
Biggar

Authors: E.N.K. Clarkson, D.A.T. Harper, A.W. Owen and C.M. Taylor

O.S. 1:50000 Sheet 72 Upper Clyde Valley

B.G.S. 1:50000 Sheet 24W Biggar (Kilbucho)

B.G.S. 1:50000 Sheet 15E Leadhills (Wandel Water)

Route: (Figure 46), (Figure 47) and (Figure 48).

Introduction

The main aim of these two excursions south of Biggar is to examine anomalous occurrences of highly fossiliferous conglomerates and mudstones within the deep-water Ordovician sequence of spilites, cherts, shales and greywackes in the Northern Belt of the Southern Uplands. All the evidence suggests that these fossil-bearing rocks were originally deposited in a variety of shelf and upper slope locations, but moved downslope into a deep sedimentary basin (possibly an ocean trench) as debris flows. The two main localities, at Kilbucho and at Wallace's Cast in the Wandel Water valley, were described, along with others, by Peach & Horne (1899). They are some 12 km apart but probably belong to the same horizon since they present remarkably similar lithologies and faunas and lie along a common NE–SW regional strike, together with geographically intermediate, though poorer exposures at Key Gill [NT 012 300] and Nisbet Burn [NT 043 319]. Ritchie & Eckford (1936) confirmed other records of similar beds 16 km WSW of Wallace's Cast at Duntercleuch [NS 834 154] and Snar (not relocated) near Wanlockhead, and believed that all these beds belong to the same stratigraphical level. In their view the fossiliferous conglomerates and shales (which they referred to as the Kilbucho–Duntercleuch Calcareous Conglomerates) lie some distance below the well-known Haggis Grits (probably a proximal turbidite), exposed in a chain of exposures close to the Southern Upland Fault between Leadburn and Crawfordjohn. This supposed stratigraphical relationship can no longer be sustained since the two are separated by strike faults and are included in different lithostratigraphic formations. The Calcareous Conglomerates form part of the Caradocian Kirkcolm Formation whereas the Haggis Grits lie within the slightly older Marchburn Formation. The occurrence of a very similar conglomerate at both Kilbucho and at Wallace's Cast, with associated cleaved fossiliferous mudstones carrying a virtually identical fauna, is particularly striking, in view of the 12 km geographical separation of the two localities. The faunas are indicative of a shallow water environment but the surrounding facies is clearly deep water. It is possible therefore that the rocks exposed belong to a single enormous submarine debris flow. Alternatively the various exposures might represent smaller-scale but not necessarily exactly contemporaneous submarine flows from the same source. Many of the fossils in the mudstones are cracked and crazed, possibly suggestive of long-distance transportation in a mud flow, and although the same effect might have been produced tectonically or diagenetically a dominant role for such processes is less likely. In the conglomerates, on the other hand, the presence of large unabraded shells and lengths of up to about 20 connected crinoid columnals is equally suggestive of either minimal transport, or more probably the floating of clasts in the fine matrix and interstitial fluid of submarine debris flows.

Excursion A. Kilbucho (Route: (Figure 46))

The excursion starts from Biggar on the A702 Edinburgh–Abington road. Take the minor road southwards past Hartree Mill and Knowehead and, crossing the Southern Upland Fault, ascend the steep hill to Crosscryne. Descend east past Howslack and Goseland near the entrance to the abandoned farm of Mitchelhill to examine two quarries on the north side of the road.

1. Roadside Quarries: cherts and lavas

The more westerly quarry [NT 072 343], very poorly exposed, shows black and red cherts, probably of deep-water origin, in association with weathered lavas. The larger quarry on the roadside 50 m east displays pillow lavas resulting from submarine extrusion. Some of the pillows are well formed, though the associated lava beds are sheared and deeply weathered. This lithological association forms the base of the Moffat Shale Group which underlies the greywacke-dominated formations.

2. Mitchelhill Farm: greywacke and chert quarries

After seeking permission from the landowner at Kilbucho Place [NT 095 392], take the farm track to Mitchelhill [NT 068 339] abandoned in 1962, where vehicles may be left. Pass through the iron gate at the north-east corner of the farmyard and take the left fork on the rough track leading north and curving round the northern face of White Hill. 100 m from the farm are several greywacke quarries on both sides of the track, some of which are new. The largest of these exposes 8 m of Kirkcolm Formation thickly-bedded quartzo-feldspathic greywacke and thin shales dipping at about 80° to the NW. Finer bands within the sequence exposed in several of the quarries show this to be a consistent orientation. The most northwesterly of the quarries exposes a nodular, pale grey chert horizon in which wavy laminations run through clots of opaque silica. In thin section this chert displays relatively well-preserved and abundant radiolarians.

3. Mitchelhill Rings: enclosure, viewpoint

Ascend the north-eastern slope of White Hill to the rocky spur upon which stands the fine Iron-Age fort of Mitchelhill Rings [NT 063 342]. This is now represented by two deep circular ditches enclosing a round central space 36 m by 33 m, which may once have contained small circular houses. A palisaded enclosure, the largest known in Scotland (80 m by 120 m) is found on the summit of White Hill. (Royal Commission on the Ancient and Historical Monuments of Scotland, Peebleshire, 1967).

From the hillside above Mitchelhill Rings may be seen the whole length of the deep valley lying to the south, along which runs a major strike fault, forming the southern boundary of the Kirkcolm Formation. The valley is dominated by the mass of Culter Fell (761 m), the highest point in this part of Southern Scotland, formed from greywackes of the succeeding Portpatrick Formation. From the valley the Kilbucho Burn flows eastwards, and the Crannie Burn westwards, so that the valley forms a watershed open at both ends. Three prominent river terraces are clearly seen from this viewpoint. On the lowest of these is the ruined 13th century church of St Bega, abandoned in 1810. The 18th century manse is still inhabited. These terraces were formerly used for cultivation and probably influenced the chosen site for the Iron Age settlement.

4. New Quarry: Kirkcolm Formation

Descend the hill to the southernmost of three quarries [NT 058 336], opened in 1989 to provide roadstone for the farm roads. This quarry shows the order of the succession. Near vertical slightly overturned bedding surfaces in the Kirkcolm Formation greywackes strike approximately E–W. A northward younging direction is here indicated by sole-markings on the bedding planes facing the observer. Since the conglomerates and mudstones seen in the other quarries are located further up the hillside they most probably lie stratigraphically higher. The likely succession is thus greywacke-conglomerate-mudstone, in accordance with a debris flow a few metres thick in which the heavy particles have settled first.

5. East Quarry; Caradoc fossiliferous mudstone

Just above the New Quarry is the easternmost of the two old quarries [NT 058 336], some 20 m across. In the western part of this quarry sandstones are poorly exposed, but the sequence fines to the east to a cleaved mudstone with an abundant shelly fauna. This includes fifteen species of trilobites, dominated by *Calyptaulax brongniartii* (see Clarkson & Tripp 1983) and *Iliaenus* (*Parillaenus*?) sp. There also occur *Stenopareia* aff. *transmota*, *Cybeloides* d. *rugosa*, *Hibbertia* d. *flanganni*, *Remopleurides* sp. *Sphaerocoryphe* sp. and others (Owen & Clarkson 1992). The rich brachiopod fauna (Harper in prep) contains *Orthambonites playfairi*, *Palaeostrophomena kilbuchoensis*, *Isophragma pseudoretroflexum*, *Sowerbyites hibernicus*, *Colaptomena concentrica*, *Christiania perrugata elongata*, and species of *Hesperorthis*,

Glyptorthis, *Dolcrorthis*, *Skenidioides*, *Plaesiomys*, *Scaphorthis*, *Titanambonites*, *Bilobia*, *Sowerbyella*, *Eoplectodonta*, *Cyphomena*, dalmanellids and rhynchonellids. The brachiopod fauna most closely resembles that described by Mitchell (1977) from the mid-Caradoc Bardahessiagh Formation, Pomeroy, Northern Ireland but, like the trilobite fauna, it also shares elements with the broadly coeval Balclatchie and Ardwell formations at Girvan. Branching bryozoans, ostracodes, bivalves, gastropods, nautiloids and crinoids are also abundant, commonly (though not invariably) in a cracked or broken condition. This quarry is also the type locality for the scleractiniomorph coral *Kilbuchophyllia* (Scrutton & Clarkson 1991). This unique discoidal coral, which belongs to an order all of its own, *Kilbuchophyllida*, is the first well-authenticated example of a Palaeozoic scleractiniomorph. It probably represents an early and unsuccessful attempt at skeletal acquisition by the group of sea anemones that ultimately gave rise to true scleractinian corals in the Trias, some 220 million years later.

6. West Quarry: Caradoc conglomerate

This quarry [NT 057 336], some 6 m across, lies 30 m from the eastern one, and slightly higher on the hillside. The exposed rock consists of coarse, unsorted greywacke conglomerate, with angular pebbles, 10 mm or more in diameter, of white quartzite and vein quartz, but with subsidiary clasts of igneous and metamorphic rock, flakes of mica, and fragments of limestone, black chert, and other sedimentary rocks; detrital fossils, brachiopods and lengths of crinoid stem are also present. The conglomerate is matrix-supported, but is unusual in having large clasts over 300 mm long of mudstone, which is commonly highly fossiliferous. The fossils are excellently preserved and, unlike those in the mudstones in the eastern quarry, are undeformed. The mudstone clasts are angular or subangular and were probably partly lithified before their erosion from a pre-existing source and subsequent incorporation in the conglomerate. They have weathered out in places to give the quarry face a carious appearance. A thin, near vertical, band of mudstone at the west end of the quarry has also yielded a few fossils. Fossils in excellent mouldic preservation thus occur here in the West Quarry both within the large mudstone clasts and as individual detrital clasts within the conglomerate and, usually in a distorted state, in the cleaved mudstones within the East Quarry.

7. Crannie Burn: screes

At the south west end of White Hill [NT 052 335], are spectacular screes, the results of erosion by the westward-flowing Crannie Burn. They consist mainly of fine-grained Kirkcolm Formation greywacke, but there are some pebbles of chert. Above the screes two parallel faults traverse the gully west of White Hill and several small exposures on the hillside show greywackes dipping some 65° to the NW.

Excursion B. The Wandel Water

The Wandel Water, which runs WNW into the Clyde, lies in a valley several kilometres long, draining the high ground north-east of Abington. Excellent sections, many of which were referred to by Peach & Horne (1899), expose volcanic and sedimentary rocks of the Northern Belt of the Southern Uplands, including a further development of the shelly mudstones and conglomerates previously encountered at Kilbucho, which lies some 12 km to the north-east. The area is best reached from the A 702 between Abington and Lamington by a road [NS 947 275] 500 m north of the large farm at Wandel. This narrow, initially metalled, road, after passing the Wandel Cottages, becomes a track leading to the Birnock Forestry plantation belonging to the Economic Forestry Group. Cars may be left at the forestry gate some 500 m west of the ruins of Birnock Cottage, which forms a convenient central point for the various locations.

1. Wallace's Cast: fossiliferous mudstones and conglomerates.

The natural erosional feature of Wallace's Cast [NS 967 263] comprises an upstanding ridge (possibly a large landslide) in front of an arcuate, almost semi-circular hollow. The ridge is composed of vertical, thickly-bedded Kirkcolm Formation greywackes interbedded with grey shales striking almost due E–W. The similar coarse greywackes and laminated mudstones of the hillside around the hollow and beside the adjacent burn are also vertical, or nearly so, but have a more NE–SW strike. Some 10 m WNW of the western extremity of Wallace's Cast, the steep bank above the wall exposes a sequence of cleaved mudstones and conglomerates, though the section at present is rather overgrown. Fossils occur

abundantly in the mudstones, in the mudstone clasts and as individual detrital particles in the conglomerate, just as they do at Kilbucho. The faunal list of trilobites, brachiopods, bivalves, and gastropods, is comparable with that at Kilbucho, though there seem to be fewer trilobites, the coral Kilbuchophyllia is rare and branching bryozoans are more abundant.

2. Hawkwood Burn: Glenkiln Shales

At the confluence of the Hawkwood Burn and the Wandel Water [NS 973 259] is an exposure of vertically bedded, dark Glenkiln shales from which Peach & Horne (1899) recorded a rich and diverse fauna of graptolites including *Didymograptus superstes* and *Climacograptus tricornis*. At present the locality does not seem to be especially productive, and better faunas are to be found on new forestry tracks north of the Wandel Water, and in Rein Gill (localities 3 and 4).

3. Forestry Tracks: Glenkiln Shales

North-east from the ruins of Birnock Cottage a prominent new forestry track, roughly parallel with the Wandel Water, exposes Glenkiln Shales [NS 976 258] and greywackes. This may be reached by a small pipe-bridge crossing the Wandel Water 200 m east of Birnock. Although much of the shale currently exposed along the track is sulphurous and shattered, representative Glenkiln graptolites and inarticulate brachiopods may be obtained at several places along the eastern part of the track, wherever the shale is darkest in colour. Passing west along the track the proportion of greywacke increases and no more graptolites are found. The graptolites are in a fair state of preservation, and have been provisionally identified by A.W.A. Rushton (British Geological Survey) as *Dicellograptus exilis*, *Climacograptus antiquus*, *bicornate climacograptids* and *species of Dicranograptus*, *Cryptograptus* and *Orthograptus*.

4. Rein Gill: Glenkiln Shales

Some 10 to 15 m of vertically-bedded, cherty shale are exposed on the eastern bank of Rein Gill [NS 981 259]. The graptolites present here are fairly abundant and are reasonably well-preserved. They represent a typical Glenkiln fauna, like that described for locality 3.

5–12. Upper Hawkwood Burn: Llanvirn Cherts and Hyaloclastites

The uppermost part of Hawkwood Burn [NS 972 248], where the rocks are well exposed, may be reached either by ascending the burn from Birnock, or by taking the upper of the two forestry tracks on the south-east side of the Wandel Water, leaving the cars at the U-bend towards the top of the hill and thence proceeding on foot. This presents no problems at the time of writing (1992) but may be difficult in a few years time owing to the growth of young trees. These may also obscure the present fine panorama northwards to the Carboniferous felsite laccolith of Tinto Hill. The section cut by the Hawkwood Burn, described by Peach & Horne (1899) is easily accessible, and chert, shale, greywacke and agglomerate are well-exposed in crags and faces, especially on the western side of the burn. According to Peach & Horne, the structure here is that of a tight anticline, with Arenig volcanics exposed in the centre of the fold, and younger rocks to the north and south. The rocks, however, are cut by many NE-SW trending faults, and the structure is probably one of more complex imbrication.

The best section is exposed on the western bank where, on ascending the valley, Caradoc greywackes are first encountered (5) followed by thin shales which have yielded a few graptolites. A few metres farther south lies a sequence of red and grey cherts with interbedded red shales, well-exposed on both sides of the burn and forming sharp crags. At (6) and (7) the cherts are seen to be tightly folded and their apparent thickness of 15 m must be greatly exaggerated. Both the red cherts and the associated grey cherts are full of radiolarians, visible with a lens as round specks and in thin section as single or double-walled spheres, some of which retain radial spines. In places the grey cherts contain clasts of devitrified igneous material. At some localities (6, 8, 9), the red shales interbedded with the cherts yield a sparse fauna of conodonts, white in colour and lying flat on the bedding planes. They thus occur in a similar manner to those described by Lamont & Lindstrom (1957) from elsewhere in the Northern Belt. Rare thin-bivalves and inarticulate brachiopods including *Lingula* also occur in the red shales. The conodonts occur in thin layers (Armstrong et al. 1990). *Periodon aculeatus* ramiform elements are common and, together with the rarer *Prioniodus*, *Drepanoistodus* and *Protopanderodus*, comprise a characteristic specialised deepwater association of Llanvirn age. This is compatible with a

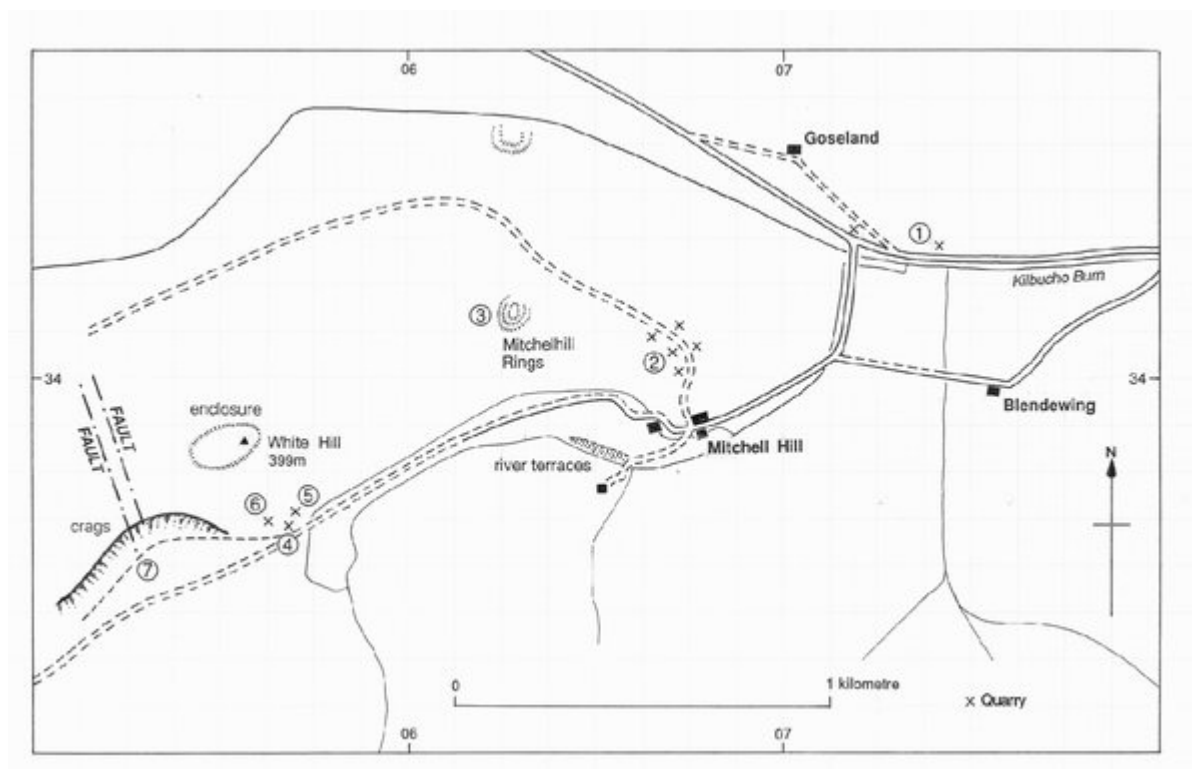
stratigraphic position for the red cherts and mudstones towards the base of the Moffat Shale Group.

Another feature preserved in the western bank (10) is a prominent fault-bounded slice of volcanic rock which Peach & Horne (1899) believed to form the core of an anticline. The rock consists of separate pillows (up to 30 cm across), some shattered into angular fragments, all set in a dirty green chloritic ashy matrix. This rock is a hyaloclastite, a product of explosive submarine volcanic activity. Analyses by J.G. Fitton and D. James (University of Edinburgh) indicate a tholeiitic basalt, rich in Cr and Ni but with very low concentrations of the more immobile incompatible elements (rare-earth elements, Nb, Zr), typical of mid-ocean ridge or back-arc basalts. Original olivine phenocrysts have been converted to calcite, also present in the cracks. The pillows must have been rapidly quenched but any original glass has devitrified. Since the pillows, whether explosively shattered or not, are free of vesicles a crystallisation below a depth of 2 km of water is suggested.

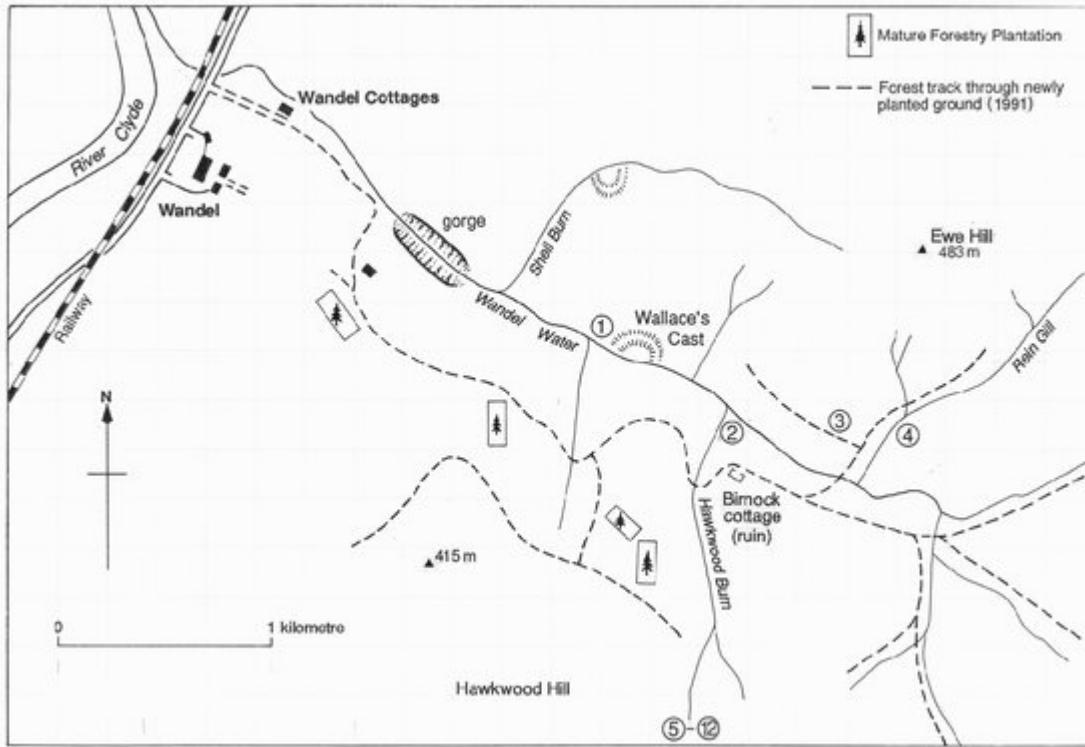
Farther to the south the red (11) and grey (12) cherts reappear. At this latter locality is a poorly exposed bank of shaly debris containing rare and fragmentary graptolites characteristic of the Glenkiln Shales.

Equivalent sections are preserved in several of the high valleys in the surrounding hills such as Rough Gill, Deil's Barn Door, Lead Burn and reference may be made to Peach & Horne (1899) for details. As these sections are less accessible and involve hard walking over long distances they are not considered further in this account.

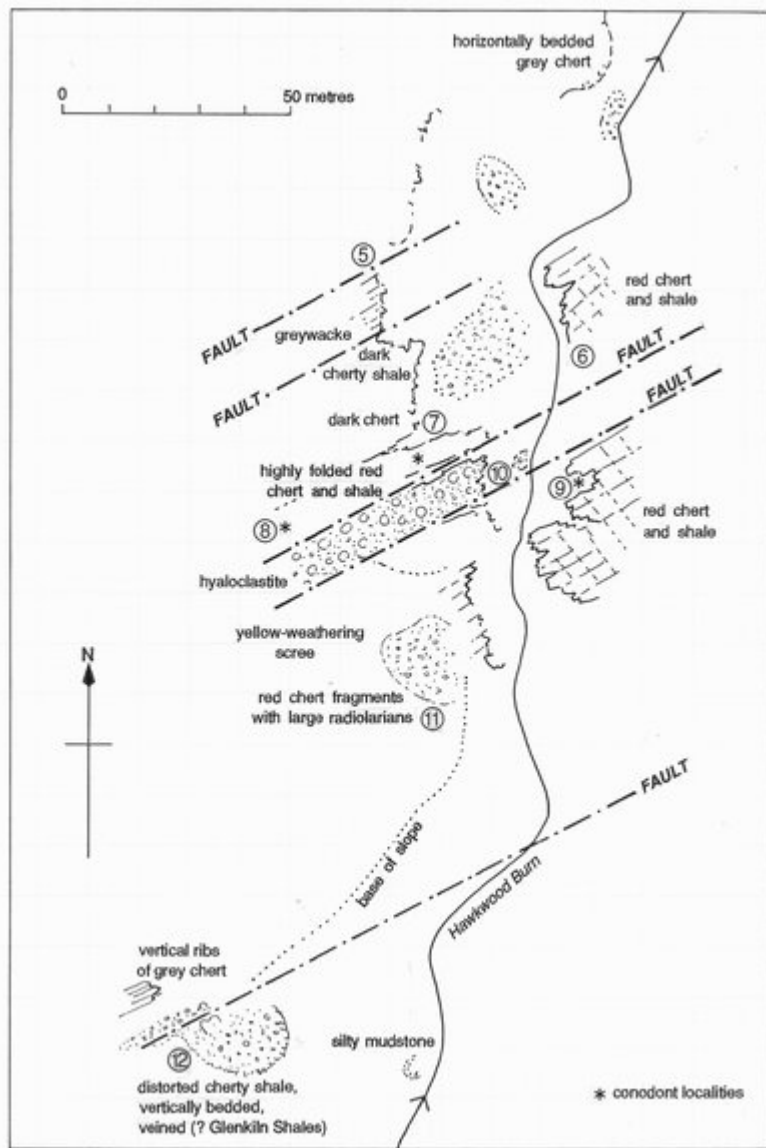
References



(Figure 46) Kilbucho.



(Figure 47) Wandel Water.



(Figure 48) Upper Hawkwood Burn.