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APPENDIX LISTING GRAPTOLITE ZONE DATA FOR CHURKIN, CARTER, AND JOHNSON, GEOLOGY

Churkin, Carter, Johnson

British zone graptolite	Local zone graptolite	Formation	Location	Source of data	Thickness in meters	Mean X of sections	Standard deviation Sx	Number of taxa	Remarks (unless otherwise indicated, sections are nearly pure dark shale and chert)
<i>Monograptus turriculatus</i>	<i>Monograptus turriculatus</i>	Road River Fm.	Road River, Yukon Territory	Jackson and Lenz, 1962	10.7			2	Minor interbeds of cherty limestone.
<i>M. turriculatus</i>	<i>M. turriculatus</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	31			3	85% nongraptolitic mudstone, 2% ash.
<i>M. turriculatus</i> (lower part)	<i>Rastrinea maxima</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	6.6	12.9	12.5	5	85% gray mudstone/claystone.
<i>M. turriculatus</i>	<i>Spilograptus turriculatus</i>	"Rastrites Beds"	Kimekulle, Sweden	Maern and others, 1948	3.1			6	83% gray mudstone; 10% red mudstone, 2% bentonite, 5% black shale.
<i>Monograptus sedgwickii</i>	<i>Monograptus sedgwickii</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	12.8			9	4% limestone, 3% ash, 3% calcareous grit.
<i>M. sedgwickii</i>	<i>M. sedgwickii</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	8.4	10.6	3.11	4	20% claystone, some calcareous nodules. Small unconformity reported in section.
<i>*M. sedgwickii</i>	<i>M. sedgwickii</i>	Old Chapel mudstones	Clivedon River, Wales	Jones, 1965	37.2			1	Sandy micaceous mudstone with shaly interbeds.
<i>Monograptus concolutus</i>	<i>Monograptus concolutus</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	5.4			8	Contains claystone and calcareous nodules.
<i>M. concolutus</i>	<i>Demirestrites concolutus</i>	Dyuskskaya Svita	Yugorskiy Peninsula, USSR	Koren' and Enokyan, 1970	7	6.2	1.1	7	Some concretions of shaly limestone.
<i>*M. concolutus</i> (lower part) and <i>Monograptus gregarius</i> (upper part)	<i>Petalolithus folium</i>	"Rastrites Beds"	Kimekulle, Sweden	Maern and others, 1948	0.4			10	19
<i>M. gregarius</i>	<i>M. gregarius</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	7.9			7	10% claystone + calcareous nodules.
<i>M. gregarius</i>	<i>M. gregarius</i>	Rheidol Fm.	Rheidol Gorge, Wales	Sudbury, 1958	19.8			8	73% barren blue-gray mudstone.
<i>M. gregarius</i>	<i>Ptilograptus gregarius</i> and <i>Demirestrites trilingulatus</i>	Dyuskskaya Svita	Yugorskiy Peninsula, USSR	Koren' and Enokyan, 1970	9.5	10.5	6.5	5	Calcareous concretions.
<i>M. gregarius</i> (lower part)	<i>Monograptus trilingulatus</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	4.9			9	22
<i>*M. gregarius</i>	<i>Demirestrites trilingulatus</i>	Unnamed formations in drill cores	Norilsk, USSR	Obut and others	97			18	34
<i>Monograptus cyphus</i>	<i>Monograptus cyphus</i>	Descon Fm.	Esquibel Is., Alaska	Churkin and others, 1971	4.64			7	24
<i>M. cyphus</i>	<i>M. cyphus</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	7.3			8	25
<i>M. cyphus</i> (lower part)	<i>Monograptus acilacis</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	1.7	4.7	1.9	7	17
<i>M. cyphus</i>	<i>M. cyphus</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	2.1			6	15
<i>M. cyphus</i>	<i>Permograptus revolutus</i>	"Rastrites Beds"	Kimekulle, Sweden	Maern and others, 1948	3.2			3	4
<i>Cystograptus vesiculosus</i>	<i>Cystograptus vesiculosus</i>	Descon Fm.	Esquibel Is., SE Alaska	Churkin and others, 1971	2.5			5	12
<i>C. vesiculosus</i>	<i>C. vesiculosus</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	1.3			7	13
<i>C. vesiculosus</i>	<i>Dicelophgraptus extremus</i>	"Rastrites Beds"	Kimekulle, Sweden	Maern and others, 1948	3.0	2.4	0.7	3	3
<i>C. vesiculosus</i>	<i>Monograptus alatus</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	2.7			6	12
<i>Akidograptus acuminatus</i>	<i>Akidograptus acuminatus</i>	Descon Fm.	Esquibel Is., SE Alaska	Churkin and others, 1971; Lamphere and others (in press)	1.7			5	8
<i>A. acuminatus</i>	<i>A. acuminatus</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	5.0			6	12
<i>A. acuminatus</i>	<i>A. acuminatus</i>	"Rastrites Beds"	Kimekulle, Sweden	Maern and others, 1948	6.5	3.3	2.9	5	11
<i>A. acuminatus</i>	<i>A. acuminatus</i>	Stockdale Shales	Hongtill Fells, England	Rickards, 1970	0.1			5	8
<i>Clupograptus petenculatus</i>	<i>Clupograptus petenculatus</i>	Descon Fm.	Esquibel Is., SE Alaska	Churkin and others, 1971; Lamphere and others (in press)	0.8	1.0	0.2	2	3
<i>G. petenculatus</i>	<i>G. petenculatus</i>	Birkhill Shales	Dobb's Lim, Scotland	Toghini, 1968	1.1			3	6

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Top not paleontologically defined.
 About 50% section is shaly limestone and about 50% is thin shale. Some mafic lavas. Soviet authors have created many new genera by subdivision of *Monograptus*.

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<i>Dicellograptus complanatus</i> and <i>Dicellograptus anceps</i>	<i>Dicellograptus ornatus</i>	Phi Kappa Fm. Idaho	Pioneer Mts., Idaho	Carter and Churkin, (in press)	10.7		5	23		
<i>D. complanatus</i>	<i>D. complanatus</i>	Hartfell Shales	Dobb's Linn., Scotland	Toghill, 1970	9.5	13.4	4	4	93% barren mudstone, 1% fossiliferous black shale (40 mm).	
<i>Dicellograptus anceps</i>	<i>Dicellograptus anceps</i>	Hartfell Shales	Dobb's Linn., Scotland	Toghill, 1970	4.6	14.1	8	16	93% barren gray mudstone, 7% graptolitic black mudstone.	
<i>Dicellograptus complanatus</i> and <i>Dicellograptus anceps</i>	<i>Dicellograptus complanatus ornatus</i>	Maravillas Chert	Marathon, Texas	Berry, 1960	15.3		5	12	80% chert, 20% pink or buff shale.	
<i>+D. anceps</i>	<i>Dicellograptus ornatus</i>	Road River Fm. Oregon	Blackstone River, Yukon Territory	Jackson and Lenz, 1962	33.6+		4	6	Base of zone lithologically defined.	
<i>Dicellograptus complanatus</i> (lower part) and <i>Dicellograptus jinnaris</i> (upper part)	<i>Climacograptus mantoulinensis</i>	Mecasty Shale	Anticosti Is., Canada	Riva, 1969	24.4		8	12		
<i>P. jinnaris</i>	<i>P. jinnaris</i>	Phi Kappa Fm.	Pioneer Mts., Idaho	Carter and Churkin (in press)	2.4		6	17		
<i>+P. jinnaris</i> (lower part)	<i>Climacograptus pygmaeus</i>	Mecasty Shale	Dobb's Linn., Scotland	Toghill, 1970	4.9	3.7	6	20		
<i>Dicranograptus cilingani</i> (upper part)	<i>Climacograptus tubuliferous</i>	Phi Kappa Fm.	Pioneer Mts., Idaho	Carter and Churkin (in press)	25.0		8	22		
<i>D. cilingani</i> (middle part)	<i>Orthograptus ruodmanni</i> (<i>Climacograptus mirimus</i>)	Mecasty Shale	Anticosti Is., Canada	Riva, 1969	1.8		5	7		
<i>D. cilingani</i> (lower part)	<i>Coenopoda americana</i> (<i>Coenopoda californaris</i>)	Mecasty Shale	Anticosti Is., Canada	Riva, 1969	3.7-25.9	25.9	7	11		
<i>D. cilingani</i> (upper part)	<i>Climacograptus spiniferus</i>	Mecasty Shale	Anticosti Is., Canada	Riva, 1969	20.4		6	10		
<i>Dicranograptus multidentis</i>	<i>Climacograptus bicornis</i>	Phi Kappa Fm.	Pioneer Mts., Idaho	Carter and Churkin (in press)	12.2	12.2	11	23		
<i>+D. multidentis</i>	<i>Amplexograptus vasei</i> and <i>Diplograptus molleus</i>	Chasmps Series	Kinnekuile, Sweden	Maern and others, 1948	13.0		4	6	33% bentonite, 30% mudstone and shale, 25% limestone, 12% cherty beds.	
<i>+D. multidentis</i>	<i>Climacograptus petifer</i>	--	Taimyr Peninsula, USSR	Dout and Sobolevskaya, 1964	49.0		4	7	Some limestone.	
<i>Momagraptus gracilis</i>	<i>Momagraptus</i>	Phi Kappa Fm.	Pioneer Mts., Idaho	Carter and Churkin (in press)	38.1		10	23		
<i>M. gracilis</i>	<i>M. gracilis**</i>	Sams Spring Fm. * (Vinini Fm.)	Toquima Range, Nevada	Kay, 1962; McKee (in press)	24.4	31.3	11	22	*May include uppermost Petes Summit Fm. **May include part of <i>paralograptus multidentis</i> zone. Kay table 3, d; table 4, a, b, c; faunas; McKee D212500 to D212900 faunas.	
<i>+M. gracilis</i> (upper part)	<i>Climacograptus bicornis</i>	Woods Hollow Shale	Marathon, Texas	Berry, 1960	47.3	143.7	14	34	Some limestone and siltstone.	
<i>M. gracilis</i> (lower part)	<i>Momagraptus gracilis</i>	Woods Hollow Shale	Marathon, Texas	Berry, 1960	96.4		12	35	Limestone and siltstone interbeds.	
<i>+M. gracilis</i>	<i>M. gracilis</i>	--	Taimyr Peninsula, USSR	Dout and Sobolevskaya, 1964	60.0		5	7	Has siltstone and minor limestone.	
<i>Cyrtograptus terebriculosus</i>	<i>Cyrtograptus terebriculosus</i>	Petes Summit Fm. (Vinini Fm.)	Toquima Range, Nevada	Kay, 1962; McKee (in press)	7.6	7.6	3	4	McKee D211700 and D211800 faunas. Thin quartzite in section.	
<i>+G. terebriculosus</i>	<i>G. cf. G. terebriculosus</i>	Fort Peña & Woods Hollow Shale	Marathon, Texas	Berry, 1960	13.7		4	5	Mostly limestone and siltstone with some shale interbeds.	
<i>Dicranograptus multidentis</i>	<i>Dicranograptus multidentis</i>	Petes Summit Fm. (Vinini Fm.)	Toquima Range, Nevada	Kay, 1962; McKee (in press)	21.4	21.4	--	9	14	May include part of <i>paralograptus vasei</i> zone; Kay table 3, c fauna; McKee D211700 to D213000 faunas. Thin quartzite in section.

+D. marchisoni (lower part) <i>D. marchisoni</i> <i>D. marchisoni</i> <i>D. marchisoni</i> <i>D. marchisoni</i> <i>D. marchisoni</i> (upper part)	<i>Parajiosograptus</i> <i>tenuicollis</i> <i>(Hallograptus</i> <i>echardi)</i> <i>P. tenuicollis</i> <i>(H. echardi)</i>	Glengie Fm.	Kicking Horse River, British Columbia Marathon, Texas	Larson and Jackson, 1966 Berry, 1960	6.1+	47.0	ARENIG	11	17	
D. hirundo	<i>Dijunograptus</i> <i>hirundo</i>	Pete Summit Fm. (Vinit Fm.)	Toiyabe Range, Nevada	Kay, 1962; McKee (in press)	12.2	12.2	--	14	16	Table 3, b (Kay); columns D2121CO and D2128aCO (McKee).
+ <i>Isoograptus</i> <i>gibberulus</i>	<i>Isoograptus</i>	Phi Kappa Fm.	Pioneer Mts., Idaho (Peak 8832 sec.)	Carter and Churkin (in press)	15.3			3	9	Interbedded with quartzite.
+ <i>I. gibberulus</i>		---	Toiyabe Range, Nevada	R. J. Ross, Jr., written commun., 1976	61.0					
+ <i>Dijunograptus</i> <i>nitidus</i>	<i>Dijunograptus</i> <i>protobifidus</i>	Phi Kappa Fm.	Pioneer Mts., Idaho	Carter and Churkin (in press)	2.2			6	17	Interbedded with quartzite.
+ <i>D. nitidus</i>	<i>D. protobifidus</i> and <i>Dijunograptus</i> <i>bifidus</i>	---	Toiyabe Range, Nevada	R. J. Ross, Jr., written commun., 1976	38.0					Calcareous shale.
<i>Dijunograptus</i> <i>deilexus</i>	<i>Dijunograptus</i> <i>extensus</i>	Road River Fm.	Peel River, Yukon Territory	Jackson and Lenz, 1962	36.6			6	12	

1/ Thickness of discrete interbeds of other lithologies has been excluded.
+Shown for comparison but not used in construction of Table 1 and Figures 2 and 3 because of inhomogeneous lithology, etc.

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