DEPARTMENT OF THE INTERIOR
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GRAPTOLITE IDENTIFICATION CHART FOR FIELD DETERMINATION OF GEOLOGIC AGE

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OIL AND GAS INVESTIGATIONS
CHART OC 66

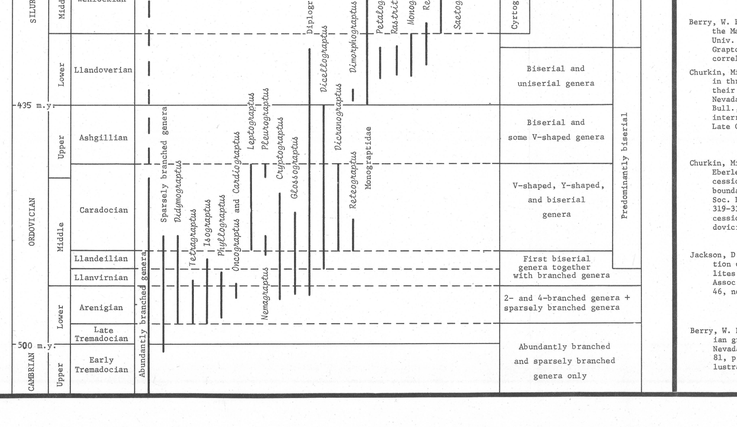
NAME	DIAGNOSTIC CHARACTERS	OTHER FORMS WITH WHICH THIS MIGHT BE CONFUSED	TIME-RANGE
Monograptus hercynicus group	Straight or slightly curved rhabdosome. Some with strongly curved initial portion (J-shaped). A small tongue-like structure (T) developed on dorsal side of sicula. Initial thecae strongly hooked and generally changing shape along rhabdosome.	Difficult to distinguish from some Early Silurian curved species. Look for conspicuous tongue (T) on sicula. Earlier monograptids, particularly Late Silurian (Ludlovian) species also have dorsal tongues but these are much less pronounced. Sometimes associated with *Linograptus* and *Abiesgraptus*.	Early Devonian
Abiesgraptus	Main stipe with regularly spaced, paired lateral branches. Dorsal rod visible in well preserved specimens.	Very rare, can be confused with *Pseudograptus*, which differs by having unpaired irregularly spaced lateral branches without dorsal rod. *Abiesgraptus* occurs with monograptids rather than biserial genera. Stipe fragments of *Abiesgraptus* and *Linograptus* may be confused with fragments of the Ordovician genera *Didymograptus*, *Tetragraptus*, etc., but the Ordovician graptolites lack a dorsal rod along their axes.	Early Devonian
Linograptus	Rhabdosome composed of two or more branches radiating from central point. No secondary branching.	*Linograptus*, like *Abiesgraptus*, occurs with monograptids.	Late Silurian and Early Devonian
Monograptidae	Uniserial with dorsal rod. Shapes of thecae and of entire rhabdosome determine species. Some easily recognized species with restricted range are illustrated below.	Can be confused with broken stipes of *Didymograptus*. Look for sicula and dorsal rod in *Monograptus*. Look for symmetrical join of 2 stipes at sicula in *Didymograptus*.	Silurian and Early Devonian. Late Silurian and Devonian monograptids are generally straight; curved species are few. Early and Middle Silurian faunas contain many strongly curved species. Association of monograptids and biserial graptolites indicates Early Silurian (Llandoverian).
Cyrtograptus	Rhabdosome spirally coiled with secondary branches developed like spokes on a wheel.	None	Middle Silurian
Retiolites	Lacy secondary mesh within basic network of alternating thecae.	*Retiograptus*, which lacks a secondary mesh.	Early and Middle Silurian
Monograptus spiralis group	Spirally coiled rhabdosome.	None	Late Early Silurian
Rastrites	Curved rhabdosome. Thecae widely spaced, very long, narrow and straight. Thecae attached to extremely thin thread-like rod. Hooked ends of thecae sometimes preserved.	A few species of *Monograptus*, but thecae in *Rastrites* are completely isolated from one another and are more nearly perpendicular to the stipe.	Early Silurian
Petalograptus	Leaf-shaped rhabdosome. Thecae long, straight, or gently curving, and greatly overlapping.	*Phyllograptus* has similar outline but can be distinguished by presence of thecae along central axis.	Early Silurian
Dimorphograptus	Initial portion uniserial, changing distally to biserial. Uniserial portion often gently curved.	None	Early Silurian

NAME	DIAGNOSTIC CHARACTERS	OTHER FORMS WITH WHICH THIS MIGHT BE CONFUSED	TIME-RANGE
Diplograptidae	Straight single stipe with thecae on both sides (biserial). Proximal (narrow) end often bearing distinctive spines. Some of these spinous species (see below) are very useful for precise age determination.	This is a long-ranging group consisting of many genera and species. Genera are determined on basis of thecal shape. *Orthograptus* Thecae straight. *Glyptograptus* Thecae with gently sigmoidal curvature. *Climacograptus - Amplexograptus* Thecae strongly sigmoidal with apertures in semicircular excavations. *Diplograptus* Thecae are amplexograptid types at start and more gently sigmoid (glyptograptid) type distally.	Middle Ordovician to Early Silurian
Dicellograptus	V-shaped rhabdosome. Very strong curvature of thecae.	See *Leptograptus*.	Middle and Late Ordovician
Pleurograptus	Rhabdosome branched. Main stipe slightly curved and with irregularly spaced secondary branches on one or both sides. Secondary branches may be branched.	Could be confused with *Abiesgraptus*, which differs by not having branched secondary branches. *Pleurograptus* occurs with biserial genera, whereas *Abiesgraptus* occurs with monograptids. *Pleurograptus* is very rare in North America.	Early Late Ordovician
Leptograptus	Two slender stipes forming an angle of divergence of nearly 180° (slightly reclined). Serrated margin of stipe difficult to see because thecae are inclined at low angle to stipe.	*Dicellograptus* has more complexly curved thecae, and the angle of divergence of its branches is generally less than 90°.	Middle and Late Ordovician
Reteograptus	Orderly, boxlike network of alternating thecae.	See *Retiolites*.	Middle Ordovician
Dicranograptus	Y-shaped rhabdosome. Biserial initially and then dividing into 2 uniserial branches. Curved thecae, often with small spines.	Broken uniserial stipes can be confused with monograptids or didymograptids. However, dicranograptids lack the dorsal rod of monograptids and have curved thecae instead of the straight thecae of didymograptids.	Middle Ordovician
Glossograptus	Biserial with large spines on both sides of the rhabdosome.	Could be confused with spined species of Diplograptidae, which generally have shorter and straighter spines.	Middle Ordovician
Cryptograptus	Straight biserial stipe with spines on proximal end. Thecae may appear *Orthograptus*-like to nearly *Climacograptus*-like. Entire rhabdosome parallel-sided.	Scalloped margins (a series of semicircular curves) generally distinguish *Cryptograptus* from most Diplograptidae. Can be oriented so that thecae are not visible and rhabdosome margins appear straight. In this orientation, *C. tricornis*, a very diagnostic species, is characterized by 3 proximal spines.	Early and Middle Ordovician
Nemagraptus	Rhabdosome branched and bilaterally symmetrical. Two main stipes reclined or more usually curved into S-shape. Evenly spaced secondary branches on convex side of each main stipe.	Fragments can be confused with other branched graptolites. Look for diagnostic associates *Didymograptus* and *Glossograptus*.	Middle Ordovician
Didymograptus	Two-branched, pendent, horizontal or reclined. Thecae simple, straight or slightly curved.	See Monograptidae	Early and Middle Ordovician

NAME	DIAGNOSTIC CHARACTERS	OTHER FORMS WITH WHICH THIS MIGHT BE CONFUSED	TIME-RANGE
Isograptus	Two wide stipes, reclined; sicula and thread-like extension usually prominent.	Could be confused with wide-stiped *Tetragraptus*, which usually will show portions of more than 2 stipes.	Early Ordovician and early Middle Ordovician
Cardiograptus (A) and *Oncograptus* (B)	*Cardiograptus* has two stipes back to back (bisterial); *Oncograptus* is also biserial initially; later the stipes diverge.	Could be confused with flattened *Phyllograptus*, but does not have any sign of a row of thecae along central axis.	Early Ordovician and earliest Middle Ordovician
Phyllograptus	Four stipes joined along their dorsal margins at right angles to each other. Usually flattened so only 2 stipes appear in profile and a third appears in ventral view along the central axis.	See *Cardiograptus* and *Petalograptus*.	Early Ordovician and earliest Middle Ordovician
Tetragraptus	Four-branched, bilaterally symmetrical. Thecae simple, straight or slightly curved.	None when four branches are visible. See *Isograptus*.	Early Ordovician and earliest Middle Ordovician
Sparsely branched genera with bilateral symmetry	Bilateral symmetry of rhabdosome. Stipes uniserial. Thecae straight.	Single stipes can be confused with *Monograptus*. Look for sicula.	Mainly Early Ordovician, but range into Middle Ordovician
Sparsely branched genera with radial symmetry	Dichotomous (paired) branching. Sicula present.	Could be confused with plants. Look for thecae on sides of branches.	Mainly Early Ordovician but range into Middle Ordovician
Abundantly branched genera	Rhabdosome with many branches, sometimes anastomosing or connected by transverse branches. "Stem" and root-like processes at one end. Many fan-shaped.	Could be confused with plants. Look for thecae on sides of branches.	Late Cambrian-Mississippian. Abundant specimens without associated different types of graptolites, generally Cambrian. Common with other types of graptolites in the Early Ordovician. Rare in Middle Ordovician-Mississippian

Axial view of unflattened specimen

s = sicula



IMPORTANCE OF GRAPTOLITES

Graptolites are very useful fossils for age determination and correlation of Late Cambrian through Early Devonian rocks. Knowledge of the basic shapes of graptolites illustrated on this chart can help a geologist without special knowledge of paleontology to make preliminary age determinations in the field to a geologic system and in many cases to within a series. Moreover, graptolites in the hands of a paleontologist can give unusually precise long-range correlations. Another advantage provided by graptolites is that they can occur in practically any fine-grained marine sedimentary rock and are abundant in argillaceous and cherty sediments which are generally without shelly fossils.

During the earlier Ordovician, up to about the Llandeilian, graptolites in North America can be divided into two faunal provinces: A Pacific faunal province that covered western and arctic parts of North America and extended into various regions now bordering the Pacific basin; and the Atlantic faunal province that covered eastern North America and Europe. The chart is based largely on those graptolites of the Pacific faunal province that are most easily identified and most often encountered. Because of the general nature of the chart it can be used with little modification in the Atlantic province. Starting in the Middle Ordovician, graptolite faunas the world over become less provincial and the chart can be used wherever graptolites are found, taking into account minor local variations.

HOW TO FIND GRAPTOLITES

The most important rules to follow in searching for graptolites are:

1) Look for them in rock types in which they occur abundantly--shale, slate and siltstone, and especially shaly partings in thin-bedded siliceous shale and chert. Dark brown or black lithologies are most productive, while green and red shales only rarely have graptolites. Don't be discouraged by volcanics in the section. Check fine-grained tuffaceous sediments and platy limestones.

2) Look for graptolites on rock surfaces as nearly parallel to bedding as possible. In intensely folded and weakly metamorphosed rocks, look in places where cleavage most closely parallels bedding.

3) Search thoroughly. When you find appropriate lithology and structure, quickly scan bedding planes in talus. Then split rock and examine bedding planes. Check any shiny, carbonized or pyritic fragment for toothed or notched edges like that of a sam. All graptolites have row(s) of thecae (tube-like structures) that when flattened produce serrated margin(s) resembling a saw blade. Primitive plants and dendritic manganese resemble some of the graptolite outlines, but are without thecae.

HOW TO USE GRAPTOLITES FOR DETERMINING GEOLOGIC AGE

To determine the geologic age of a graptolite collection, identify within the collection the individual graptolite groups shown on this chart. Note the time-range of each major graptolite group and bracket the age of the total collection by overlapping time-ranges of its individual components.

Graptolitic shales, especially when interlayered with chert, are generally condensed sections. Therefore, make numerous precisely located collections in any shale section more than several feet thick. You may have an entire geologic system represented by several hundred feet of section. Individually wrap in paper every rock slab containing graptolites, preferably making small packages. For shipment, use padded boxes not exceeding 20 lbs each. If you find abundant graptolites in fissile shale, quarry some thick slabs to be split later in a paleontological laboratory.

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GLOSSARY

Rhabdosome--exoskeleton of the entire graptolite colony.

Stipe--one branch of a branched rhabdosome or the entire colony of an unbranched rhabdosome.

Sicula--initial cone-shaped chamber from which thecae develop to form colony.

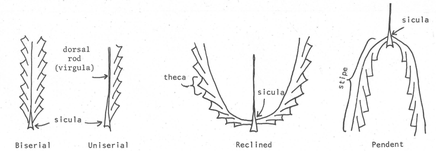
Theca--individual tube or cup-like structure that presumably housed a soft-bodied animal.

Pendent--rhabdosome with branches approximately parallel and hanging below sicula. Thecae inward facing.

Reclined--rhabdosome with branches growing upward. Thecae outward facing.

Uniserial--stipe consisting of a single row of thecae only.

Biserial--stipe with a row of thecae on both sides.



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