES
CHEATHAM
DAVIDSON
WILSON
PUTNAM
CUMBERLAND
MORGAN
ANDERSON
UNION
GRAINGER
HAMBLEN
KNOX
JEFFERSON
GREENE
WASHINGTON
CARTER
UNICOI
MITCHELL
AVERY
WATAUGA
WILKES
YADKIN
FORSYTH

JOINT PATTERNS IN LIMESTONE AND DOLOMITE IN THE CENTRAL AND NORTHERN APPALACHIAN BASIN

By

George W. Colton, William J. Perry, and Jean D. MacKenzie

EXPLANATION


JOINT SET OF GREATEST PROMINENCE (1st RANK)
DIP DIRECTION
2nd RANK JOINT SET
JOINT SET OF LEAST PROMINENCE (4th RANK)
3rd RANK JOINT SET

Throughgoing (cross-cutting) sets are shown as broad heavy lines

Joint localities, numbered by county, are summarized in accompanying table

U.S. Geological Survey
Open-File Report -

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

SCALE 1:1 000 000

25 0 25 50 75 100 125 150 175 KILOMETERS

25 0 25 50 75 MILES