DEPARTMENT OF THE INTERIOR
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PREPARED IN COOPERATION WITH THE DEPARTMENT OF ENERGY
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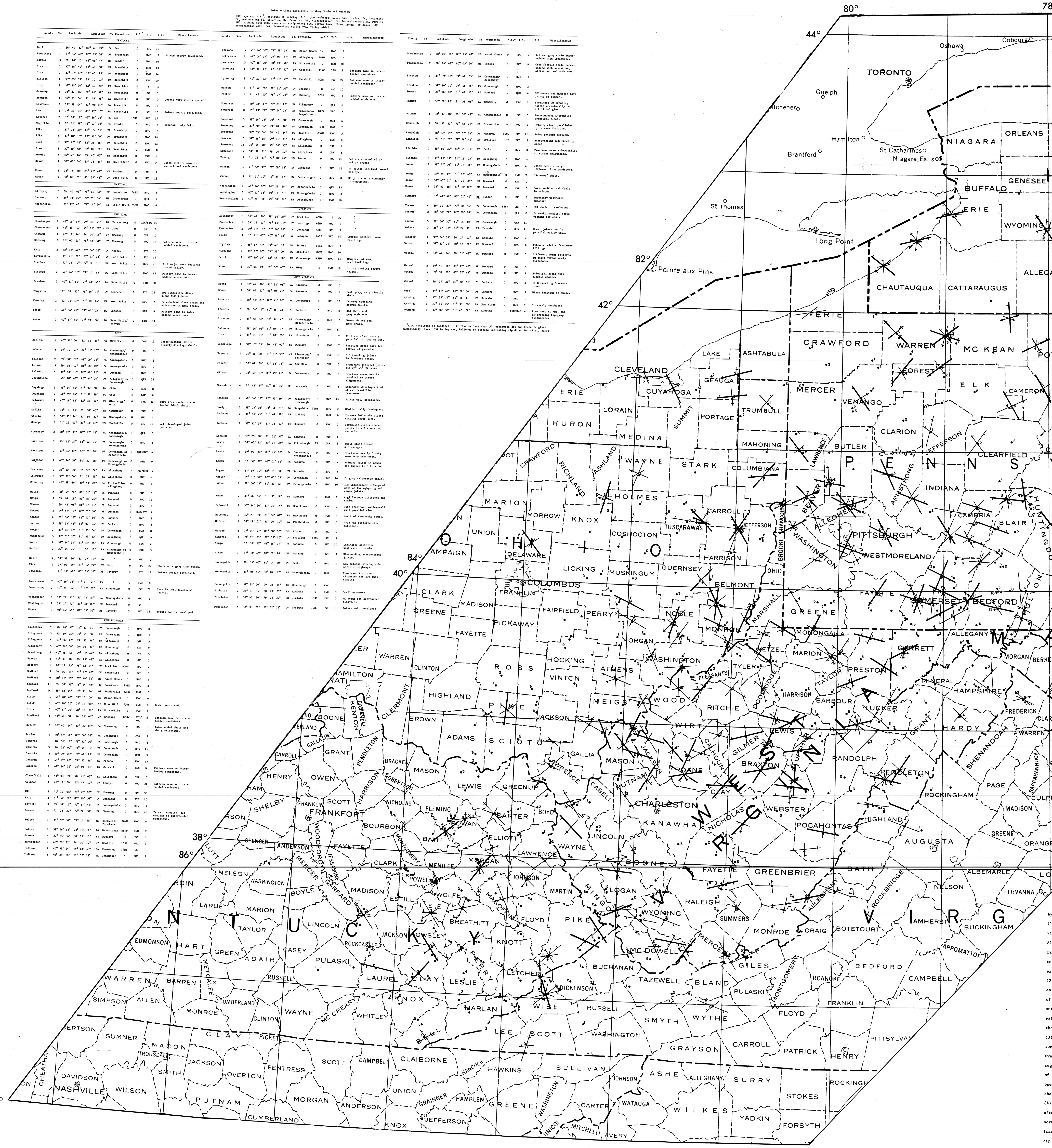
OPEN-FILE REPORT 81-837
SHEET 1 OF 4

Joint - Cleat Localities in Gray Shale and Mudrock

[SY, system; A.B.*, attitude of bedding; T.O. type outcrops; S.S., sample size; CA, Cambrian; OR, Ordovician; SI, Silurian; DV, Devonian; MS, Mississippian; PA, Pennsylvanian; PE, Permian; 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									
Bell	1	36° 40' 52"	83° 41' 09"	PA	Lee	0	HWC	10	
Breathitt	1	37° 36' 49"	83° 25' 06"	PA	Breathitt	0	HWC	7	Joints poorly developed.
Carter	3	38° 18' 25'	83° 09' 47"	MS	Border	0	HWC	16	
Clay	2	37° 18' 40"	83° 40' 50"	PA	Breathitt	0	HWC	13	
Clay	3	37° 07' 45"	83° 46' 25"	PA	Breathitt	0	HWC	14	
Elliott	1	38° 03' 39"	83° 10' 13"	PA	Breathitt	0	HWC	10	
Floyd	2	37° 30' 30"	82° 50' 20"	PA	Breathitt	0	?	5	
Greenup	1	38° 32' 46"	82° 46' 39"	PA	Breathitt	0	HWC	13	
Johnson	1	37° 50' 34"	82° 49' 38"	PA	Breathitt	0	HWC	5	Joints very widely spaced.
Lawrence	3	37° 59' 04"	82° 40' 20"	PA	Breathitt	0	HWC	13	
Lee	2	37° 34' 03"	83° 42' 10"	PA	Breathitt	0	HWC	15	Joints poorly developed.
Letcher	2	37° 09' 18"	82° 38' 02"	PA	Lee	15SE	HWC	17	
Magoffin	3	37° 41' 38"	83° 01' 52"	PA	Breathitt	0	HWC	9	Exposure only fair.
Pike	1	37° 25' 56"	82° 15' 55"	PA	Breathitt	0	HWC	7	
Pike	6	37° 18' 10"	82° 36' 49"	PA	Breathitt	0	HWC	18	
Pike	7	37° 17' 42"	82° 36' 36"	PA	Breathitt	0	HWC	22	
Pike	8	37° 30' 58"	82° 09' 02"	PA	Breathitt	0	HWC	8	
Powell	5	37° 47' 46"	83° 40' 00"	PA	Breathitt	0	HWC	4	
Rowan	1	38° 02' 44"	83° 23' 58"	PA	Breathitt?	0	HWC	14	Joint pattern same in mudrock and sandstone.
Rowan	8	38° 15' 20"	83° 25' 42"	MS	Borden	0	HWC	14	
Rowan	9	38° 09' 52"	83° 35' 43"	DV	Ohio Shale	0	HWC	28	
MARYLAND									
Allegany	2	39° 40' 09"	78° 25' 50"	DV	Hampshire	44SE	HWC	5	
Garrett	4	39° 33' 27"	79° 23' 06"	MS	Greenbriar	0	QRR	7	
Washington	1	39° 42' 48"	78° 11' 36"	SI	Wills Creek	53SE	HWC	6	
NEW YORK									
Chautauqua	1	42° 19' 57"	79° 36' 43"	DV	Perrysburg	0	LAK/STG	25	
Chautauqua	3	42° 31' 04"	79° 16' 28"	DV	Java	0	LAK	18	
Chemung	1	42° 11' 14"	76° 50' 11"	DV	Chemung	0	QRR	15	
Chemung	2	42° 00' 51"	76° 42' 51"	DV	Chemung	0	HWC	18	Pattern same in interbedded sandstone.
Erie	2	42° 41' 42"	78° 56' 06"	DV	Moscow	0	STG	25	
Livingston	1	42° 41' 52"	77° 53' 12"	DV	West Falls	0	STG	14	
Steuben	1	42° 25' 17"	77° 12' 31"	DV	West Falls	0	HWC	21	Both major sets inclined toward valley.
Steuben	2	42° 24' 16"	77° 12' 15"	DV	West Falls	0	HWC	15	Pattern same in interbedded sandstone.
Steuben	3	42° 31' 16"	77° 41' 42"	DV	West Falls	0	STG	18	
Tompkins	1	42° 32' 23"	76° 36' 17"	DV	Genesee	0	STG	33	Two kimberlite dikes along NNW joints.
Wyoming	2	42° 34' 48"	78° 00 44"	DV	West Falls	0	STG	32	Interbedded black shale and siltstone in gray shale.
Yates	1	42° 36' 41"	77° 04' 03"	DV	Genesee	0	STG	9	Pattern same in interbedded sandstone.
Yates	2	42° 37' 56"	77° 21' 56"	DV	West Falls/Sonyea	0	STG	23	
OHIO									
Ashland	2	40° 36' 50"	82° 15' 28"	MS	Waverly	0	CON	13	Cross-cutting joints clearly distinguishable.
Athens	3	39° 19' 41"	82° 05' 15"	PA	Conemaugh/Monongahela	0	HWC	15	
Belmont	2	39° 54' 24"	81° 09' 36"	PA	Monongahela	0	HWC	3	
Belmont	3	39° 52' 12"	81° 08' 00"	PA	Monongahela	0	HWC	7	
Belmont	4	39° 53' 18"	80° 48' 12"	PE	Dunkard	0	HWC	2	
Columbiana	1	40° 48' 48"	80° 44' 24"	PA	Allegheny or Conemaugh	0	QRR	25	
Cuyahoga	1	41° 24' 54"	81° 37' 58"	DV	Ohio	0	HWC	8	
Cuyahoga	2	41° 29' 14"	81° 54' 29"	DV	Ohio	0	LAK	8	
Delaware	4	40° 16' 15"	82° 56' 52"	DV	Olentangy/Ohio	0	VAL	61	Dark gray shale interbedded black shale.
Gallia	2	39° 19' 15"	82° 58' 40"	PA	Conemaugh	0	HWC	8	
Gallia	3	38° 50' 24"	82° 10' 57"	PA	Monongahela	0	HWC	4	
Geauga	2	41° 22' 01"	81° 03' 46"	MS	Meadville	0	STG	12	Well-developed joint pattern.
Guernsey	2	40° 02' 30"	80° 17' 42"	PA	Monongahela/Conemaugh	0	QRR	5	
Harrison	2	40° 15' 24"	81° 02' 24"	PA	Conemaugh/Monongahela	0	HWC	4	
Harrison	3	40° 24' 00"	80° 56' 48"	PA	Conemaugh or Monongahela	0	QRR/HWC	6	
Harrison	4	40° 24' 54"	80° 57' 18"	PA	Conemaugh or Monongahela	0	QRR	9	
Lawrence	2	38° 40' 30"	82 38' 24"	PA	Allegheny	?	HWC/RRC	5	
Lawrence	6	38° 39' 56"	82° 39' 59"	PA	Allegheny	0	HWC	14	
Mahoning	1	40° 59' 36"	80° 43' 24"	PA	Pottsville/Allegheny	0	HWC	5	
Meigs	2	38° 58' 24"	81° 52' 36"	PE	Dunkard	0	HWC	8	
Meigs	3	39° 09' 19"	81° 48' 27"	PE	Dunkard	0	HWC	12	
Monroe	1	39° 44' 06"	81° 07' 06"	PE	Dunkard	0	HWC	6	
Monroe	3	39° 47' 12"	80° 52' 54"	PE	Dunkard	0	HWC/STG	4	
Monroe	4	39° 36' 18"	81° 02' 36"	PE	Dunkard	0	HWC	3	
Monroe	5	39° 35' 48"	81° 02' 24"	PE	Dunkard	0	HWC	2	
Morgan	2	39° 44' 12"	81° 55' 54"	PA	Conemaugh	0	HWC	8	
Muskingum	5	39° 51' 55"	81° 59' 25"	PA	Allegheny	0	QRR	9	
Noble	1	39° 44' 54"	81° 32' 36"	PA	Conemaugh	0	HWC	2	
Noble	2	39° 45' 24"	81° 32' 18"	PA	Conemaugh or Monongahela	0	HWC	3	
Noble	4	39° 38' 30"	81° 29' 18"	PA	?	0	HWC	3	
Pike	1	39° 03' 29"	83° 04' 24"	DV	Ohio	0	HWC	27	Shale more gray than black.
Trumbull	1	41° 19' 41"	80° 43' 37"	MS	Waverly	0	STG	11	Joints poorly developed.
Tuscarawas	7	40° 29' 18"	81° 28' 41"	PA	?	0	HWC	8	
Tuscarawas	9	40° 28' 04"	81° 18' 58"	PA	Conemaugh	0	HWC	21	Usually well-developed joints.
Washington	2	39° 29' 42"	81° 44' 54"	PA	Monongahela	0	HWC	5	
Washington	7	39° 24' 42"	81° 28' 06"	PE	Dunkard	0	HWC	13	
Wayne	1	40° 47' 46"	81° 55' 05"	MS	Waverly	0	HWC	18	Joints poorly developed.
PENNSYLVANIA									
Allegheny	2	40° 16' 54"	79° 53' 24"	PA	Conemaugh	0	HWC	8	
Allegheny	3	40° 19' 24"	79° 56' 30"	PA	Conemaugh	0	QRR	5	
Allegheny	4	40° 36' 42"	79° 56' 48"	PA	Conemaugh	0	QRR	5	
Allegheny	5	40° 36' 30"	79° 53' 30"	PA	Conemaugh	0	HWC	9	
Armstrong	1	40° 48' 42"	79° 31' 42"	PA	Allegheny	0	STG	5	
Beaver	1	40° 39' 48"	80° 19' 48"	PA	Allegheny	0	HWC	10	
Bedford	1	40° 12' 35"	78° 32' 00"	DV	Brallier	45NW	HWC	7	
Bedford	7	40° 00' 18"	78° 17' 48"	DV	Hampshire	0	HWC	3	
Bedford	9	40° 11' 55"	78° 40' 35"	MS	Mauch Chunk	0	HWC	5	
Bedford	11	39° 57' 36"	78° 44' 42"	DV	Foreknobs	23SE	HWC	8	
Bedford	14	39° 53' 00"	78° 30' 24"	OR	Reedsville	22SE	HWC	7	
Blair	5	40° 48' 42"	78° 24' 00"	MS	Mauch Chunk	0	HWC	9	
Blair	8	40° 40' 35"	78° 14' 00"	SI	Rose Hill	75SE	HWC	8	Beds overturned.
Blair	10	40° 27' 06"	78° 32' 30"	PA	Pottsville	0	HWC	2	
Bradford	1	41° 41' 58"	76° 32' 04"	DV	Chemung	06SW	STG/HWC	16	Pattern same in interbedded sandstone.
Butler	3	40° 45' 54"	80° 06' 00"	PA	Conemaugh	0	HWC	8	Interbedded shale and shaly siltstone.
Butler	4	40° 45' 54"	80° 06' 06"	PA	Conemaugh	0	CON	8	
Cambria	1	40° 36' 12"	78° 42' 00"	PA	Conemaugh	?	HWC	5	
Cambria	3	40° 22' 00"	78° 46' 35"	PA	Conemaugh	0	HWC	15	
Cambria	5	40° 29' 20"	78° 44' 25"	PA	Conemaugh	0	CON	9	
Cambria	6	40° 22' 48"	78° 57' 48"	MS	Pocono	0	HWC	15	
Cameron	1	41° 24' 35"	78° 01' 33"	DV	Catskill	0	HWC	12	Pattern same as interbedded sandstone.
Clearfield	3	41° 03' 39"	78° 41' 03"	PA	Allegheny	0	QRR	7	
Clinton	1	41° 19' 39"	77° 47' 17"	DV	Oswayo	0	HWC	31	Pattern same as interbedded sandstone.
Elk	3	41° 19' 05"	78° 22' 03"	DV	Chemung	0	HWC	30	
Erie	2	41° 59' 51"	80° 19' 56"	DV	Conneaut	0	STG	15	
Fayette	3	39° 59' 12"	79° 37' 45"	PA	Monongahela	0	HWC	4	
Forest	4	41° 33' 37"	79° 24' 38"	DV	Chemung	0	HWC	25	Pattern complex, but similar to interbedded sandstone.
Fulton	1	39° 52' 54"	78° 14' 48"	MS	Rockwell/Purslane	80NW	HWC	6	
Fulton	4	39° 46' 18"	78° 12' 12"	DV	Mahantango	88NW	HWC	2	
Greene	4	39° 55' 36"	80° 24' 12"	PE	Dunkard	0	HWC	1	
Huntington	2	40° 28' 42"	78° 00' 12"	DV	Brallier	15SE	HWC	5	
Indiana	1	40° 39' 54"	79° 18' 48"	PA	Conemaugh	14NE	HWC	13	
Indiana	3	40° 34' 18"	78° 57' 12"	PA	Conemaugh	?	HWC	2	
Indiana	5	40° 24' 36"	78° 58' 55"	MS	Mauch Chunk	?W	HWC	7	
Jefferson	1	41° 08' 57"	79° 08' 27"	PA	Allegheny	20SW	HWC	7	
Lawrence	5	40° 58' 00"	80° 21' 48"	PA	Pottsville	0	HWC	10	
Lycoming	1	41° 31' 47"	77° 26' 52"	DV	Catskill	30NW	STG	18	Pattern same in interbedded sandstone.
Lycoming	2	41° 20' 43"	77° 05' 50"	DV	Catskill	80NW	HWC	22	Pattern same in interbedded sandstone.
McKean	3	41° 57' 50"	78° 22' 59"	DV	Chemung	0	VAL	20	
Potter	1	41° 46' 15"	78° 07' 31"	DV	Chemung	05SE	HWC	8	Pattern same as interbedded sandstone.
Somerset	1	40° 08' 30"	79° 01' 12"	PA	Allegheny	?	QRR	6	
Somerset	8	39° 49' 24"	78° 54' 24"	DV	Foreknobs/Hampshire	10NW	RRC	4	
Somerset	10	39° 56' 25"	79° 15' 20"	PA	Conemaugh	0	QRR	6	
Somerset	12	39° 50' 36"	79° 02' 18"	PA	Conemaugh	30S	HWC	2	
Somerset	13	39° 55' 54"	78° 47' 24"	DV	Brallier	05NW	HWC	5	
Somerset	15	39° 56' 18"	79° 16' 30"	PA	Allegheny	0	HWC	8	
Somerset	16	39° 54' 40"	79° 06' 30"	PA	Allegheny	0	QRR	4	
Somerset	17	39° 59' 42"	79° 00' 12"	PA	Allegheny	0	QRR	6	
Venango	3	41° 22' 57"	79° 48' 44"	MS	Pocono	0	HWC	20	Pattern controlled by valley trends.
Warren	4	41° 50' 38"	78° 59' 16"	DV	Conneaut	0	HWC	12	NW joints inclined toward valley.
Warren	5	41° 51' 10"	79° 28' 47"	DV	Cattaraugus	0	HWC	8	NE joints more commonly throughgoing.
Washington	1	40° 26' 00"	80° 26' 18"	PA	Monongahela	0	QRR	13	
Washington	2	40° 12' 15"	80° 14' 51"	PA	Monongahela	0	HWC	3	
Westmoreland	3	40° 24' 00"	79° 34' 24"	PA	Pittsburgh	0	HWC	10	
VIRGINIA									
Alleghany	1	37° 49' 20"	79° 58' 56"	DV	Brallier	60NW	?	30	
Frederick	1	39° 12' 12"	78° 15' 12"	DV	Jennings	66NW	HWC	3	
Frederick	2	39° 13' 18"	78° 16' 12"	DV	Jennings	53SE	HWC	2	
Giles	3	37° 21' 00"	80° 48' 12"	SI	Cacapon	26SE	HWC	10	Complex pattern; some faulting.
Highland	3	38° 17' 48"	79° 47' 35"	DV	Scherr	34SE	HWC	3	
Highland	4	38° 27' 05"	79° 39' 00"	DV	Brallier	90SE	HWC	26	
Scott	1	36° 40' 09"	82° 45' 18"	CA	Conesauga	45SW	HWC	25	Complex pattern; much faulting.
Wise	3	37° 01' 49"	82° 35' 47"	PA	Wise	0	HWC	16	Joints incline toward valley.
WEST VIRGINIA									
Boone	1	37° 47' 20"	81° 32' 08"	PA	Kanawha	0	HWC	7	
Boone	3	38° 04' 52"	81° 50' 26"	PA	Kanawha	0	HWC	3	Dark gray, very fissile shale.
Braxton	1	38° 41' 23"	80° 41' 20"	PA	Conemaugh	0	HWC	13	Outcrop contains growth faults.
Braxton	2	38° 54' 16"	80° 36' 23"	PE	Dunkard	0	HWC	8	Red shale and gray mudstone.
Braxton	3	38° 52' 50"	80° 37' 47"	PA	Conemaugh/Monongahela	0	HWC	7	Brownish red and gray shale.
Calhoun	2	38° 56' 03"	81° 05' 27"	PA	Monongahela	0	HWC	11	
Clay	1	38° 34' 05"	81° 01' 50"	PA	Allegheny	?	?	9	NE-trend cleat nearly parallel to face of cut.
Doddridge	1	39° 17' 03"	80° 42' 00"	PE	Dunkard	0	HWC	7	Fracture zones parallel stream alignments.
Fayette	4	37° 51' 00"	81° 01' 33"	MS	Bluestone/Princeton	0	HWC	10	N-S trending joints in fracture zones.
Fayette	6	38° 01' 30"	80° 55' 16"	PA	New River	0	QRR	5	Prominent diagonal joints dip 25°-45° SW here.
Gilmer	1	38° 56' 17"	80° 49' 46"	PA	Conemaugh	0	HWC	15	Fracture zones nearly parallel to stream alignments.
Greenbrier	4	37° 43' 54"	80° 26' 36"	MS	Maccrady	0	HWC	5	Extensive development of of calcite-filled fractures.
Hancock	2	40° 36' 19"	80° 33' 19"	PA	Allegheny/Conemaugh	0	HWC	19	Joints well developed.
Hardy	2	39° 05' 58"	78° 51' 31"	DV	Hampshire	11NE	HWC	2	Statistically inadequate.
Jackson	1	38° 53' 27"	81° 44' 18"	PE	Dunkard	0	HWC	6	Intense E-W shale cleat; spacing about 5/ft.
Jackson	2	38° 42' 57"	81° 38' 42"	PE	Dunkard	0	HWC	3	Irregular widely spaced joints in siltstone and mudrock.
Kanawha	2	38° 25' 18"	81° 32' 54"	PA	Kanawha	0	HWC	2	
Lewis	1	39° 03' 23"	80° 34' 35"	PA	Pittsburgh	?S	QRR	18	Shale cleat almost a cleavage.
Lewis	2	39° 02' 20"	80° 25' 08"	PA	Conemaugh/Monongahela	0	HWC	4	Fractures nearly fresh; some very weathered.
Logan	3	37° 56' 58"	82° 01' 15"	PA	Kanawha	0	HWC	4	Primary joints in zones six inches to 8 ft wide.
Logan	4	37° 59' 12"	81° 59' 30"	PA	Kanawha	0	HWC	2	
Marion	1	39° 31' 32"	80° 03' 05"	PA	Conemaugh	0	HWC	16	In gray calcareous shale.
Mason	1	38° 50' 24"	81° 59' 42"	PA	Monongahela	0	HWC	10	Two independent orthogonal sets of throughgoing and cross joints.
Mason	2	38° 46' 57"	81° 50' 18"	PE	Dunkard	0	HWC	2	Argillaceous siltstone and shale.
McDowell	2	37° 24' 30"	81° 37' 14"	PA	New River	0	HWC	2	With prominant valley-wall wall parallel cleat.
McDowell	6	37° 20' 03"	81° 51' 02"	PA	New River	0	HWC	3	North of Canebrake fault.
Mercer	1	37° 21' 52"	81° 20' 10"	PA	Pocahontas	0	HWC	14	Area has suffered mine collapse.
Mercer	3	37° 20' 47"	80° 58' 30"	MS	Hinton	0	HWC	19	
Mineral	3	39° 20' 00"	79° 05' 15"	DV	Brallier	63NW	HWC	4	
Mingo	1	37° 38' 52"	81° 58' 37"	PA	Kanawha	0	HWC	10	Laminated siltstone weathered to shale.
Mingo	1	37° 38' 45"	81° 59' 18"	PA	Kanawha	0	HWC	3	NE-trending anastomosing joints.
Monongalia	1	39° 43' 00"	80° 14' 30"	PE	Dunkard	0	HWC	8	ESE release joints; subparallel highways.
Monongalia	2	39° 40' 46"	80° 02' 17"	PA	Monongahela	0	HWC	1	Prominent fracture direction has two inch spacing.
Monongalia	3	39° 33' 30"	79° 58' 56"	PA	Conemaugh	0	HWC	7	
Nicholas	2	38° 17' 35"	80° 49' 57"	PA	Kanawha	0	HWC	3	Small exposure.
Pendleton	1	38° 42' 30"	79° 24' 39"	OR	Juniata	18SE	HWC	5	NE joint set approaches cleavage.
Pendleton	2	38° 38' 22"	79° 32' 22"	DV	Chemung	19NW	HWC	10	Joints well developed.
Pocahontas	1	38° 06' 54"	80° 15' 48"	MS	Mauch Chunk	0	HWC	7	Red and gray shale interbedded with limestone.
Pocahontas	2	38° 14' 48"	80° 05' 30"	MS	Pocono	0	HWC	4	Gray fissile shale interbedded with sandstone, siltstone, and mudstone.
Preston	1	39° 39' 12"	79° 41' 53"	PA	Conemaugh/Allegheny	0	HWC	5	
Preston	6	39° 20' 21"	79° 51' 36"	PA	Conemaugh	0	HWC	3	
Putman	1	38° 36' 00"	81° 44' 12"	PE	Dunkard	0	QRR	4	Siltstone and mudrock have joints in common.
Putman	2	38° 28' 15"	81° 56' 06"	PA	Conemaugh	0	HWC	4	Prominent SW-trending joints occasionally cut all lithologies.
Putman	3	38° 37' 18"	82° 00' 42"	PA	Monongahela	0	HWC	5	Anastomosing E-trending principal cleat.
Randolph	3	38° 54' 23"	79° 42' 21"	MS	Greenbriar	0	HWC	2	Primary cleat paralleled by release fracture.
Randolph	4	38° 55' 56"	79° 57' 24"	PA	Kanawha	14NW	HWC	21	Joint pattern complex.
Randolph	5	39° 01' 24"	79° 48' 42"	DV	Brallier	17E	HWC	6	Anastomosing ENE-trending cleat.
Ritchie	1	39° 16' 27"	80° 59' 05"	PE	Dunkard	0	HWC	8	Fracture zones sub-parallel to stream alignments.
Ritchie	3	39° 15' 17"	81° 16' 05"	PA	Allegheny	0	HWC	4	
Roane	1	38° 47' 56"	81° 14' 26"	PA	Monongahela	0	HWC	11	Joint pattern very different from sandstone.
Roane	2	38° 38' 42"	81° 23' 42"	PA	Monongahela	0	HWC	28	"Faceted" shale.
Roane	3	38° 47' 21"	81° 21' 24"	PE	Dunkard	0	HWC	3	
Roane	4	38° 49' 18"	81° 30' 00"	PE	Dunkard	0	HWC	5	Down-to-SW normal fault in mudrock.
Summers	1	37° 41' 46"	80° 52' 45"	MS	Hinton	0	HWC	6	Intensely weathered exposure.
Tucker	4	39° 11' 33"	79° 30' 57"	PA	Conemaugh	14SW	QRR	5	10% shale in sandstone.
Upshur	2	38° 50' 24"	80° 20' 18"	PA	Conemaugh	0	QRR	8	In small, shallow strip opening for coal.
Upshur	3	38° 56' 30"	80° 15' 12"	PA	Conemaugh	0	QRR	11	
Webster	3	38° 37' 18"	80° 22' 12"	PA	Kanawha	0	HWC	11	Sheet joints nearly parallel valley wall.
Webster	4	38° 34' 36"	80° 24' 12"	PA	Kanawha	0	HWC	4	
Wetzel	1	39° 31' 24"	80° 45' 24"	PE	Dunkard	0	HWC	6	Fibrous calcite fracture-fillings.
Wetzel	2	39° 42' 24"	80° 31' 48"	PE	Dunkard	0	HWC	13	Different joint patterns in stiff versus shaly siltstone.
Wetzel	3	39° 40' 18"	80° 42' 48"	PE	Dunkard	0	HWC	5	
Wetzel	4	39° 31' 30"	80° 37' 48"	PE	Dunkard	0	HWC	4	Principal cleat very closely spaced.
Wetzel	7	39° 37' 25"	80° 50' 57"	PE	Dunkard	0	HWC	2	In E-trending fracture zone.
Wood	2	39° 15' 47"	81° 29' 06"	PE	Dunkard	0	HWC	5	Minor faulting in shale.
Wyoming	2	37° 35' 19"	81° 46' 11"	PA	Kanawha	0	RRC	1	
Wyoming	5	37° 35' 09"	81° 33' 00"	PA	New River	0	HWC	2	Intensely weathered.
Wyoming	6	37° 36' 38"	81° 46' 58"	PA	Kanawha	0	RRC/HWC	4	Prominent E, NNE, and NW-trending topographic alignments.

*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).



SCALE 1:1 000 000

25 0 25 50 75 100 125 150 175 KILOMETERS

25 0 25 50 75 MILES

JOINT PATTERNS IN GRAY SHALE AND MUDROCK IN THE CENTRAL AND NORTHERN APPALACHIAN BASIN

By

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

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.

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

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