19 The Middle–Upper Jurassic sequence between Cayton Bay and Yons Nab

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Purpose

To study the succession, depositional history, and palaeontology (including plant beds) of the Middle Jurassic (Lebberston Member) to Upper Jurassic (Lower Calcareous Grit Formation), the Red Cliff Fault, Quaternary tills and examples of mass movement.

Logistics

This is a full-day excursion best commenced on a falling tide so that Locality 6 will be reached at low water. If tide times dictate, the excursion may be carried out in the reverse direction. Walking distance is about 5 km.

Take the small track which leaves the A165 in the hollow [TA 068 840] about 200 m south of the traffic lights at the junction between the A165 and the minor road to Cayton. This leads into Killerby Park where cars may be parked for a small fee. Coaches may also be parked here by prior arrangement with Mr D. R. Hindley, Killerby Park, Killerby Cliff, Cayton Bay, Scarborough, North Yorkshire, YO 3NR (tel: 01723 582495].

Note: At high tides water may reach the base of the cliff, especially on the east side of Yons Nab. ***Care must also be taken at Locality 6*** where the rising tide quickly fills gullies on the landward side of the Millepore Bed in front of Yons Nab. ***Safety helmets must be worn close to the cliff base***.

Maps

O.S. 1:50 000 sheet 101 Scarborough & Bridlington; B.G.S. 1:50 000 Sheet 54 Scarborough.

Geological background

The Middle Jurassic of the Yorkshire basin consists largely of fluviatile and deltaic sandstones with marine intercalations (Ravens-car Group). This excursion examines the upward facies transition from one of these marine intercalations (Millepore Bed of the Lebberston Member) through a mixed marine and non-marine sequence (Yons Nab Beds of the Lebberston Member) into non-marine deposits (Gristhorpe Member). This can be contrasted with the more abrupt junctions of the Gristhorpe Member with the overlying marine Scarborough Formation, and of the Scarborough Formation with the deltaic Scalby Formation. The latter contact may represent a depositional break of several million years. The Scalby Formation is the highest subdivision of the Ravenscar Group and in late Middle Jurassic (Callovian) times fully marine conditions were established by a transgression from which a sequence of limestones (Cornbrash Formation), clays (Cayton Clay Formation) and sandstones (Osgodby Formation) were deposited, the latter interrupted by minor phases of tectonic tilting and erosion. In the Upper Jurassic (Oxfordian) deepening marine conditions gave rise to the deposition of widespread silty clays (Oxford Clay Formation), which pass gradually up in a shallowing sequence into the Lower Calcareous Grit Formation. Despite its name the latter is a fine-grained sandstone. It has a calcite cement and is very rich in sponge spicules.

The considerable thickness of rocks which can be examined here is in part due to movement on the Red Cliff Fault. This fault probably has a long history of movement and in the Mesozoic was one of a suite of faults which formed the eastern margin of the Peak Trough (Milsom & Rawson, 1989).

Excursion details

From the car park take the path that leads directly down a gully to the shore (Figure 9.1). Once on the shore, turn right (east). Killerby Cliffis entirely made of till which has been much affected by mass movement. Several World War II pill boxes can be seen in various stages of descent from the cliff-top. The till fills a pre-glacial valley, which was cut to below present-day sea level, and eastwards the slope of the valley side can be seen in section with rockhead gradually rising from shore level up to the cliff-top. The character of the cliff thus changes and becomes more precipitous, to give the striking face of High Red Cliff. This cliff is composed of three units: the lower vertical part is made of sandy Osgodby Formation (13 m), the upper vertical portions are made of the Lower Calcareous Grit Formation (25 m) and these are separated by the steeply sloping face of the softer Oxford Clay Formation (40 m). In the Oxford Clay minor rhythmic alternations of harder and softer bands, visible here, may represent the effects of small climatic changes related to periodic variations in the Earth's orbit (Milankovitch cycles). It is interesting that rhythms on a similar scale continue into the Lower Calcareous Grit despite the major change in lithology.

Locality 1 [TA 075 841]

The Osgodby Formation can be examined by climbing up at the western end of its main outcrop. At the top the Hackness Rock Member (2 m) consists of sandy berthierinitic (chamositic) oolite and limy sandstone containing belemnites, *Gryphaea* and occasional ammonites. The underlying Redcliff Rock Member (II m) contains ferruginous sandstones, bands of sandy berthierinitic oolite and is more silty towards its base. Some horizons contain an abundance of bivalves and sparse ammonites. The boundary between the Hackness Rock and Redcliff Members is difficult to locate precisely, though the intervening Langdale Member is missing here due to erosion (Wright 1968)

The underlying Cayton Clay (3 m), Cornbrash Limestone (0.4 m) and Scalby Formations are usually covered by beach sand. However the Cornbrash Limestone Formation can be seen at Locality 2, where it forms a low ledge within the boulders on the upper beach and about 20 m out from the base of the cliff. Between Locality 1 and Locality 2, note the large, differentially weathering, spheroidal concretions (up to 2 m in diameter) developed in the lower part of the Redcliff Rock Member. Fallen blocks of Osgodby, Oxford Clay and Lower Calcareous Grit Formations can also be examined but attest to the considerable dangers of working in this area. The silty clays of the Oxford Clay contain poorly preserved ammonites, while the well-cemented sandstones of the Lower Calcareous Grit show an abundance of branching, network-like, burrow systems *(Thalassinoides)*.

Locality 2 [TA 077 841]

The Cornbrash Limestone Formation is an impure, nodular limestone containing ribbed oysters (*Lopha*) and occasional specimens of other bivalves (including *Trigonia, Pholadomya* and *Entolium)*. At its base, U-shaped burrows *(Rhizocorallium),* preserved in siderite, extend down into greyish silty sandstones which here represent the top (1 m +) of the Scalby Formation. Shales of the Cayton Clay Formation may occasionally be seen beneath boulders between the Cornbrash outcrop and the cliff base. In the cliff the sandstones of the Redcliff Member show oblique, westerly-dipping planes, and fallen blocks contain a fauna of bivalves (including *Pinna, Trigonia, Gervillia* and *Entolium*) and belemnites.

From Locality 2 it is best to continue above the zone of slippery green seaweed to where a prominent notice board (Figure 19.1) advises that it is not possible to walk to Filey at shore level. Here the cliff runs inland behind a large, degraded, landslip. Either scramble round the margin of the slip at shore level or climb onto the slip and follow the path which runs close to its outer edge. At the far end the path crosses an active mud flow, where the footing can be very soft and muddy as it descends again to the beach at Locality 4 [TA 080 842].

Here, Low Red Cliff is clearly different in geological character from High Red Cliff as a result of displacements on the Red Cliff Fault. The fault can be traced on the shore from the truncation of beds on its eastern side and the fault plane outcrops on the upper shore. The trace is obscured under the mud flow but the fault reappears in the cliff at the rear of the flow (Locality 3).

Locality 3 [TA 081 841]

Ascend to the west of the mud flow. Evidence of recent movement of the mud flow can usually be detected in longitudinally grooved mud surfaces and transverse crevasse-like gashes. The Red Cliff Fault is a westerly downthrowing normal fault which almost completely cuts out the Oxford Clay. The apparent vertical displacement is thus about 35 m. Small subsidiary faults can be seen on either side. Coarse crystalline calcite occurs in patches along fault planes and in joints within the Oxford Clay Formation, and fragments may be found in the scree at the cliff-foot. Return to Locality 4.

*Locality 4 [*TA 080 842]

The western end of Low Red Cliffis made up of lenticular white sandstones and grey siltstones at the base of the Scalby Formation. In places there is abundant, fine or coarse, coalified plant debris. Some of the plant material is also pyritized and weathering of this has covered the cliff face with a bright yellow sulphurous bloom. The geometry of the channel sandstones is variable, and cross-bedding, soft sediment deformation and mud-flakes can also be seen. About 30 m to the east the underlying Scarborough Formation, a thin development (2.8 m) of limy shales with two brown ironstone bands close to the top (Figure 19.2), can be found at the base of the cliff. Towards the centre of the formation, an abundance of crushed shells, with ribbed oysters (*Lopha*) and other *molluscs (Trigonia, Meleagrinella,* gastropods and belemnites), is obvious. In places the basal beds of the Scalby Formation cut down into the Scarborough Formation and the top of the Scarborough Formation is disturbed.

From here to the next headland (Locality 5) one moves gradually down succession within the Gristhorpe Member but exposures are variable depending on the amount of beach cover and till slippages from the cliff-top. Dinosaur footprints may occasionally be seen, both *in situ* and on loose blocks. Immediately under the Scarborough Formation there is a 1.4 m thick sandstone with fine cross-bedding (some authors include this, as the Helweth Beck Member, within the Scarborough Formation). Other prominent horizons in downward sequence (Figure 19.2) are a sandstone containing vertical rootlets of horsetails *(Equisetum),* a bioturbated carbonaceous sandstone lens (Figure 19.3) and a carbonaceous siltstone with plant remains (Gristhorpe Plant Bed). The latter rests on a highly bioturbated sandstone with vertical roots which is the basal bed of the Gristhorpe Member (Figure 19.2).

Locality 5 [TA 083 843]

The basal bed of the Gristhorpe Member is well seen where the top bed of the Yons Nab Beds (Lebberston Member) also forms a prominent ledge. On the ferruginous upper surface of this bed can be found internal moulds of bivalve shells and valves, including *Pholadomya, Trigonia* and *Pteroperna*. Some of the bivalves are in life position. There are also some large vertical U-shaped burrows. The sequence of the Yons Nab Beds (Figure 19.2) is displayed down the shore between Locality 5 and the prominent ledge of the Millepore Bed (Lebberston Member) (Locality 6). In the upper parts there are alternations of sandstone and shale, and poorly preserved bivalves may be found at several levels. The lower parts of the sequence are, apart from a thin ripple-marked and burrowed sandstone, entirely shale with occasional ironstone bands and concretions. Apart from small burrows the shales are only fossiliferous immediately above the Millepore Bed.

Locality 6 [TA 084 843]

The top of the Millepore Bed is well seen on the foreshore and is a sandy oolitic and bioclastic limestone (2 m) with well-developed cross-bedding. Fragments of the bryozoan, *Haploecia straminea,* from which the bed derived its name, can be found but are not common at this locality. The lower parts of the Millepore Bed are cross-bedded calcareous sandstones (7 m) which can, at low water, be seen to rest on sandstones of the Sycarham Member.

From Locality 6 look back at the cliff at a strike section of the Gristhorpe Member between Locality 5 and the next headland, Yons Nab (Locality 7). Small channels and other lateral changes can be detected within this sequence. Return to the cliff base close to Locality 5 and walk east along the ledge formed by the top bed of the Yons Nab Beds. Approaching Yons Nab, notice how the bed is removed by a northeast–southwest trending channel which cuts down from the Gristhorpe Member into the Yons Nab Beds.

Locality 7, Yons Nab [TA 085 842]

The complex channel-fill sandstones are well displayed on the shore in front of Yons Nab. To the east the upper beds of the Yons Nab Beds reappear on the eastern side of the channel. Immediately in front of Yons Nab, the siltstones of the Gristhorpe Plant Bed rest on the channel sandstones and are overlain by a bioturbated carbonaceous sandstone. However these beds are often concealed by beach gravels which here usually contain an abundance of pyrite nodules and fragments, some of which show traces of woody structure. At the base of the cliff on the east side of Yons Nab a sandstone with ironstone concretions and plant fragments contains occasional poorly preserved specimens of the fresh-water bivalve *Unio*.

Locality 8 [TA 085 841]

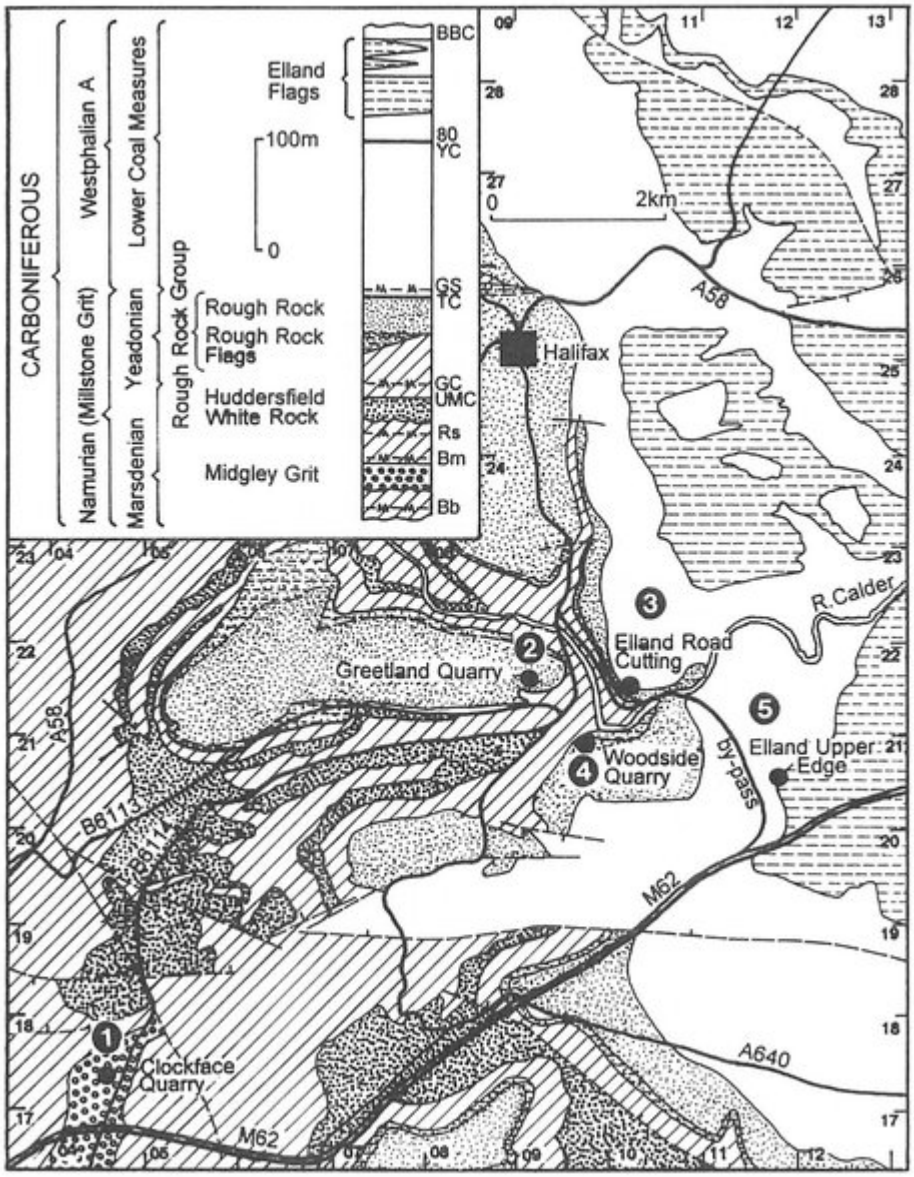
From Locality 7 to Locality 8, the cliff shows an ascending sequence through the Gristhorpe Member and the Scarborough Formation, which can be compared with the sequence between Localities 4 and 5 (Figure 19.2). The cross-bedded sandstone below the Scarborough Formation is well exposed here, as are the fossiliferous beds of the Scarborough Formation.

Locality 9 [TA 085 840]

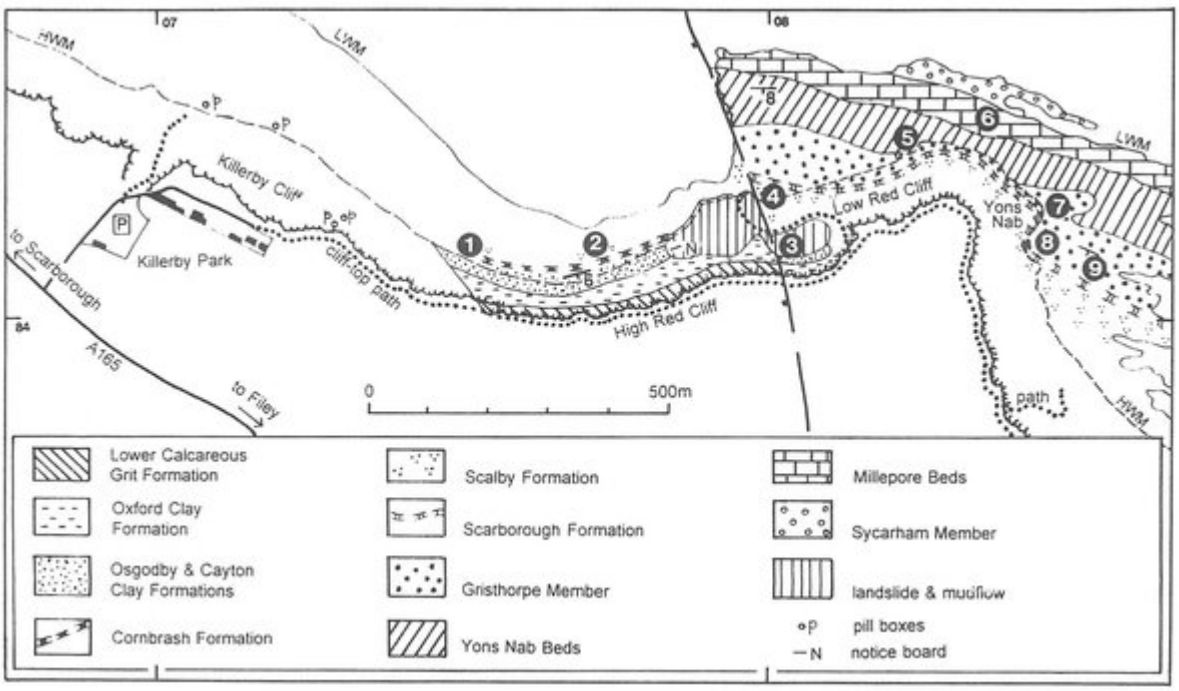
Here a large channel within the Scalby Formation cuts down into the top of the Scarborough Formation.

About 200 m south-southeast of Locality 8 [TA 086 838], climb up the clay slopes to a path that leads to the cliff-top (the lower parts of the path have been destroyed by mass movement). Take the cliff-top path over High Red Cliff back to Killerby Park. This route provides excellent views both of the coast and of the Vale of Pickering. Both Gristhorpe Cliff to the east and the headland of Scarborough Castle to the north show the same middle to upper Jurassic sequence as at High Red Cliff. Alternatively return along the shore to the path down from Killerby Park.

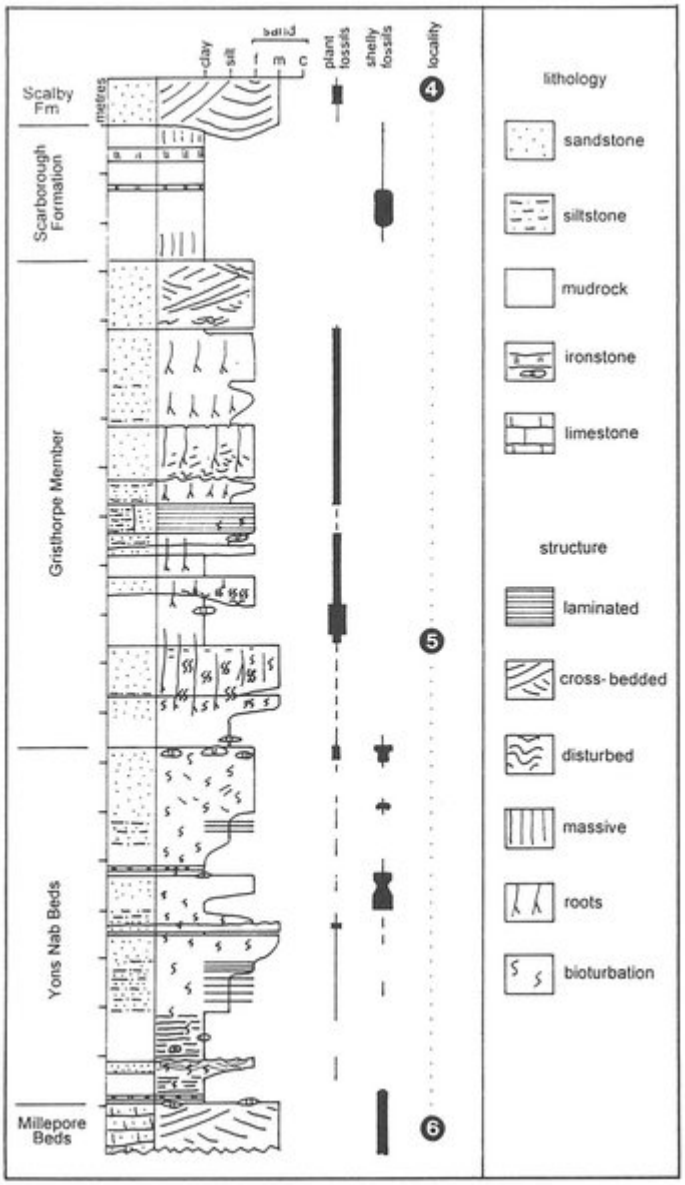
Bibliography



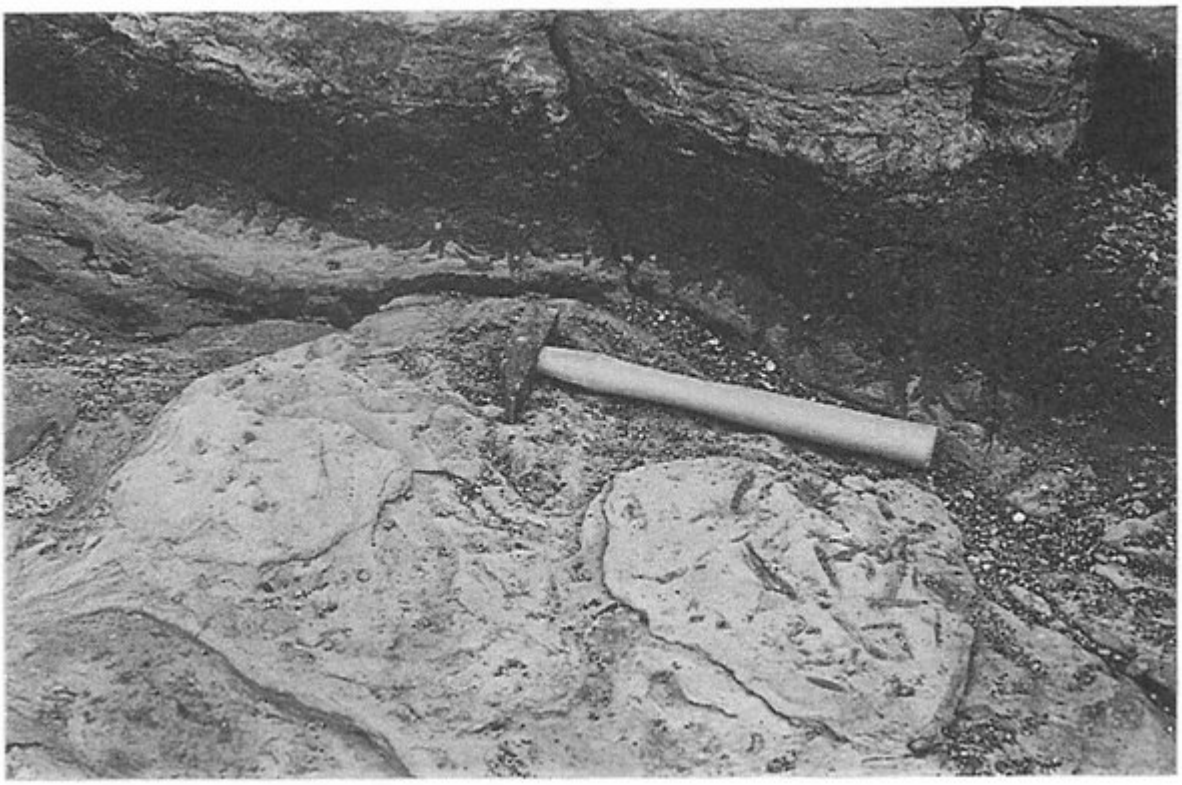
(Figure 9.1) Generalised geological map and vertical section of the Halifax area. Bb = Bilinguites bilinguis Marine Band; Bm = Bilinguites metabilinguis Marine Band; Gc = Gastrioceras cancellatum Marine Band; Gs = Gastrioceras subcrenatum Marine Band; UMC = Upper Meltham Coal; TC = Thin Coal; 80YC = 80 Yard Coal; BBC = Better Bed Coal.



(Figure 19.1) Simplified geological map of the Cayton Bay to Yons Nab area.



(Figure 19.2) Sedimentological log of the section between Yons Nab and the Red Cliff Fault.



(Figure 19.3) Bioturbated sandstone lens near the base of the Gristhorpe Member. The hammer is 350 mm long. Photo: M. Whyte.