Excursion 30 Girvan Foreshore

Key details

Author	J. Keith Ingham
Themes	Mid Ordovician–Early Silurian fore-arc sequences of the Girvan foreshore (Kennedy's Pass to Craigskelly area). To examine a variety of lithological units and their relationships, largely in stratigraphical sequence, in order to elucidate the cyclical and essentially fault-controlled environments of deposition. Opportunities for collecting fossil associations, not just of stratigraphical significance, will emphasise the importance of some associations in the understanding of palaeo-environments.
Features	Sediments and sedimentary environments ranging from shallow to extremely deep water, including shallow water carbonates, elastics, proximal and distal turbidit es, submarine fans, slump-controlled sequences, significant stratigraphical relationships, environmentally and strati-graphically significant faunas, all typical of fore-arc basin and marginal regimes.
Maps	O.S. 1:25 000 Sheet NX19 Girvan 1:50 000 Sheet 76 Girvan B.G.S. 1:50 000 Sheet 7 Girvan
Terrain	Rocky shoreline, locally rough.
Distance and Time	c. 5 km. 6–8 hours, depending on the amount of time spent at particular localities.
Access	Low tide essential, particularly in the middle and later part of the excursion. (SSSI)

Locality 1. Kennedy's Pass [NX 149 933]

Kilranny Conglomerate and Henderson's 'unconformity' (Figure 28.1)a, (Figure 30.1). Parking is available in layby on seaward side of headland.

Extensive, much faulted exposures of the Kilranny Conglomerate (Balclatchie Group–early Caradoc) are well-exposed below and beside the road. Minor faulting is much in evidence and a large dextral fault crosses the foreshore in the bay immediately to the north. The conglomerate consists for the most part of clasts of volcanic and intrusive rocks of a variety of sizes, some of the largest being a distinctive pink granite. Some were derived from the Arenig Ballantrae others from an acid igneous complex. The conglomerate was generally deposited fairly rapidly on a subsiding sea floor (probably fault controlled) but there are many framework beds. On the north side of the headland below the road and between two small faults the relationship between the Kilranny Conglomerate and the overlying Ardwell Flags can be seen (the so-called Henderson's unconformity). Examination of this junction, together with regional Mapping data, reveals it to be a channel fill whereby an erosional channel on the upper surface of the conglomerate has been progressively filled by the thinly bedded silts of the basal Ardwell Flags Formation.

Across the road, a few metres to the south is a cutting through Kilranny Conglomerate which exposes its base. Underlying the formation are the so-called 'Infra-Kilranny Greywackes' (Williams1962)—also belonging to the Balclatchie Group—consisting of shales, siltstones and fine greywackes, overlying the Benan Conglomerate (the basal formation in this tract). Occasional brachiopods and trilobites can be found here in these beds and at other localities inland.

Locality 2. Ardwell Foreshore

Ardwell Flags, 'Cascade' folding (Figure 28.1)a. Walk north-eastwards along the foreshore towards Ardwell Bay (about 1 km of fairly rough going) or drive and park at the layby about halfway along the Ardwell foreshore, progressively ascending a thick succession of Ardwell Flags. These beds comprise an alternation of fine, laminated sandstone with ripples, alternating with thin, grey mudstones. Magnificent exposures of 'cascade folding' can be seen which have been interpreted variously as a late Caledonian fold phase (Williams 1959) or as penecontemporaneous slumping of partly lithified sediment. The succession youngs obliquely seawards and in order to appreciate the second, more likely, alternative one has to rotate the entire block in one's mind to the 'horizontal' in order to appreciate that the sediment may have been transported down-slope from the NW. Towards the middle and north-eastern section of the foreshore a number of good exposures of contemporaneous sedimentary breccias and small-scale slumping will be discovered (some iron-stained): they are best seen when wet. The beds are folded and brecciated in a complex way so that cohesive strata can be seen to pass into breccia ted beds. All this speaks of the considerable instability of the environment of deposition. Fossils are relatively uncommon in this part of the succession and are dominated by graptolites and orthocone nautiloids. Examples of the former, of Caradoc age, can sometimes be obtained from the small disused quarry behind and a little to the south of Ardwell Farm.

Locality 3. Ardwell Bay–north-west side (beginning of the Whitehouse foreshore) [NX 158 943]

Uppermost Ardwell Flags with graptolites (Figure 28.1)a. Parking is available adjacent to Ardwell Farm.

This is the point at which visitors who have followed the itinerary ending with the Ardmillan Braes lower Ardwell Flags fossil locality (Excursion 28, Locality 6) will come down to the road via the track at Ardwell Farm and can pick up this itinerary if they so wish. The first exposures, on the seaward side of Ardwell Bay, are only available at low tide. They constitute the very topmost beds of the Ardwell Flags Formation and are rather folded, being largely caught between branches of the large dextral fault running out to sea from Kennedy's Pass (see Locality 1). Here the beds consist of dark shales and even-textured sandstones. The former yield graptolites–largely Orthograptus and other diplograptids diagnostic of the late Caradoc *Dicranograptus clingani* Biozone (Figure 32.3).

Locality 4. Whitehouse shore (south)

Lower Whitehouse Group -South Shore Formation (limestone flysch) (Figure 28.1)a. The aforementioned strata are followed sharply by a limestone flysch unit–the South Shore Formation at the base of the Lower Whitehouse Group. These beds are locally similarly folded and faulted and consist of alternations of graded detrital limestones and grey and green shales in a major, upward fining sequence: the basal unit is particularly coarse. The basal elements of each graded unit were deposited in fairly proximal turbidity currents from the NW–some of the units are multiple and show every member of the Bouma Sequence. Clear exposures are best seen for about a hundred metres fairly close to the road where small bluffs stick up through the sand. Some of these outcrops show beds which comprise two turbidites. These are produced when one turbidity current runs over another as the first one was still depositing its sediment. Across the foreshore along strike to the SW the rocks are largely covered with barnacles and seaweed. Fossil shelly debris, transported from an outer platformal environment has been collected from the coarse bases of the graded units but it is difficult to come by and quite dangerous to extract. The rock is hard and goggles are essential. Trilobite, brachiopod and coral fragments are the most usual finds. Of the former, the late Caradoc *Tretaspis ceriodes* (species group) is typical. This is an outer neritic trilobite of widespread distribution, being known from Scandinavia, northern England, the Welsh Borderland and even western China. Its presence at Girvan indicates that the geographical barriers (i.e. Iapetus Ocean), which had, until late Caradoc times, controlled profoundly the distribution of shallower water faunas, were beginning to break down. Upwards from this level, the essentially North American aspect of the Girvan neritic faunas, becomes less and less evident.

Locality 5. Whitehouse shore (centre)

Lower Whitehouse Group -Three Mile Formation (distal sandstone flysch), thrust foreshortening of stratigraphical succession (Figure 28.1)a, (Figure 30.2). A lay-by is available here [NX 165 947].

Within the Lower Whitehouse Group the South Shore Formation is followed by the Three Mile Formation–also nearly vertical and younging seawards. This is a distal turbidite sequence and is much less calcareous than the underlying formation. For the most part the unit consists of alternations of shales with thin yet very persistent sandstone beds which stand out sharply–a 'ribbon' rock. Two or three of the sandstones are rather thicker and provide useful marker horizons. There are no fossils known from this formation.

For structural reasons, the third and terminal formation of the Lower Whitehouse Group (the graptolitic Penwhapple Formation–lower *Pleurograptus linearis* Biozone) is not exposed on the Whitehouse foreshore. A strike-oriented thrust or reverse fault cuts out perhaps 200 m of strata here. The Lower Whitehouse Group has effectively been thrust (seawards) over the Upper Whitehouse Group. A prominent gully along the line of this fault follows the seaward margin of the Three Mile Formation (Figure 30.2).

Locality 6. Whitehouse foreshore (centre) Upper Whitehouse Group–Myoch Formation, deep water facies faunas, sandstone dykes, conjugate faulting (Figure 28.1)a, (Figure 30.2).

There are two formations in the Upper Whitehouse Group–the Myoch Formation and the Mill Formation. The former is distinctive and consists largely of red and green silty mudstones. There is a sandstone unit near the base but this is only locally seen to the SW at low water mark because of the reverse faulting mentioned above (Locality 5). In the middle sector of the foreshore the lowest beds of the Myoch Formation consists of greenish silty mudstones followed by reddish and greenish banded beds, these in turn being followed by dominantly reddish beds. It is from the upper part of the latter unit that, with patience, a substantial and strange fauna can be extracted. The fauna consists largely of trilobites and constitutes what is known as the cyclopygid biofacies. Although there are benthic elements, much of the fauna was pelagic. Typical, blind, benthic elements are *Dionide* and the trinucleids Novaspis and Nankinolithus. Pelagic elements include the all-seeing cyclopygids *Cyclopyge*, *Symphyops*, *Degamella* (two species), *Novakella*, *Microparia*, *Psilacella* and Ellipsotaphr us together with *Telephina*, *Bohemilla* and the eyeless *Raphiophorus* and a host of others, some rare (Figure 30.7). This indigenous fauna represents an Ordovician deep water assemblage and is known from a variety of levels throughout the Ordovician. It is most typical of southern Britain, central Europe and Asia. Here, at Girvan, it is found on the subtropical fringes of the North American palaeocontinent of Laurentia and reflects the widespread distribution of deep sea, colder water and ocean-going faunas. Brachiopods are relatively rare and are tiny. They also constitute a peculiar assemblage–the so-called *Foliomena* Community, believed to be the deepest water brachiopod association. For the dark, deep sea bed to accommodate benthic elements calls for the water to have been oxygenated and this is reflected in the colour of the beds — largely due to iron oxide. It is believed that these reddish silts tones of the Myoch Formation comprise the overbank 'fines' of submarine channels building up a deep water fan deriving from the west or NW perhaps near the lower ends of submarine canyons. The age is at about the boundary between the Caradoc and the Ashgill Series.

Other features which can be observed in these beds locally on the Whitehouse foreshore include sandstone dykes–sand which has been winnowed by bottom currents into deep fissures in partly consolidated sediment–an indication of submarine disturbances.

Another notable feature of much of the central tract of the Whitehouse foreshore is the conjugate (brittle fracture) faulting displayed there. Approximately N–S faults usually have sinistral displacements, whereas E–W ones are dextral. There is a substantial vertical component in all of them which can be calculated with some precision locally, particularly where the near vertical beds are also affected by the somewhat earlier thrusting. Nevertheless, this phase of faulting reflects the final brittle displacements of the beds after the formation of the Byne Hill monocline in late Silurian times, the whole tract having been pushed towards the NW. Although locally both sinistral and dextral faults can be seen together (Figure 30.2), it is more usual to find one or other set predominating.

Locality 7. Whitehouse shore (centre–small sea stacks)

Upper Whitehouse Group–Mill Formation, stratigraphical gap due to mass sediment movement, slumping, channelling, transported deep water facies faunas, graptolites (Figure 28.1)a, (Figure 30.2).

The junction between the Myoch and Mill Formations is very sharp and detailed comparisons with the succession nearer Girvan at Myoch Bay suggest that part of the succession is missing here. The nature of the junction is best seen in a rock pool between the first and second of three small sea stacks situated at about the middle of the Whitehouse Shore. Here, profound mixing of partly consolidated sediment testifies to the large scale movement of substantial tracts of sediment perhaps under the influence of contemporaneous earthquake shocks.

The Mill Formation on the Whitehouse Shore is divisible into two members–a lower laminated and largely shaley unit and an upper unit dominated by sandstones and siltstones. Both members are best seen on and around the three small sea stacks mentioned above. The lower member of grey and green banded silty shales yields graptolites indicative of the low Ashgill *Dicellograptus complanatus* Biozone (Williams 1987)(see also (Figure 32.4)). Some thin seams contain a cyclopygid biofacies trilobite fauna very similar to the one already referred to in the Myoch Formation (Locality 6) but this time the remains have been transported. Some new forms appear, not known from earlier beds, such as *Dindymene* and *Aethidionide*, the latter only otherwise known from China! It is from this unit that the famous Gray Collection of Upper Whitehouse fossils, now housed in the Natural History Museum, was obtained. The upper, sandy member also yields occasional fossils but is best examined for its cross-bedded sandstone units consisting of comminuted shelly debris (westerly derivation) and its slumped beds, seen best on the seaward side of the middle small stack. At this locality the Upper Whitehouse Group terminates with a thick channel-fill sandstone bed seen just beyond the stacks at about low water mark. Above it is a widespread bed of unfossiliferous, leaden-grey mudstone about a metre or so thick which forms the basal bed of the overlying Shalloch Formation.

Locality 8. Whitehouse shore (centre to north)

Shalloch Formation, graptolites, Tertiary dykes (Figure 28.1)a, (Figure 30.2).

Dextral faulting trending roughly E–W is responsible for the progressive 'stepping back' of the Shalloch Formation adjacent to the layby on the Whitehouse Shore and this formation then occupies the rest of the foreshore and round into the next bay to the NE–Port Cardloch (Locality 9). The formation is a sandstone flysch sequence consisting of rapidly alternating, fairly thick beds of sandstone and shale. Fossils are few (the old name for the formation was the 'Barren Flagstones') but graptolites from a thin fine-grained detrital carbonate rock about nine metres from the base again indicate the *D. complanatus* Biozone (see (Figure 32.4)). Substantially higher up the succession the mid Ashgill *D. anceps* Biozone has been recognised (Toghill 1970). Other, rare detrital carbonates have yielded shelly debris typical of the lower–middle Ashgill.

Adjacent to the Whitehouse shore layby, one of several dolerite dykes which cross the foreshore can be examined. The form of this particular one is complex and the multiple branches of it have enclosed tracts of Upper Whitehouse and Shalloch strata. The beds show evidence of baking. The age of the dykes is Tertiary and they constitute part of the Arran swarm.

Locality 9. Port Cardloch [NX 167 949]

Whitehouse Group (Figure 28.1)a, (Figure 30.3).

Parking is available by the gatehouse. In this bay at the north-eastern end of the Whitehouse Shore, the Upper Whitehouse Group makes an appearance again and is typically developed but the near basal sandy beds are much better seen than on the Whitehouse Shore, the large thrust fault having 'moved somewhat inland' at this locality (Figure 28.1)a. These thick beds of sandstone, very obviously faulted sinistrally near the road, opposite the gatehouse, are locally cross-bedded and contain frequent shale clasts. They represent migrating channel fill sands at or near the initiation of construction of the deep water submarine fan which dominates the Myoch Formation of the Upper Whitehouse Group.

Locality 10. Woodland Point

Shalloch Formation, Silurian Formations with deep submarine channelling at the base (Figure 28.1)a, b, (Figure 30.4).

A short walk along the foreshore northwards from Port Cardloch leads to the promontory known as Woodland Point. Initially, on its south side, exposures of the Upper Whitehouse Group are poor and variable, depending on the migrating beach sand cover, but seawards a substantial and much faulted Shalloch Formation sequence dominates the foreshore. This deep water flysch-type succession can be correlated, bed for bed, with the Whitehouse Shore exposures (Locality 8). On Woodland Point itself, rocks of different type and age are encountered but a low tide here is essential for seeing the successional details and relationships. The latter can best be worked out on the southern side of the Point where the regularly bedded sandstones and shales of the early mid Ashgill Shalloch Formation are overlain unconformably by calcareous sandstones (locally coarse) of the basal Woodland Formation. These contain pentamerid brachiopods and are of Early Silurian (Early Llandovery) age. The unconformity is angular (about 8°) and overstep is towards the south. This unconformity is not believed to represent a period of uplift and subaerial erosion but a time of deep Silurian submarine channelling into Ordovician fault blocks (Figure 30.5). This is partly reflected by the extreme variability of the Lower Silurian rocks over short distances (Locality 12).A substantial part of the Ashgill Series is missing here as compared with the succession seen in the Craighead Inlier (Excursion 31).

Seawards, the calcareous sandstones become increasingly muddy, with bands of purer carbonate rock, and the fossils more frequent (*Pentamerus*, *Stricklandia*, *Leptaena*), with some of the brachiopods in their original growth positions. Above these, and just before the rocky headland, thinly bedded shales at the top of the Woodland Formation are seen in places beneath the beach sand. The shales exhibit evidence of slumping and contain Lower Llandovery graptolites (*Monograptus typhus* Biozone)(see also (Figure 32.8)).

The rocky headland consists entirely of coarse clastic rocks constituting the Lower Llandovery Scart [=Saugh Hill] Formation. This largely conglomeratic unit contains, besides the usual igneous clasts and shale flakes, a particularly high proportion of quartz pebbles. The deposit is believed to have accumulated rapidly on a subsiding sea floor and overall the entire Llandovery succession here is of a cyclical nature, beginning with moderately shallow water sands progressing to slumped graptolitic shales, followed by the even deeper water Scart elastics–a situation reminiscent of parts of the underlying Ordovician sequence. This indicates that the proximal fore-arc regime which began in the Girvan area in Late Llanvirn times continued into the Silurian some 30 million years later.

Locality 11. Black Neuk to Myoch Bridge area

Shalloch Formation, Lower Whitehouse Group–Penwhapple Formation, graptolites, Upper Whitehouse Group–Myoch and Mill Formations (full development), graptolites, trilobites, channel fills, mud clast conglomerates, evidence of mass sediment transport from shallow into deep water (Figure 28.1) b, (Figure 30.4), (Figure 30.6).

Parking is available by pulling off the road, immediately before the field, a short distance to the north of Myoch Bridge [NX 179 958] .

A walk from the north side of Woodland Point along the rocky foreshore known as Black Neuk takes one down the succession again over typical Shalloch Formation flysch facies. A striking lithological change as one approaches the bay is indicative of the top of the Upper Whitehouse Group (Mill Formation). The succession abruptly becomes shaley and the 1 mthick leaden grey mudstone at the base of the Shalloch Formation is well-exposed but here there is no channel-fill sandstone beneath it. Instead, a thick greenish grey shale unit, sparsely fossiliferous (largely graptolites) forms the topmost unit of the Mill Formation — thicker and much more shaley here than on the Whitehouse Shore (Locality 6). The lower units of the Upper Whitehouse Group (Myoch Formation) are only sporadically exposed below the curve of the main road.

The largely sandy beach between Black Neuk and the rocky foreshore of the Myoch Bridge area (c. 0.5 km to the NE) conceals some faulting, for the exposures near the bridge incorporate both Lower and Upper Whitehouse Group sediments. A large isolated outcrop sticking up though the lower beach is entirely Shalloch Formation.

The Lower Whitehouse Group, although severely deformed, is dominantly shaley and constitutes part of the Penwhapple Formation at the summit of the Group. In Myoch Burn, a short distance upstream from the road, dark shales with occasional sandstones yield graptolites indicative of the *Pleurograptus linearis* Biozone—a zone which crosses the Caradoc-Ashgill boundary. Here part of the lower, Caradoc, portion of the zone is represented.

The geology of the Myoch Foreshore is extremely complex both successionally and structurally (Figure 30.6) but the area is significant in exposing the most complete Upper Whitehouse sequence known and rock units are preserved here which have no equivalents on the Whitehouse Shore owing to the contemporaneous mass sediment transport there (Locality 6). A full Myoch Formation succession is exposed, beginning with the basal sandstones and mudstone-matrix conglomerates, seen near the bridge, passing up into the typical greenish and reddish silty mudstones containing fossils of the deep water cyclopygid biofacies, as elsewhere (e.g. Localities 11D, E, F and J). However the succession nearest the road differs from that in the central part of the Whitehouse Shore in that the reddish mudstone contains a substantial sandstone/shale channel fill unit disposed in a plunging syncline (Figure 30.6) with the reddish beds reappearing in the core. The seaward side of this syncline is truncated by a thrust belt beyond which a typical Myoch Formation sequence contains no such unit, reflecting its extremely localised occurrence.

Above the Myoch Formation, only the uppermost shale member of the Mill Formation has an equivalent on the Whitehouse shore where it rests abruptly on the red mudstones (Locality 6). Important members within the Mill Formation of the Myoch Foreshore are the thin graptolitic shale near the base and the mudstone conglomerate some metres higher in the succession. The former, much affected by strike faulting, yields abundant graptolites at several levels (Localities 11A, B and G). *Dicellograptus complanatus*, *D. gravis* and *Orthograptus* of the *calcaratus* species group are common. The fauna is considered to represent a level close to the boundary between the *Pleurograptus linearis* and *Dicellograptus complanatus* biozones (Williams 1987). As lowest Ashgill strata in Scandinavia are known to correlate with the highest part of the *Pleurograptus linearis* biozone and, inland at Girvan (Penwhapple Burn), an horizon within the Myoch Formation has yielded highest Caradoc trilobites of Scandinavian aspect, the Caradoc–Ashgill boundary must lie within the upper part of the reddish silty mudstones of the Myoch Formation, i.e., within the upper part of the *Pleurograptus linearis* Biozone.

The aforementioned muds tone conglomerate member of the Upper Whitehouse Group is well exposed on the Myoch foreshore (Figure 30.6) and is a most interesting deposit. Where it first appears, not far from the sea wall (Locality 11C), it is less than 1 mthick but as it is traced across the foreshore (across several faults and thrusts) it expands in thickness considerably and yet is not present in the succession as seen across the bay to the south at Black Neuk. It is evidently a channel fill deposit and consists for the most part of a grey calcareous mudstone matrix containing a wide variety of clasts. Most of the latter are of deformed grey and green mudstone or siltstone flakes which were evidently ripped up from the local sea floor as this mass slide deposit was emplaced in the deep water environment indicated by much of the Upper Whitehouse succession. There are also limestone clasts and occasional igneous pebbles transported, like the matrix, from a much shallower, platformal, situation. Only one small group of igneous pebbles is known ((Figure 30.6), Locality 11C). Please do not remove them. The overall lithology of this unit can be seen best in a small embayment about half-way along its main outcrop near low water (Locality 11K). The fauna available from the matrix reflects the platformal origin and consists of a diverse assemblage of trilobites, brachiopods and gastropods. Of the former, the trinucleid *Tretaspis* cf. *hadelandica convergens* is particularly significant, for it first appears elsewhere (northern England, Wales) at the beginning of the Ashgill Series (Pusgillian Stage) as does its associate, the brachiopod *Skenidioides greenoughi*. The brachiopods *Onniella* and *Orthambonites* are also common, the whole assemblage reflecting the much more cosmopolitan nature of the outer neritic faunas at this level than hitherto, but one trilobite, the trinucleid *Cryptolithus lotus lotus*, is a North American form and its presence reflects the continuing Laurentian influence. It is known particularly from Locality 11H. In the British Isles this trilobite is only otherwise known from Pomeroy in Northern Ireland.

Above the mud clast conglomerate member of the Mill Formation there follows some 16 m of predominantly greyish green silty shale with occasional graptolites (*Dicellograptus complanatus* Biozone), equivalent in part to the thinner shaley and sandy sequence forming the summit of the Upper Whitehouse Group on the small sea stacks in the central tract of the Whitehouse foreshore (Locality 7). Comparison shows that a substantial part of the Mill Formation present on the Myoch foreshore is not represented at the latter locality. Thus the Upper Whitehouse succession of the Myoch tract is the most complete one known.

Following the terminal shaley unit of the Upper Whitehouse Group the c.1 m thick leaden grey mudstone at the base of the Shalloch Formation is well displayed in the deep, curved gully scoured out by the sea (Locality 11 L). Beyond this, a low rocky platform of typical and rather faulted Shalloch Formation is seen before sand cover obliterates most of the succession, apart from the large, low, rocky tract a short distance to the north.

Locality 12. Craigskelly area [NX 180 961] , adjacent to Ainslie Manor Nursing Home (site of former Haven Hotel)

Shalloch Formation, Lower Silurian succession, channel fill Craigskelly Conglomerate, Woodland Formation, shelly fossils, graptolites, Scart Formation, rapid substrate loading and deformation (Figure 28.1)b, (Figure 30.8).

Parking is available, with toilet facilities, in the large car park a short distance to the north on the outskirts of Girvan.

The largely sandy foreshore between the Myoch outcrops and the Craigskelly area certainly conceals the thickest development of the low Ashgill Shalloch Formation in the whole Girvan foreshore tract. It also conceals a section of the major sinistral fault traceable from the upper reaches of Ardmillan Burn which crosses the foreshore a short distance to the south of Myoch Bridge and again in the Craigskelly area.

The large, rocky bluff projecting through the beach is Craigskelly itself which, together with the much lower, but extensive Horse Rock to the landward side, are composed of the Craigskelly Conglomerate Formation of Lower Llandovery age. The two outcrops are substantially offset and help define the position of the Ardmillan Burn Fault mentioned above. On the Horse Rock outcrops the conglomerate is seen to rest with a small angular unconformity on the underlying sandstone/shale sequence of the Shalloch Formation. Many other small faults can be traced but the relationship is clear. The Craigskelly Formation is some 40 m thick, consists largely of acid igneous clasts derived from a volcanic/plutonic arc no great distance to the north, together with debris from the Ballantrae Volcanic Complex and younger Ordovician sediments. It is therefore not unlike many of the conglomerates in the Middle to Upper Ordovician part of the Girvan sequence and probably reflects a similar proximal fore-arc fault-controlled origin. It is very limited in its distribution for it is not present at the base of the Silurian sequence at Woodland Point across the bay to the SW. In fact the last vestige of it can be seen (by boat) on the landward of the two small islands (Scart Rocks) to the north of Woodland Point (see (Figure 30.4)). It is evidently disposed in the form of a broad channel fill which has scoured down deeply into the underlying tilted Ordovician rocks (see also (Figure 30.5)).

To the north, above the Craigskelly Conglomerate of the Horse Rock, the Woodland Formation is seen as at Woodland Point but the lower beds are not well exposed, being best seen in small outcrops jutting through the sand between the Horse Rock and the Cow Rock. These beds are rather more calcareous here than on Woodland Point and contain corals and trilobites as well as the usual brachiopods.

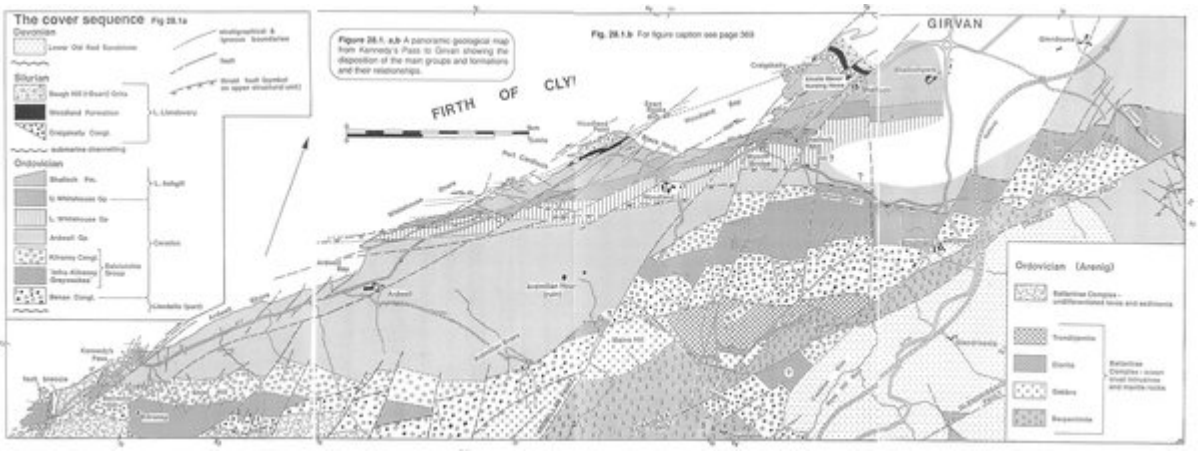
The upper, shaley part of the Woodland Formation is next seen on the southern flanks of the Cow Rock and adjacent faulted exposures but graptolites are rare. The beds are strongly folded and abruptly truncated above by the next clastic unit, the so-called Quartz Conglomerate. Again, this is another very local deposit at the base of the Scart [=Saugh Hill] Formation. It is a distinctive unit, consisting largely of small clasts of vein quartz and some shale flakes set in a sandy matrix. Examination of the available sections which are extensive, particularly at low tide, reveals that this conglomerate has locally injected the underlying shale unit and in places has peeled off substantial slabs of the shale which must have been only partly lithified at the time. The folding pattern in the underlying shale in which the folds fan out over the extent of the available outcrops indicates that they too are directly related to the abrupt deposition of the Quartz Conglomerate. This relationship again indicates an extremely active environment of deposition in which contemporaneous faulting, not far to the north, was triggering mass debris flows which then locally disrupted the not yet fully consolidated substrate.

At low tide on the seaward exposures of the shale /Quartz Conglomerate outcrop extensive exposures of a Tertiary dolerite dyke with chilled margins can be seen.

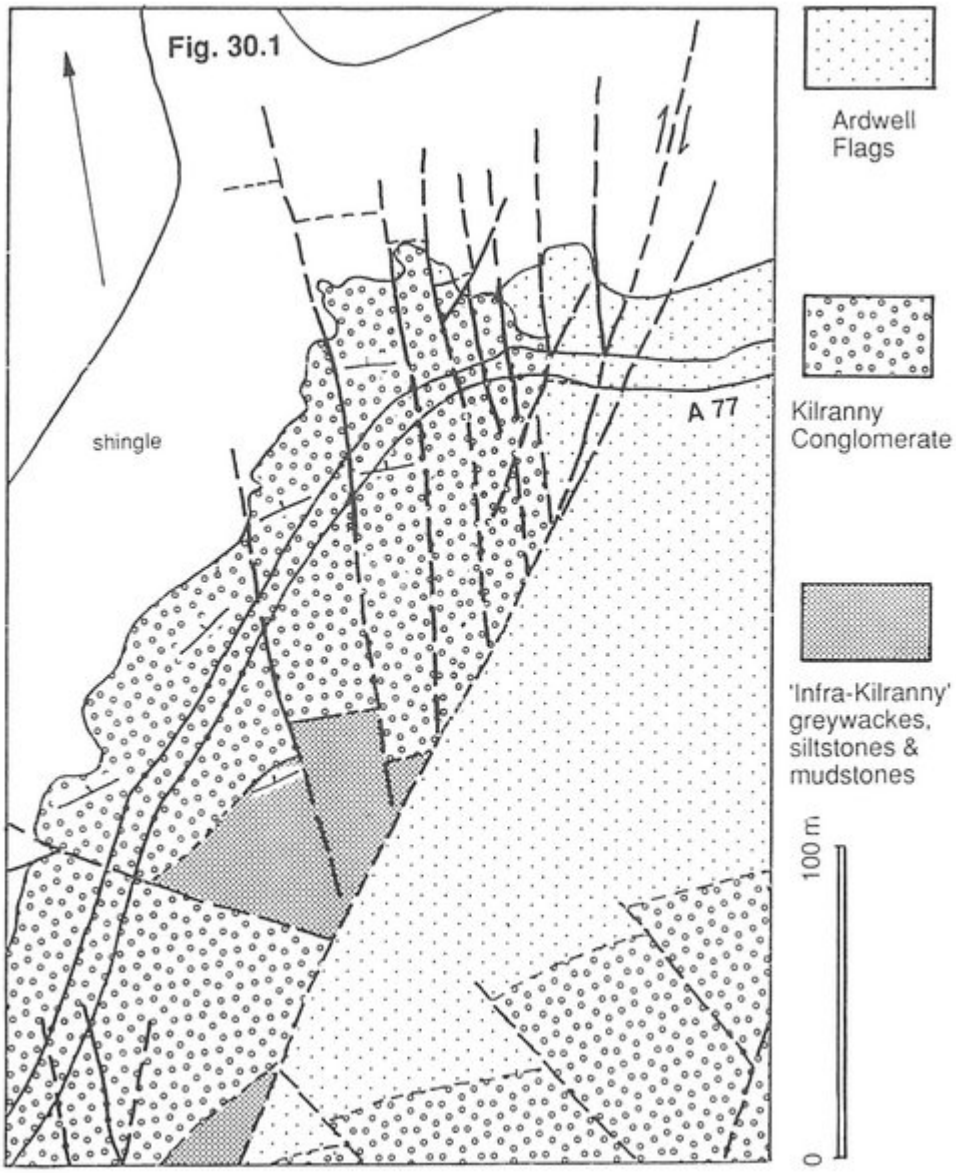
A short distance to the north of the Cow Rock, the last few exposures of typical Scart Formation (as at Woodland Point) project through the sand at the beginning of the expanse of Girvan town Beach.

References

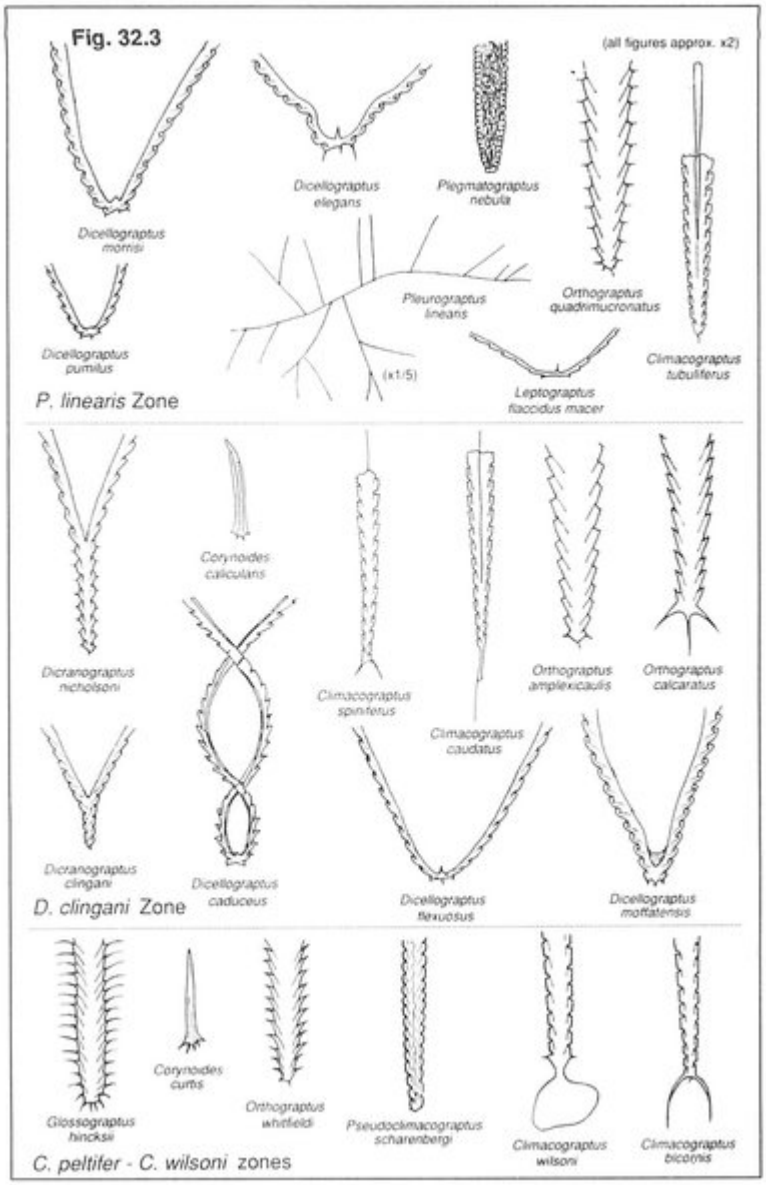
[References for excursion 25–31]



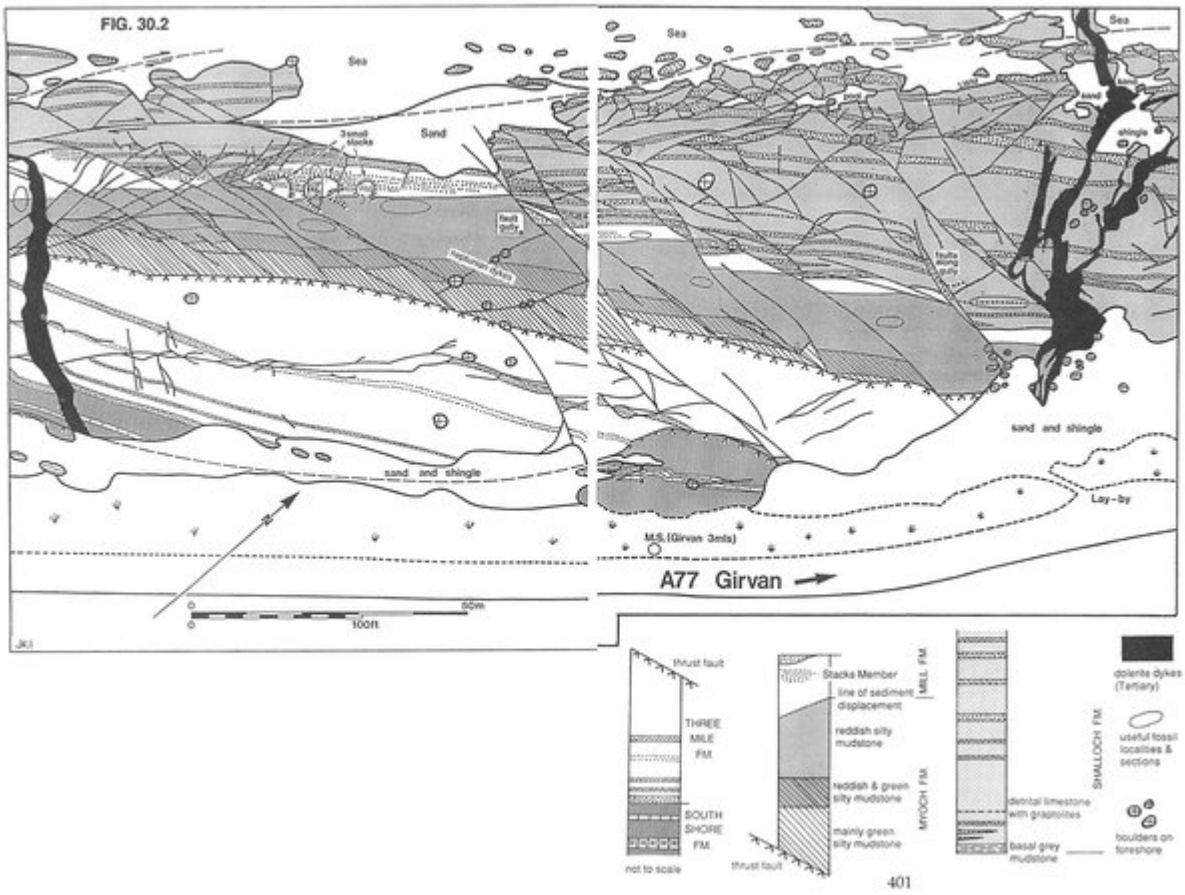
(Figure 28.1) a,b A panoramic geological map from Kennedy's Pass to Girvan showing the disposition of the main groups and formations and their re lationships.



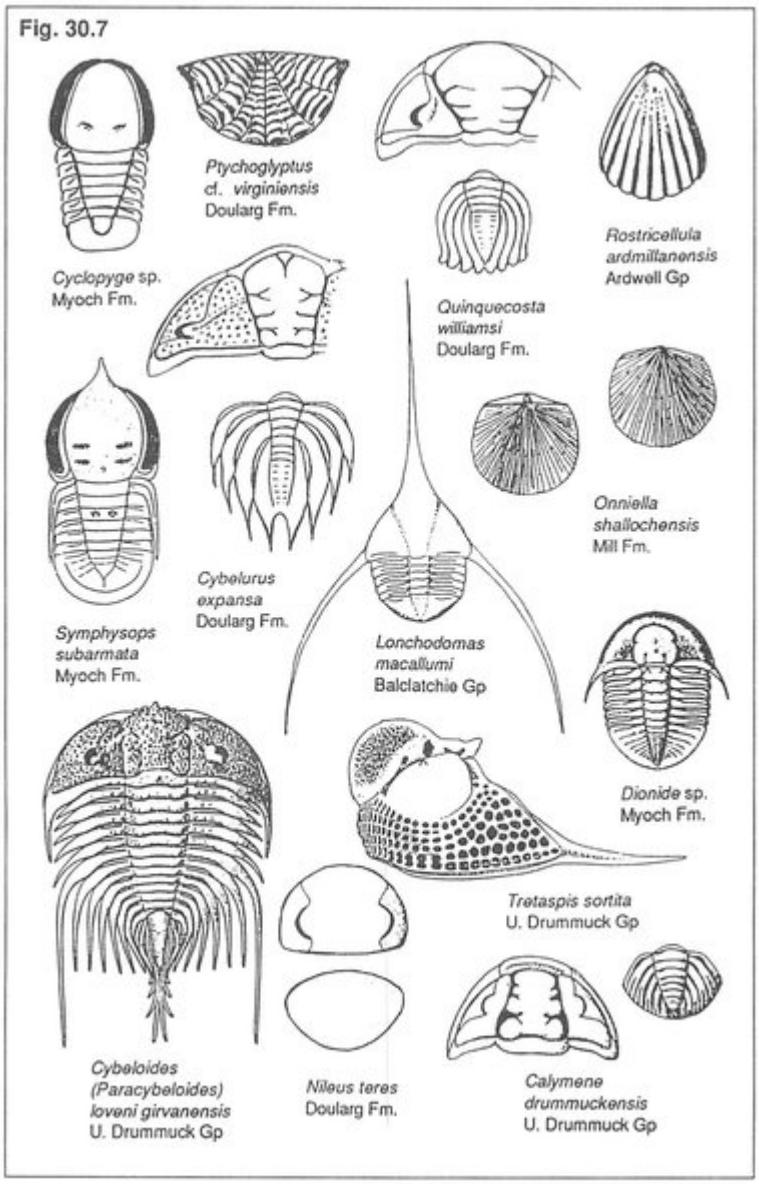
(Figure 30.1) Detailed geological map of the area around Kennedy's Pass.



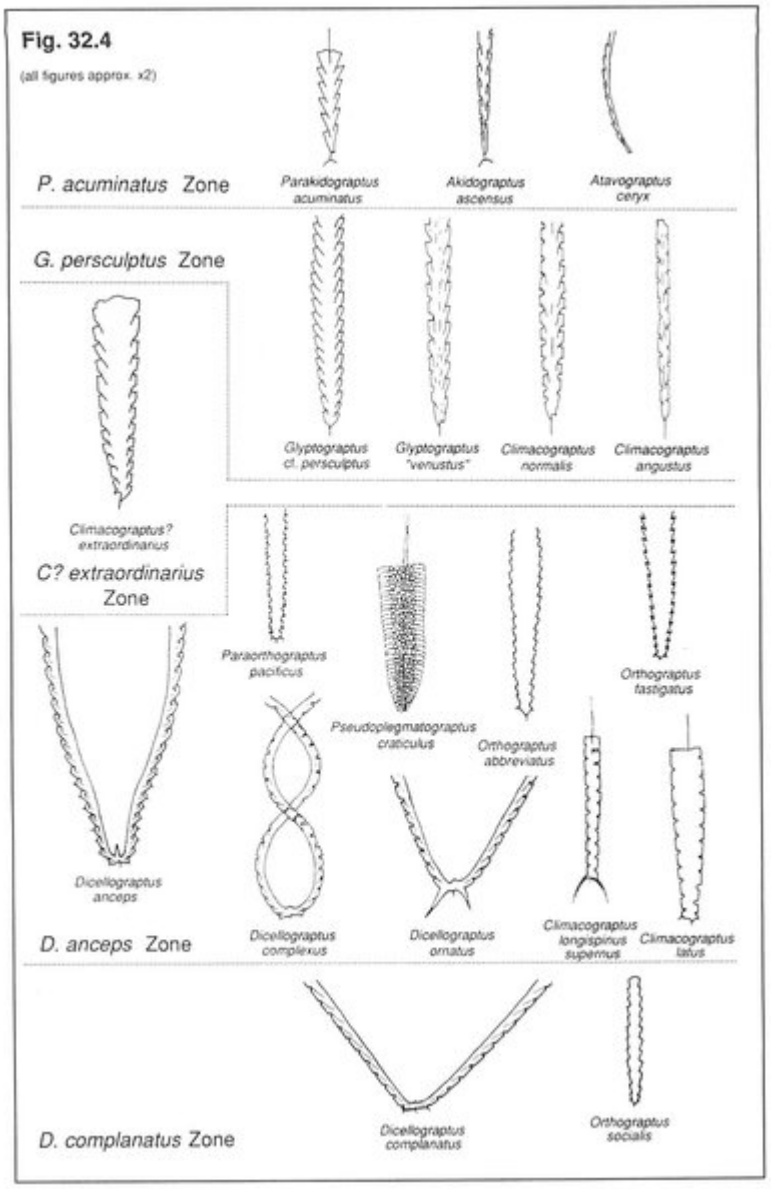
(Figure 32.3) Schematic figures illustrating some of the characteristic Upper Ordovician graptolites found at Dob's Linn.



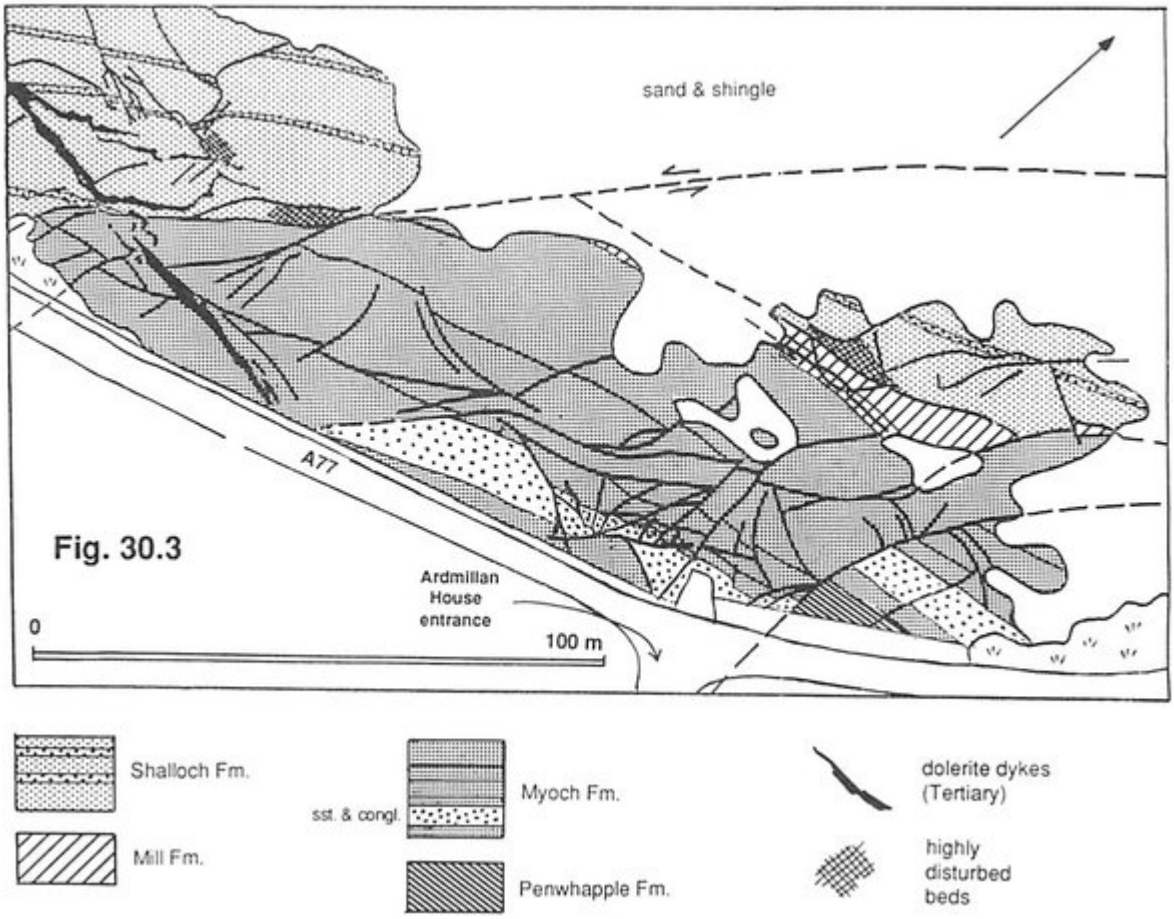
(Figure 30.2) Detailed geological map of the central part of the Whitehouse Shore.



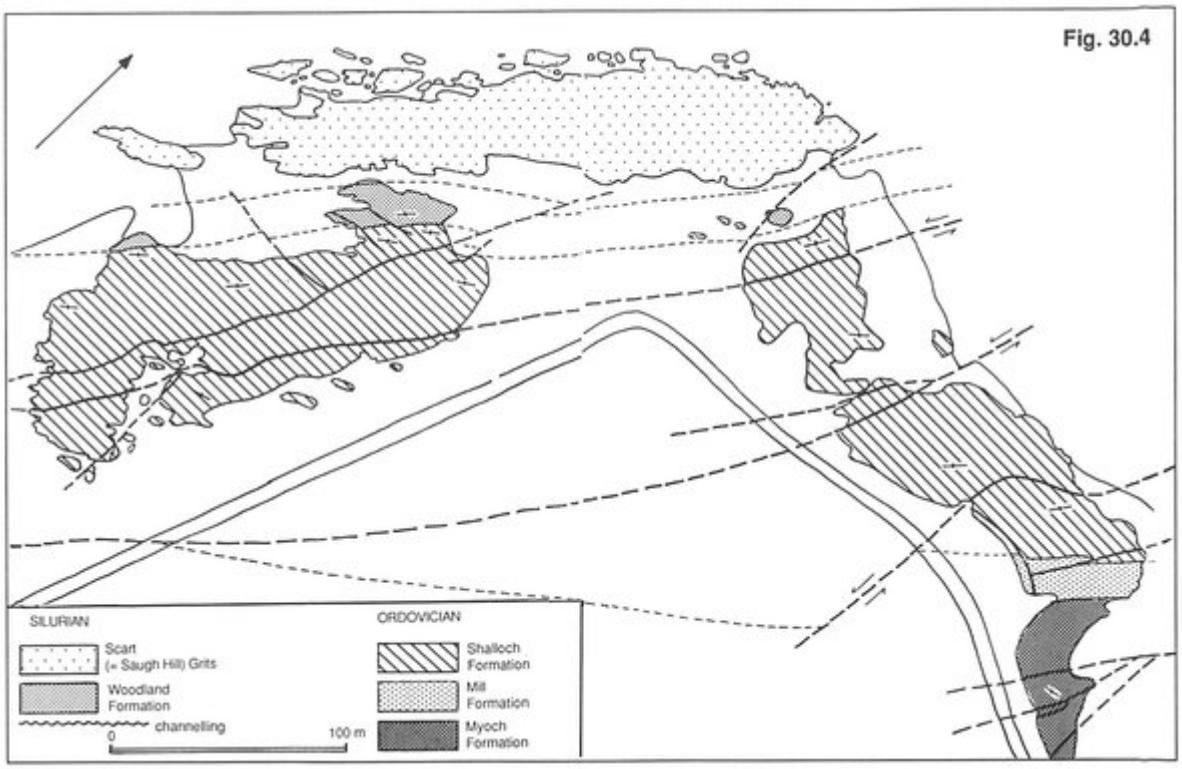
(Figure 30.7) A selection of trilobites and brachiopods from various horizons in the Ordovician strata of the Girvan district.



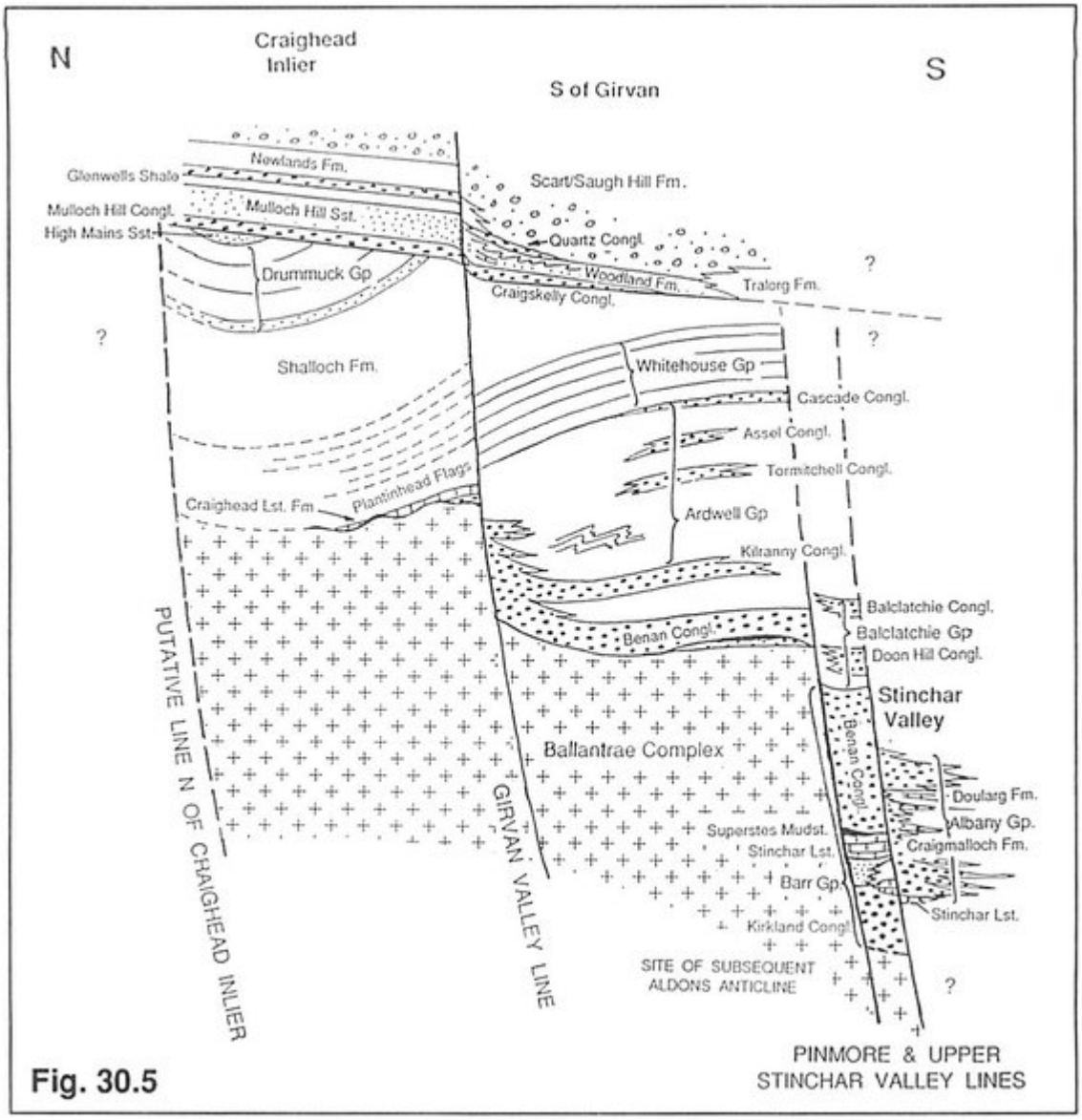
(Figure 32.4) Schematic figures illustrating some of the characteristic Upper Ordovician and Lower Silurian graptolites found at Dob's Linn.



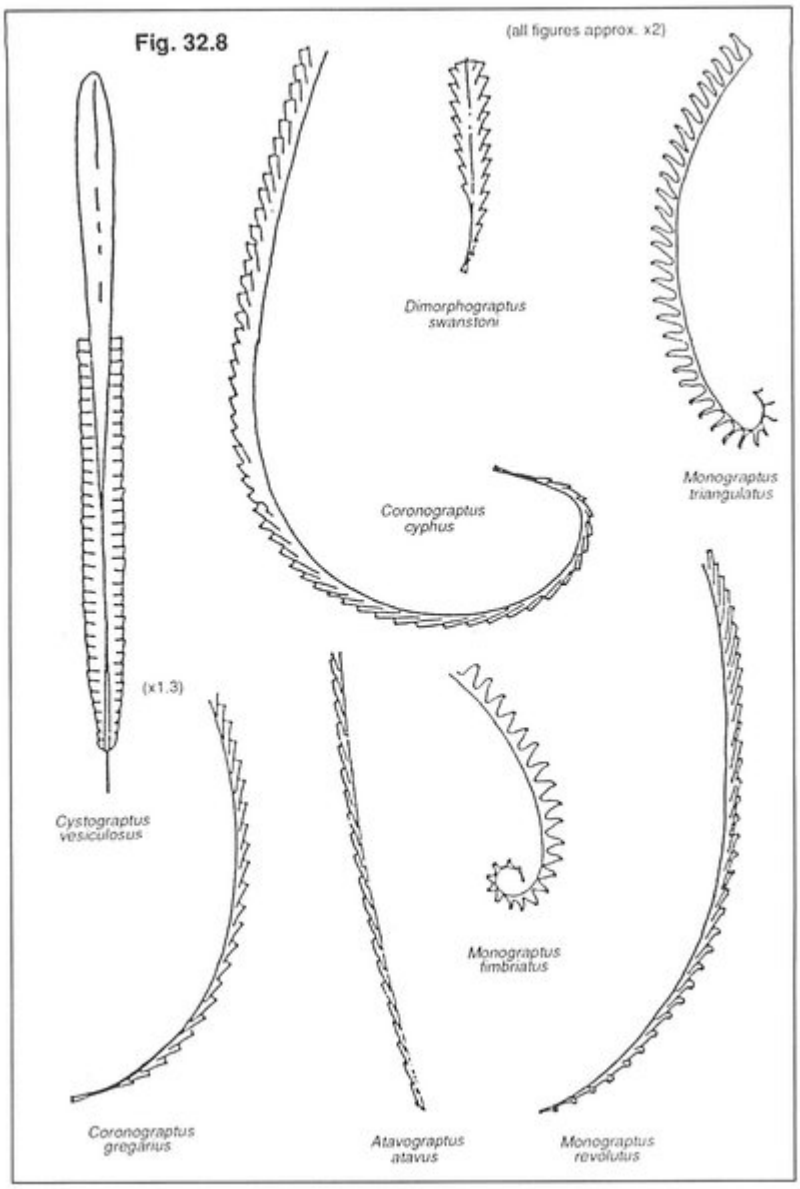
(Figure 30.3) Detailed geological map of the foreshore at Port Cardloch.



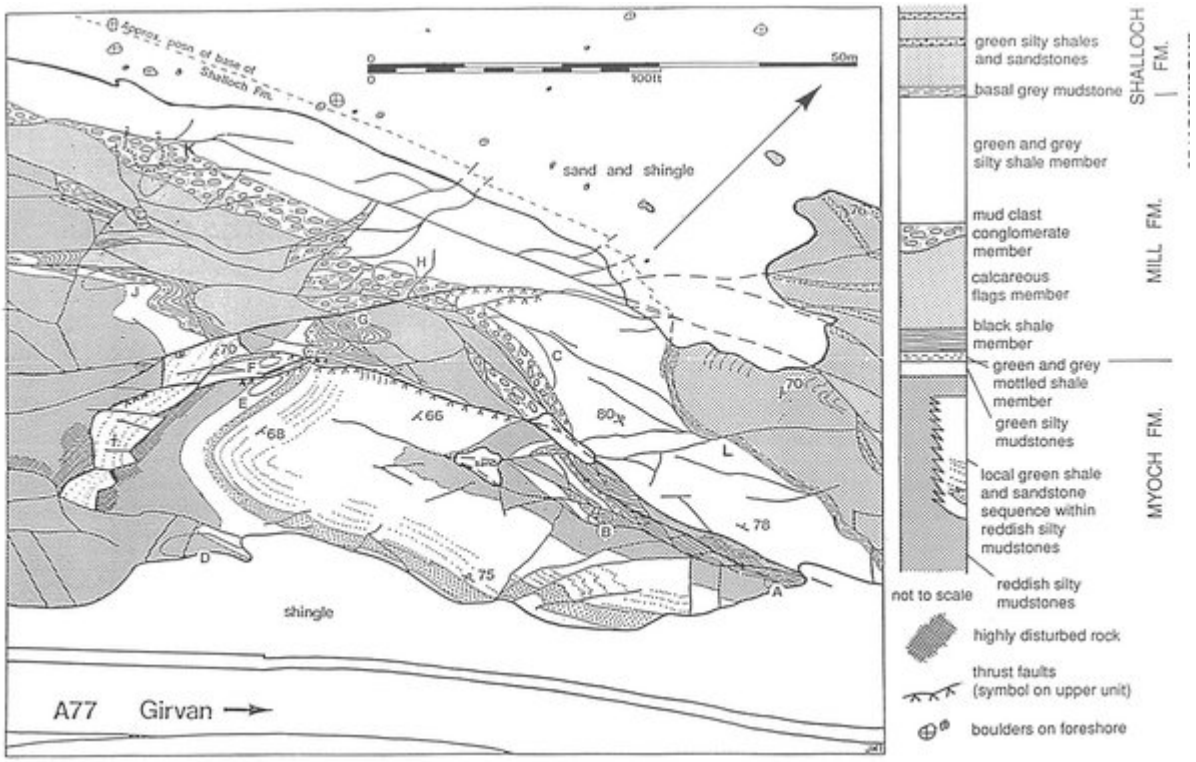
(Figure 30.4) Simplified geological map of Woodland Point.



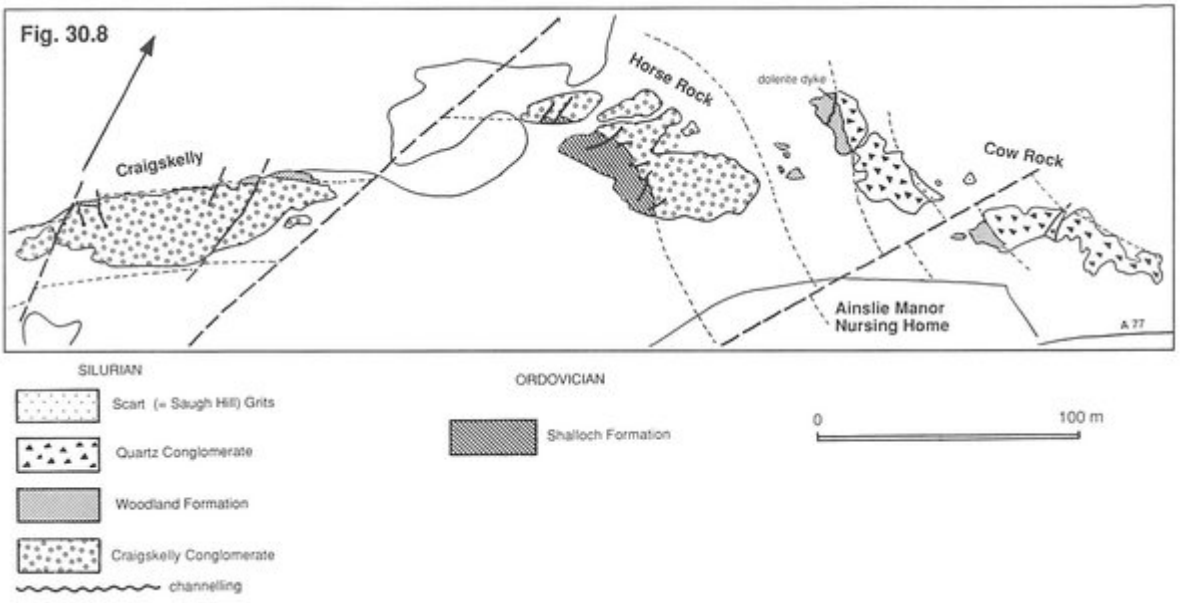
(Figure 30.5) Stratigraphical sketch section, illustrating the nature of the sub-Silurian unconformity in the Girvan district, which is believed to reflect submarine channelling across pre-Silurian fault blocks: basement faulting has not only controlled Ordovician sedimentation but the effects continue into the Silurian.



(Figure 32.8) Illustrations of some characterisitic Lower Silurian graptolites found at Dob's Linn (adapted from Webb et al. in press).



(Figure 30.6) Detailed geological map of part of the foreshore at Myoch Bay (Shalloch Mill)



(Figure 30.8) Detailed map of the geology around Craigskelly: the strata are almost vertical so that outcrop widths reflect thicknesses.