EXCURSION

Precambrian and Lower Cambrian rocks of the Nuneaton Inlier: A Field Excursion to Boon's and Hartshill Quarries

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The purpose of this field excursion was to examine the rock sequences exposed within the core of the Nuneaton Inlier, an elongate structural belt formed by tectonic uplift along the north-eastern margin of the Warwickshire Coalfield (Fig. 1). The field party first visited Boon's Quarry, to view Precambrian ('Neoproterozoic III') rocks of the Caldecote Volcanic Formation and the Lower Cambrian Hartshill Sandstone Formation, and to focus in particular on the erosional and angular unconformity that separates the two rock sequences. In the adjacent Hartshill Quarry, the traverse was continued through an extensive and unbroken section of strata which shows the evolution of sedimentation within the Hartshill Sandstone Formation. The locations of these quarries and their geological setting within the Nuneaton Inlier are shown in Figure 1.

Research into the geology of the Inlier was pioneered by Lapworth (1882, 1898) at a time when new quarry sections were being opened. Recent investigations, utilising geochemical comparisons, have confirmed that the Caldecote Formation is a component of the Charnian Supergroup (Carney and Pharaoh, 1993), whose type area is in the Charnwood Forest some 23km farther to the north-east (Moseley and Ford, 1985). The Charnian rocks in turn are part of a major crustal basement entity, termed the 'Charnwood Terrane' by Pharaoh *et al.* (1987), which is present at depth throughout much of the English Midlands. The sequence of events within the Charnwood Terrane, as demonstrated by the Nuneaton exposures, commenced with the phase of volcanic activity which formed the Caldecote Formation. This was then intruded by diorites, dated at 603 Ma (Tucker and Pharaoh, 1991), and subsequently folded and mildly metamorphosed. By latest Precambrian and earliest Cambrian times the Charnwood Terrane bordered the western margin of the Gondwana supercontinent, forming part of the province of Avalonia (McKerrow *et al.*, 1992). A period of erosion and weathering of this landmass occurred prior to inundation by the waters of the advancing Iapetus Ocean. This marine transgression resulted in deposition of the Lower Cambrian Hartshill Sandstone Formation (Brasier *et al.*, 1978), which is 260m thick. A continuation of marine conditions is represented by the overlying mudstones of the Stockingford Shale Group, of Lower Cambrian to Lower Ordovician (Tremadoc) age (Taylor and Rushton, 1971).

1. Boon's Quarry (SP3299 9467)

Formerly called Man-Abell's Quarry, Boon's is a disused roadstone quarry that is partly backfilled by the waste from nearby opencast coal workings. It is currently owned by ARC Central and managed from their office at Judkins' Quarry, Nuneaton. The localities visited, numbered in Figure 2, are part of a Site of Special Scientific Interest (SSSI) designated by English Nature.

Locality 1 exposes a well-bedded volcaniclastic succession, and is the type section for the Caldecote Volcanic Formation (Bridge *et al.*, in press). This formation probably accumulated in seas marginal to active volcanoes (Carney and Pharaoh, 1993), and is a markedly bimodal volcano-sedimentary association. The principal component is massive crystal-lapilli tuff, which represents the proximal deposits of powerful pyroclastic eruptions. Subordinate interbeds, collectively referred to as the 'tuffaceous siltstone facies grouping', represent a more distal facies accumulated at some distance from the vents, or at times of relatively subdued volcanism (Fig. 3).

At Locality 1, beds of the tuffaceous siltstone facies grouping form a series of upwards-coarsening cycles (A to E in Fig. 3) overlain by massive crystal-lapilli tuff (Bed 11 in Fig. 3). Tuffaceous mudstone forms the basal bed of most upwards-coarsening cycles. It is apparently structureless at outcrop, but polished slabs commonly show an intensely convoluted silty lamination. Tuffaceous siltstones typically show a well-developed planar lamination, and are cross-laminated near the middle of Bed 4 (Fig. 3). Convoluted lamination is displayed in the upper part of the same bed; the structure is attributed to processes of liquefaction or water-escape that operated within the unconsolidated sediment pile. The tuffaceous siltstones are at least in part of primary pyroclastic origin, since thin sections show that some of the silty laminae are composed of vitric tuff rich in fine ash-size shards of recrystallized volcanic glass. Tuffaceous sandstones are subordinate components of the succession. They commonly form discrete, pale grey, 5 to 20mm-thick parallel-sided and sharp-margined beds intercalated with tuffaceous siltstone near the tops of upwards-coarsening cycles. Some of these sandstones show evidence of load-casting and sediment mixing with adjacent mudstone and siltstone beds. In Bed 3, sandstone forms the basal parts of normally graded sedimentary layers, each measuring several centimetres thick. Such repetitive grading is typical of the 'Bouma' divisions B to E, described from turbidite beds deposited by sediment gravity flows (Walker, 1967). Most sandstone compositions are indicative of an epiclastic origin; they are rich in lithic grains, which include microcrystalline andesite or dacite, and crystals of feldspar and quartz. The grey to green colour variegation of these beds reflects the varying proportions of chlorite, epidote and white mica produced by metamorphic recrystallisation under lower greenschist facies conditions.

Crystal-lapilli tuff is exposed in the south-west of Locality 1 (Bed 11 of Fig. 3), and for much of the quarry face extending upwards to the Lower Cambrian unconformity. Identical rocks are thickly developed in the small pit to the east of the type section. The distinctive coarse-grained texture of crystal-lapilli tuff is best displayed on the weathered surfaces of debris

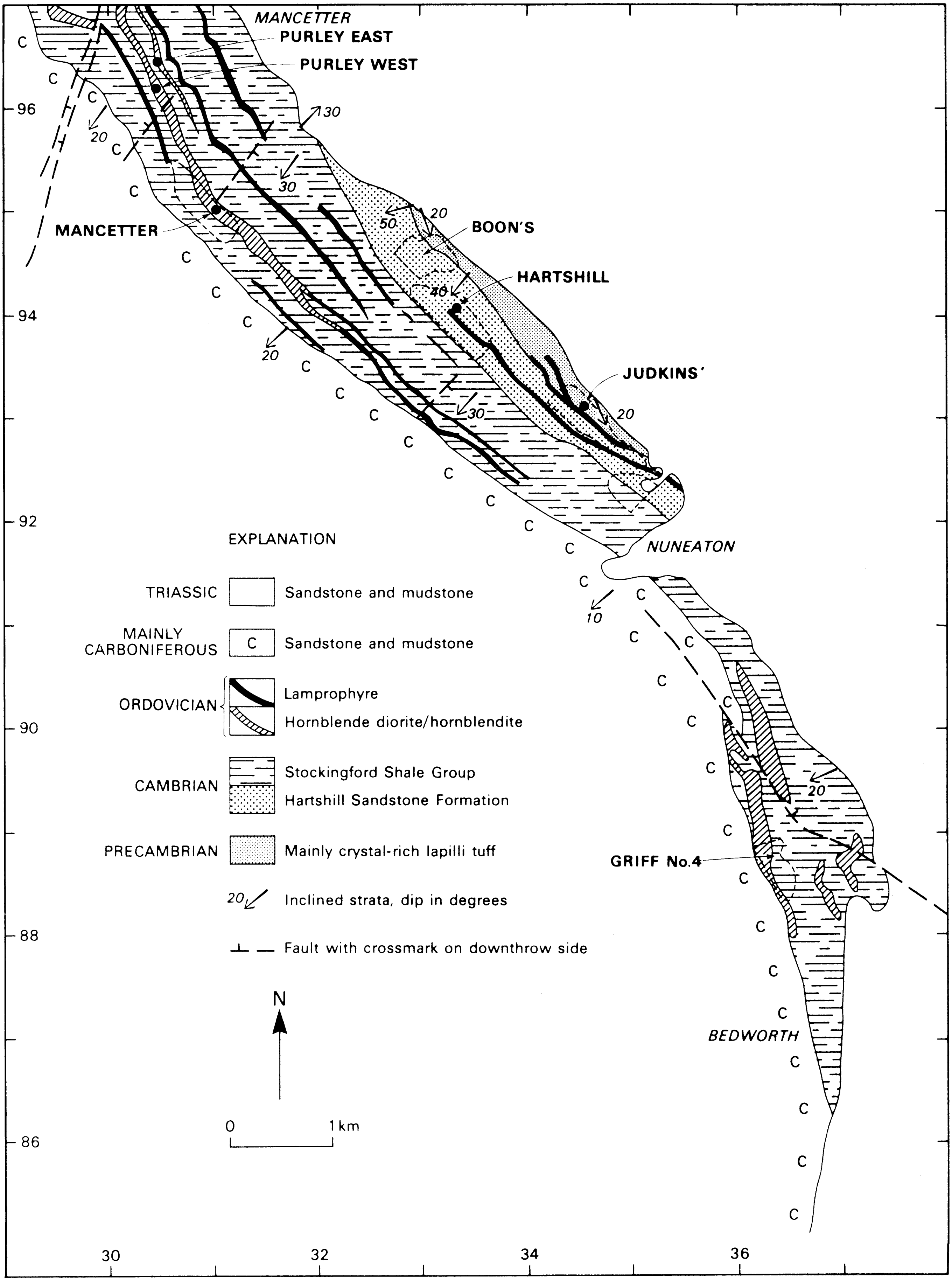

Fig. 1. Geological setting of the Nuneaton Inlier showing the locations of the principal quarries (in bold type).

at the base of the cut and along the roadway. Plagioclase feldspar forms the white to pale pink crystals, between 1 and 4mm in size, which constitute 50 to 60 per cent of the rock. Many are subhedral in form, with rounded-off crystal terminations; they additionally show extensive subgrain development, some having broken down to clusters of angular fragments. Quartz crystals (15-20% of the rock) appear grey and glassy. Their roundness, and the presence of groundmass embayments when viewed in thin section, are both interpreted as original magmatic features. Quartz crystals are of similar size to the feldspars and, like the latter, show modification due to internal micro-fracturing, many having disintegrated into smaller fragments. Individual matrix constituents are difficult to resolve microscopically in these rocks, owing to the pervasive lower greenschist facies alteration. Identical crystal-lapilli tuffs in Judkins' Quarry are fresher, however, and commonly show the outlines of devitrified and recrystallized glass shards in the matrix (Carney and Pharaoh, 1993). Blocky inclusions account for less than 10 per cent of the crystal-lapilli tuff, and are of two types. The first consists of dark porphyritic inclusions (also described by Allen, 1957). These have ovoid to equidimensional shapes and contain crystals in similar proportions to the enclosing tuffs. Thin sections suggest that the darker colour of these inclusions reflects, at least in part, the abundance of chlorite minerals in the matrix. The second inclusion type consists of angular lithic blocks, up to several centimetres across, variously composed of andesite or dacite, welded tuff with compressed vitric shards, and devitrified glass with relict perlitic texture. A primary pyroclastic origin for crystal-lapilli tuff, involving the explosive eruption of dacitic magmas, is inferred from the fragmental nature of the lithology, the abundance of juvenile volcanic constituents (crystals and vitric shards) in its matrix, and its chemical composition (Carney and Pharaoh, 1993). Allen (1957) suggested that these rocks are welded tuffs, but thin sections show that welding was not a significant process during compaction; for example, the devitrified glass shards in the matrix have suffered little flattening or plastic deformation. In gross lithology and petrography, however, crystal-lapilli tuffs bear a close resemblance to certain types of massive and crystal-enriched rocks found in volcaniclastic successions that have accumulated in seas marginal to active volcanic arcs. These are interpreted as the proximal deposits of subaqueous pyroclastic flows (e. g. Cas and Wright, 1987).

A subvertical sheet of basaltic andesite intrudes crystal-lapilli tuff at Locality 2. Its upper surface is truncated at the unconformity with the Hartshill Sandstone, proving its Precambrian age.

The unconformity is displayed intact at Locality 3. Coarse-grained breccias and granulestones of the Hartshill Sandstone Formation rest on an irregular surface of crystal-lapilli tuff. Convexities on this surface correspond to the tops of spheroid-shaped rock masses. These form an apparent weathering profile in the upper 2m of the Caldecote Volcanic Formation. Each spheroid or corestone is separated from its neighbour by red-coloured weathering rinds which have developed a tangential 'onion-skin'-like exfoliation fabric. Within these rinds, the only remaining components are granule-sized quartz crystals. These do not change in shape, distribution or abundance when traced into fresh tuff forming the interior of the spheroids, suggesting that they are relicts derived from *in situ* weathering of the tuff. Thin sections show the weathered rinds to be composed of white mica aggregates, probably representing diagenetically altered clay material, that are penetrated by anastomosing stringers and veinlets filled with opaque minerals. Certain aspects of this apparent weathering profile are worthy of discussion and further research. The first concerns the corestones (Brasier and Hewitt, 1979), which are similar in morphology to those developed below the saprolitic zones of modern tropical lateritic soil profiles, as described from Uganda by McFarlane (1983). By analogy, the weathering of these Precambrian rocks must have occurred when Avalonia lay at low latitudes. However, palaeogeographic reconstructions for the latest Vendian by McKerrow *et al.* (1992) place Central England at about 40°S, which would be outside of the modern tropical climatic belt. Possible explanations are that this type of weathering extended to higher latitudes in latest Precambrian-Early Cambrian times, or that the palaeogeographic reconstructions reflect a rapid southwards drift of Avalonia away from the tropics at a relatively late stage in the Vendian.

A few metres north-east of Locality 3 there is a minor inversion of the stratigraphy, with Precambrian rocks overlying a 0.5m thick, cleaved and fractured mudstone bed along a sharp contact. This mudstone contains a sparse acritarch fauna (genus *Leiosphaeridia*; Molyneux, 1992), suggesting that it is one of the marine beds in the Hartshill Sandstone. The overlying Precambrian rocks were thus moved into place along a reverse fault. Upwards, this fault appears to flatten out along the unconformity surface, which is therefore locally a shear plane.

The geological traverse through the Hartshill Sandstone Formation starts at Locality 3. The succession, summarised in Figure 4 and Table 1, consists of six members. For convenience, the Boon's, Park Hill and Tuttle Hill Members are subdivided further into packages of strata, lettered A to L, showing unifying characteristics of lithology and/or internal sedimentary structure (Carney, 1992).

The red-coloured strata resting on the unconformity surface at Localities 3 and 4 belong to Unit A of the Boon's Member. This member, recognised only in Boon's Quarry, was named by Carney (1992) as a revision of the previous scheme which placed the Park Hill Member at the base (e. g. Brasier *et al.*, 1978). Unit A is an association of two lithologies. Bouldery breccio-conglomerate beds, well-exposed at Locality 4, are poorly sorted and of immature composition. They contain sporadic very large (up to 2m dimension) cobbles and boulders of Caldecote Formation crystal-lapilli tuff whose rounded shapes indicate that they are corestones incorporated into the sediment from the weathered Precambrian land surface. Breccio-conglomerate beds are structureless and, apart from the

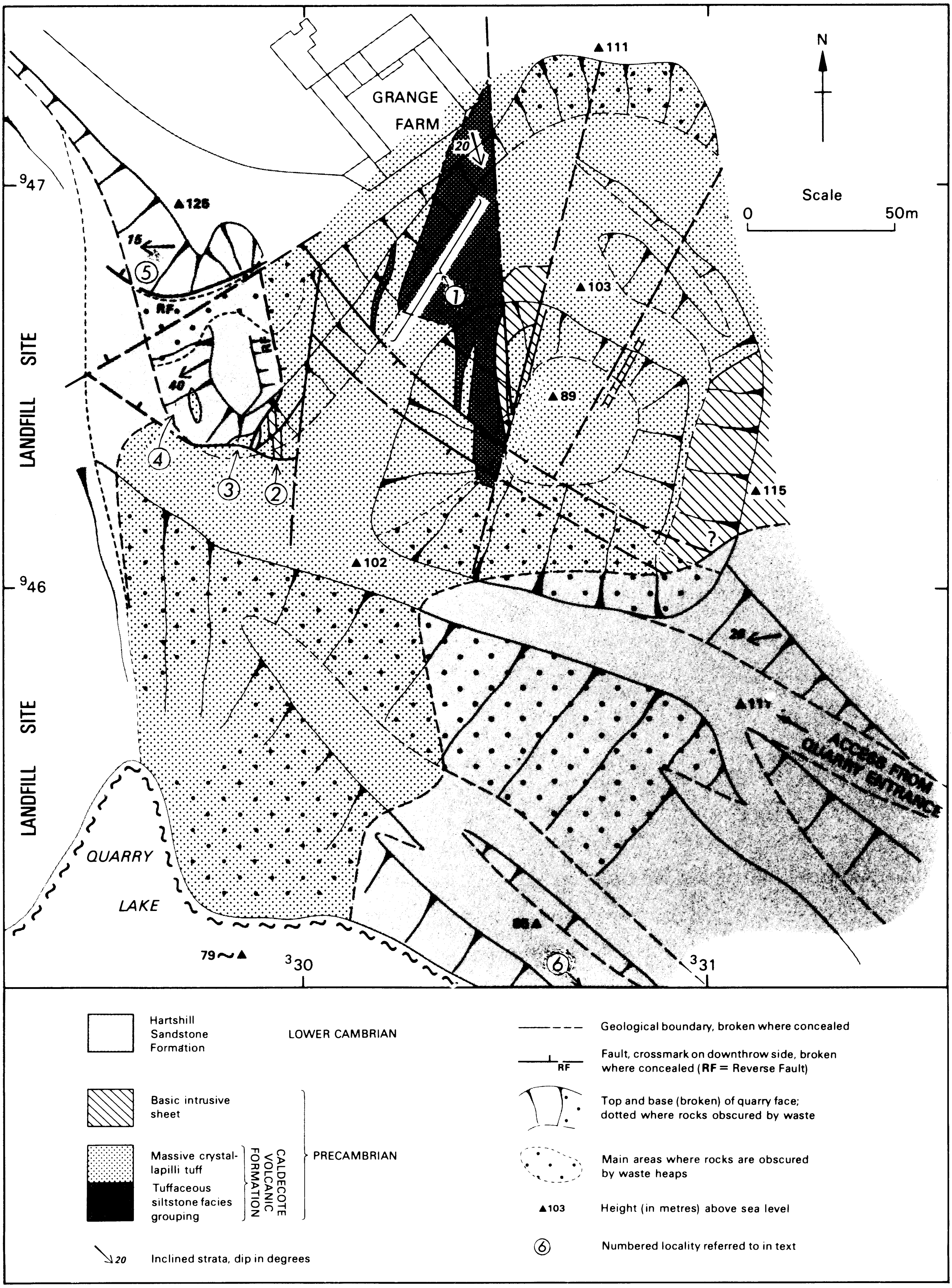

Fig. 2. Geological sketch map of the northern part of Boon's Quarry.

corestones, are principally composed of angular, fine-grained Caldecote Formation clasts averaging 0.5-2cm across. Granulestones are the second type of Unit A lithology; they also have abundant angular Precambrian clasts, but do not contain corestone fragments, are better sorted than the breccio-conglomerates, and show a crudely-developed internal planar bedding. This is defined by the parallel orientation of platy clasts and by layers relatively impoverished in the larger clasts and/or enriched in coarse-grained sand.

The Unit A association is envisaged to represent the deposits of debris flows (breccio-conglomerates) and sheet floods (granulestones) emplaced by gravity processes acting on weathered and consequently unconsolidated rock waste. A marine influence is also suggested, however, by the acritarchs found within sporadic thin mudstone beds in the Boon's Member (Molyneux, 1992). Unit A may then represent part of an alluvial fan/submarine fan delta complex developed at the margins of a steep, fault-controlled shoreline. Beds of Unit B, which may represent deposition on a more distal part of the fan delta, are described below at Locality 6.

The upper component of the Boon's Member, Unit C, is exposed at Locality 5, the lithic sandstones and breccias of Unit B having been faulted out. The succession comprises tabular beds of litharenite whose relatively mature composition is reflected by their grey colour and lower content of opaque and lithic grains. Most beds are structureless, but some have plane to low angle cross-bedding. The bed tops are in places slightly undulatory, providing the first indication of wave or current reworking in the Hartshill Sandstone.

Some of the lamprophyre sills that invade the Cambrian succession in the Nuneaton Inlier can be viewed at Locality 5. Related intrusions of hornblende diorite, up to 60m thick near Bedworth, have yielded a (Late Ordovician) radiometric age of 442Ma (Noble *et al.*, 1993).

North-westwards from Locality 5, up the incline past the landfill site, the exposed grey sandstones are much-fractured. At the top of this incline (not shown in Fig. 2), the north-western quarry face shows good sections through grey sublitharenites or lithic subarkoses forming the middle part (Unit E) of the Park Hill Member. These sandstones form sharp-based, tabular beds between 0.2 and 2m thick. Each bed is a coset of between 2 and 5 planar cross-bedded sets. The cross-bedding regularly changes its direction of inclination, from one set to the next, producing a 'herringbone' pattern which is characteristic of the Park Hill Member. Some of the lower bounding surfaces of the cosets have scoured bases. Their top surfaces may consist of rippled coarse-grained sandstone. Mudstone-draped partings are only sporadically seen. Cosets of this type are probably sections through sandwaves formed in a tidal regime in which the ebb and flood currents were apparently of equal strength, flowing to the south-west and north-east. Trough cross-bedding is sporadically seen, with foreset inclinations usually to the east or east-south-east.

Locality 6 is on the lower south-eastern quarry face, by the corner to the left of the roadway, about 100m

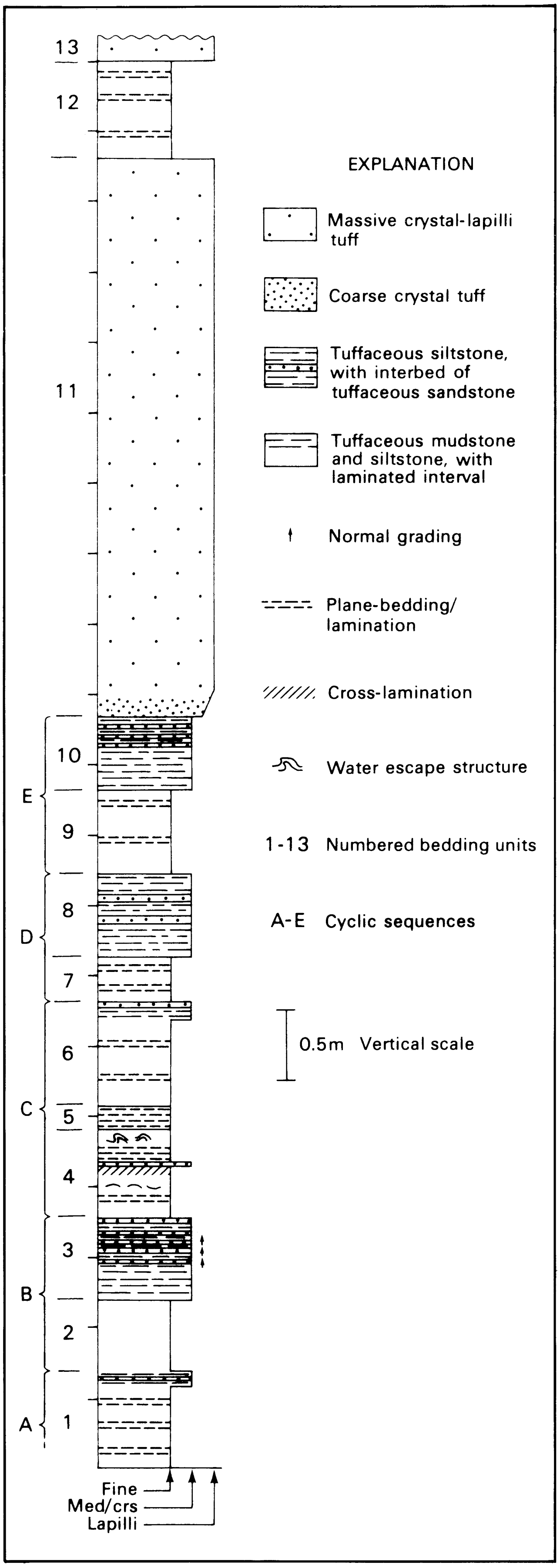

Fig. 3. Measured section in the Caldecote Volcanic Formation at Locality 1 (Fig. 2).

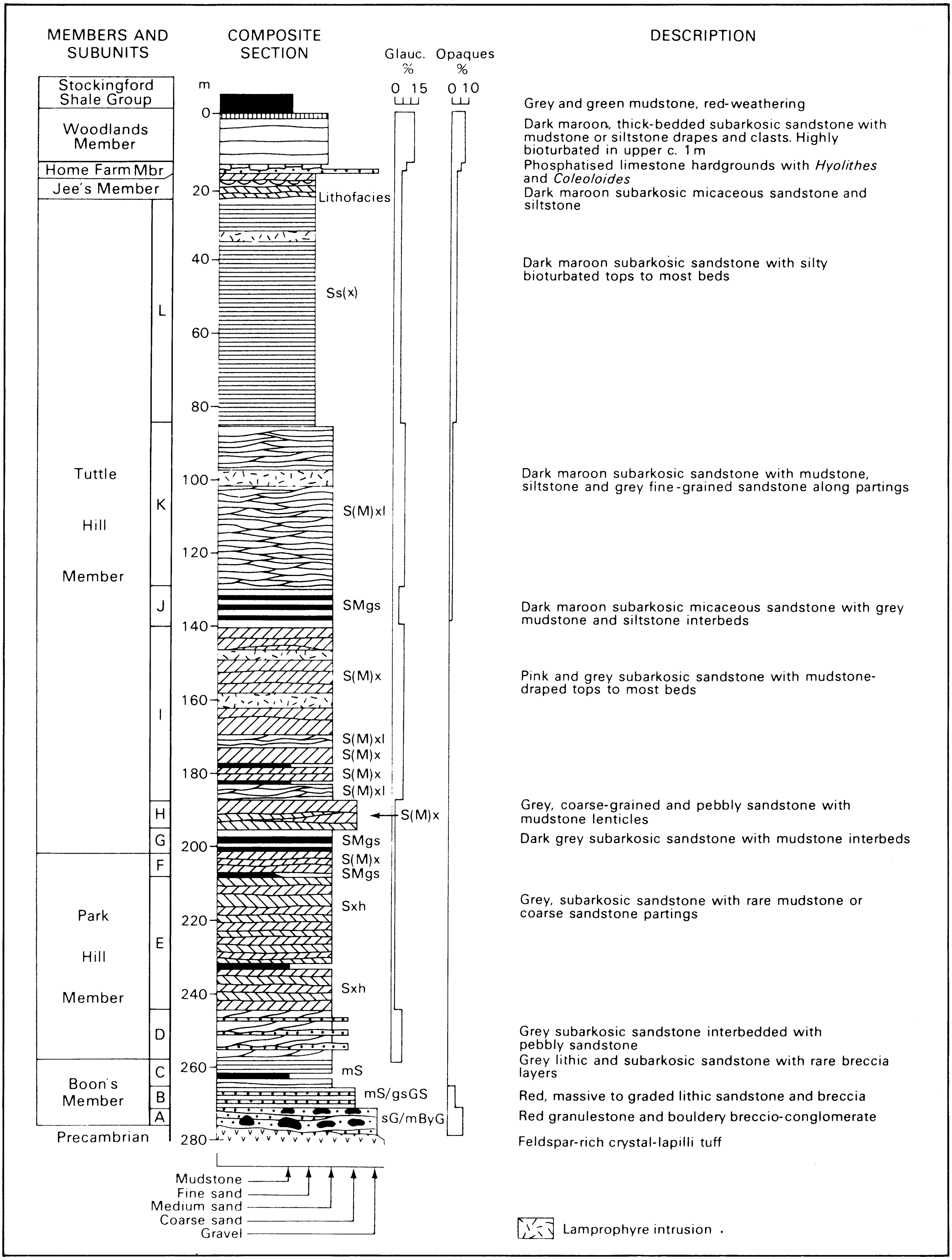

Fig. 4. Composite stratigraphical column in the Hartshill Sandstone Formation based on exposures in Boon's and Hartshill Quarries. An explanation of the lithofacies codes is given in Table 1.

CLASTIC SHELF FACIES ASSOCIATION

FACIES CODE	
Ss(x)	Sandstone with plane-bedding; rarely with low-angle cross-bedding
S(M)xl	Sandstone with mudstone drapes, in compound, lenticular cosets
S(M)x	Sandstone with mudstone drapes, in cosets of tabular-planar cross-bedding
Sxh	Sandstone with sporadic mudstone drapes, in cosets of herringbone cross-bedding
GyS(M)x	Coarse, gravelly sandstone with mudstone lenticles; massive to cross-bedded
SMgs	Sandstone and mudstone, plane-bedded and graded in part

FAN DELTA FACIES ASSOCIATION

FACIES CODE	
mS	Massive sandstone
gsGS	Sandstone with gravelly layers, graded and plane-bedded
sG	Granulestone, plane-bedded
mByG	Massive bouldery breccio-conglomerate

Other symbols

~	Bioturbation
	Mudstone bed
	Clast

NB 'Plane bedding' or 'Plane lamination' refers to bedding or lamination that is planar and parallel to the bounding surfaces of the bed.

Table 1. Explanation of facies codes and other symbols used in Fig. 4.

farther down the incline from the arrow shown in Figure 2. It is the only exposure of the beds inferred to belong to Unit B in the Boon's Member. The unit, about 9m thick, consists of red, medium to coarse-grained lithic-rich sandstones with subordinate layers of matrix-supported breccia in the lower to middle part. The sandstones are plane-bedded or structureless, and the breccia layers, from a few to several centimetres thick, are parallel-sided and sharp-based. Such features are reminiscent of proximal turbidite sequences (Hiscott and Middleton, 1979; Ghibaudo, 1992), and compatible with deposition from sediment-laden currents. The lower proportions of angular pebble-size Precambrian clasts in these sandstones, compared to the Unit A beds, suggests a greater distance travelled by each flow prior to deposition.

2. Hartshill Quarry (SP336 937)

This was formerly known as Jee's Quarry. It is still being worked as a source of constructional aggregate by Tarmac Ltd. The best sections occur on the older faces, around the north-eastern and south-eastern parts of the quarry, which together expose about 80 per cent of the Hartshill succession (Fig. 4). The geology and locality information are given in Figure 5.

Spectacular bedding plane exposures in Unit E of the Park Hill Member occur along the north-eastern quarry levels. At Locality 1, the bedding plane is pock-marked by large (c.0.8m across), scoop-shaped scour pits whose asymmetry of profile indicates a current flow to the south-west (down-dip). The asymmetric ripple marks nearby also give this current direction. Analogous scour pits, described from Early Cambrian sandstones in the USA, are interpreted to have formed by the action of ebb tidal currents (Simpson and Eriksson, 1990). A similar interpretation here would indicate that the ebb current flowed south-westwards, away from a shoreline situated farther to the north-east, and that the north-easterly current direction measured in the complex 'herringbone'-patterned cosets of Unit E is that of the flood tide. Furthermore, the east to east-south-east current flow directions measured for many of the trough cross-bedded sandstones is possibly the longshore component of this tidal system.

One of the rare mudstone beds in the Park Hill Member occurs above this bedding plane; it is overlain by plane-bedded sandstone and cross-bedded coarse-grained sandstone which may represent storm deposits.

Locality 2 exposes a stratigraphically higher sandstone bedding plane which shows, in plan view, bedding and laminae disposed in strongly arcuate, overlapping patterns. This is interpreted as a planed-off section through a swarm of sinuous-crested megaripples formed by a south-easterly directed, possibly longshore, current.

Farther to the south-east, between Localities 2 and 3, many bedding planes show the marks of burrowing organisms. From this part of the succession, Brasier and Hewitt (1979) described the trace fossils *Psammichnites*, *Neonereites*, *Arenicolites* and *Planolites*, with *Diplocraterion* identified more recently (Brasier, written communication, 1990). Locality 3 shows a bedding plane with asymmetric ripples indicative of south-westerly current flow. Between Localities 3 and 4 are seen further extensive ripple-marked surfaces, and a series of northerly-trending raised sandstone ribs of problematic origin. Near Locality 4, large elliptical structures on a bedding plane were possibly produced by the escape of water during sediment compaction.

The contact between the Park Hill and Tuttle Hill members, at Locality 4, is placed at the lower surface of a 1.3m-thick bed consisting of mudstone with thin sandstone layers, forming the base of Unit G. In practice, there is a broad transition through the contrasting lithofacies of Units F, G and H. The sedimentological change is heralded in Unit F by a thinning of the sandstone beds near the base, where mudstone and siltstone intervals up to several centimetres thick are also intercalated. The succeeding, thickly developed, dark grey mudstones and siltstones at the base of Unit G of the Tuttle Hill Member suggest deposition following a flooding event on the Cambrian shelf. The overlying sandstones include beds with tabular geometry, showing plane-laminated internal structure, normal or reverse grading, or abrupt changes between texturally differing sandstone layers. They are interpreted as the deposits of sediment gravity flows induced by storm events acting on a shoreline that had receded as a result of the flooding event.

The shearing seen in the basal, mudstone-rich part of Unit G indicates a phase of north-eastwards directed compression during which most of the strain was taken up within easily deformable sedimentary layers; Caledonian or Variscan ages for this deformation are equally possible.

The next stage in the transition is represented at Locality 5 by Unit H. The grey pebbly sandstones seen here are amongst the coarsest-grained in the Tuttle Hill Member. The middle and lower parts of each sandstone bed are either massive or show poorly-developed cross-bedding with foresets, where seen, indicative of a north-easterly current flow (these directions are as observed, with no corrections made for subsequent tectonic tilting). The upper several centimetres of many of these beds are cross-laminated and show a reversed, south-westwards current flow. A distinctive feature of this unit is the occurrence of highly lenticular packages of laminated mudstone and siltstone between the sandstone beds; these are up to 0.7m thick. Mudstone also occurs as intraclasts within erosive-based sandstone beds. The overall character of Unit H could suggest deposition within a storm-influenced offshore ridge system similar to those described by Hein *et al.* (1991).

Unit I of the Tuttle Hill Member commences at Locality 6. The lower part of the unit comprises alternations of medium to thickly-bedded, planar (locally trough) cross-bedded sandstone and thinly bedded, compound-lenticular cross-bedded sandstone. Each of these sedimentary 'packages' measures several metres in thickness. The planar cross-bedded sandstones are interpreted as sections through migratory dune-like sandwaves formed in a north-east directed current regime; the compound-lenticular beds formed sandwaves in a more unsteady regime, with the mudstone drapes representing slack periods between each current event. The compound-lenticular cross-bedded sandstones show a heirarchy of internal discontinuities, commonly outlined by mudstone drapes or trails of mudstone clasts. In this respect, they resemble the Class V sandwaves of Allen (1980). Conditions of abundant arenaceous supply are suggested by the thickness (2m) of the planar cross-bedded sandstone beds in the vicinity of the two lamprophyre sheets intruded above the middle part of Unit I. Above this, the beds become thinner towards Unit J.

At Locality 7, beds in Unit J comprise a heterolithic (sandstone-mudstone) interval within the Tuttle Hill Member. The sandstones have parallel bases and tops and are either structureless, or show inverse or normal grading. In a well-developed example, ripple cross-laminated fine-grained sandstone and siltstone forms a several centimetre-thick capping. The sandstone beds may be of storm origin, similar to those in Unit G.

Commencing at Locality 8, Unit K is a thick and uniform sequence of compound-lenticular cross-bedded sandstones. Some of these beds show normal grading with ripple-marked sandstone or siltstone tops, while others are capped by poorly sorted sandy and silty layers containing mudstone rafts, possibly indicative of storm reworking of bed tops. Most beds are similar to the compound-lenticular sandstones near the base of Unit I, and are probably sections through sandwaves. The sandstones seen here are typical of the middle to upper parts of the Tuttle Hill Member; they are medium- to fine-grained, micaceous, dark maroon subarkoses or lithic subarkoses. Green glauconite grains are conspicuous on weathered surfaces, particularly when viewed by hand lens. Bioturbation is also commonly seen along the bedding planes.

A sharp sedimentological change is seen at Locality 9, where the lenticular-bedded sandstones of Unit K give way to a thick succession of perfectly planar-based and flat-topped beds in Unit L, the highest component of the Tuttle Hill Member. These beds of medium-grained sandstone, between 0.4 and 0.8m thick, commonly show faint plane-lamination, or very low-angle cross-lamination. Mudstone drapes are only sporadically present, but as the upper part of each sandstone bed is deeply bioturbated it is possible that the sand and mud components have been extensively mixed. The interpretation of these beds is problematic; each may represent a separate episode of storm-induced deposition on a part of the shelf situated close to an abundant supply of arenaceous material.

Locality 10 shows the Jee's Member to comprise cosets of planar and trough cross-bedded sandstone, with some plane-bedded intervals. Winnowed lags of coarse-grained sandstone occur along some of the bed tops. These features suggest greater exposure to wave and/or current action, perhaps indicative of a general shoaling of the shelf to shallower water depth. Brasier and Hewitt (1979) describe extensive bioturbation in this member, noting the presence of the trace fossils *Isopodichnus*, *Arenicolites*, *Planolites* and *Didymaulichnus* suggestive of the '*Cruziana* ichnofacies'; this is perhaps indicative of a shallow water, shoreface setting.

One of the most significant components of the Hartshill Sandstone is the Home Farm Member. It is only about 2m thick and is partly exposed at Locality 11. It principally comprises the red sandy limestones and phosphatised limestone conglomerates of the well-known *Hyolithes* Limestone. Quartz-pebble conglomerates, not exposed here, occur beneath the limestone, and rest erosively upon the Jee's Member.

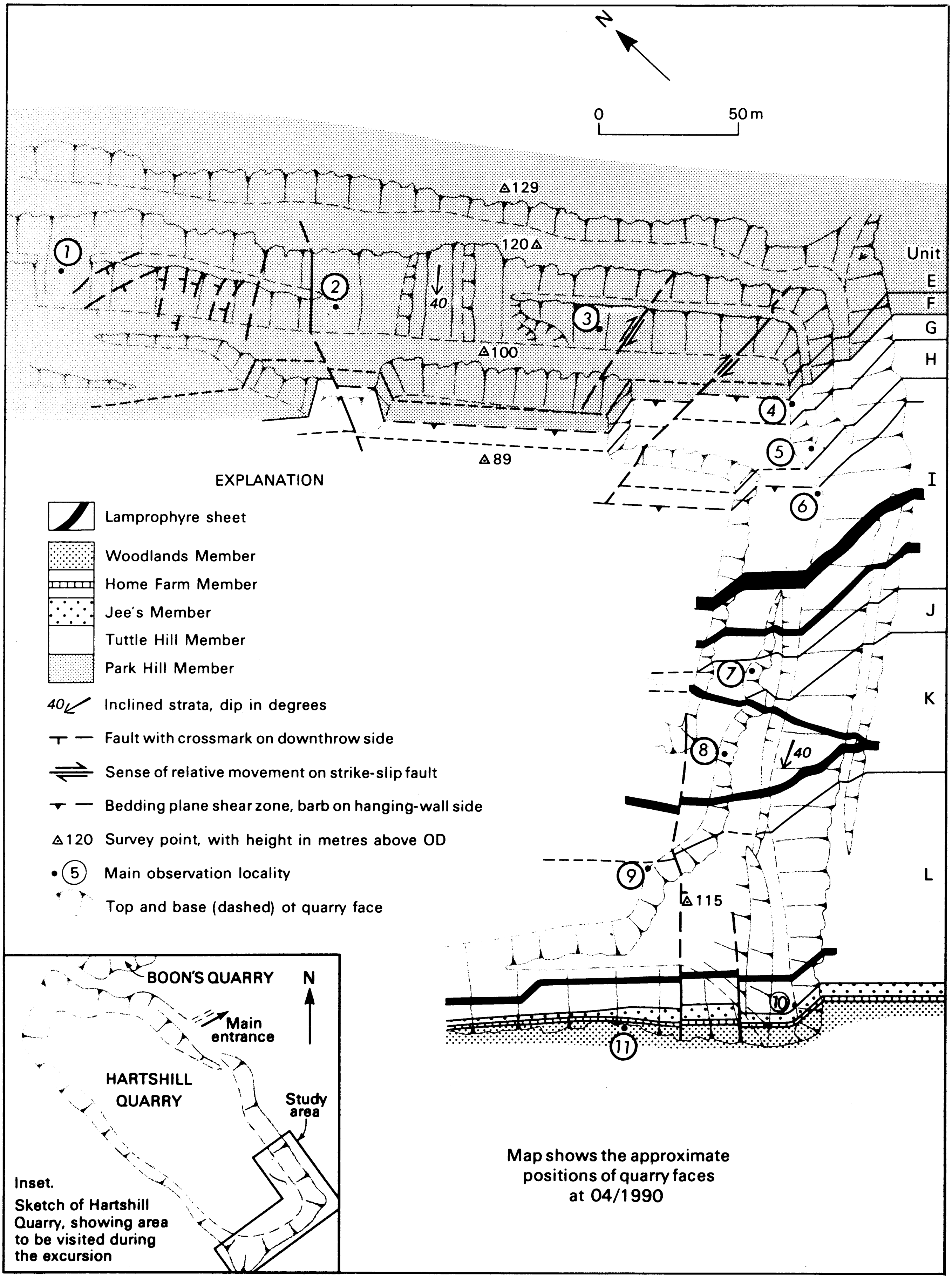

Fig. 5. Geological sketch map of the south-eastern part of Hartshill Quarry.

Tubular fossils, representing *Hyolithellus*, *Coleoloides* and *Torellela* are easily distinguishable on weathered surfaces at this exposure. They are part of the extensive and diverse fauna of this member, reviewed by Brasier (1989 and other publications), which spans the latest Tommotian and earliest Atdabanian stages of the Lower Cambrian (Brasier *et al.*, 1992). The sharply defined sedimentary discontinuities common throughout the *Hyolithes* Limestone are interpreted as hardground surfaces formed by successive episodes of marine erosion in an environment starved of arenaceous clastic material (Brasier and Hewitt, 1979). Such conditions typically arise during the accumulation of condensed sedimentary sections (e. g. Haq, 1991), suggesting that the base of the Home Farm Member is an important Lower Cambrian sequence stratigraphical marker horizon. In keeping with this are the regional correlations, summarised in Brasier *et al.* (1992), which show that the Home Farm Member corresponds to a hiatus in sedimentation that is recognised throughout the Early Cambrian province of England and Newfoundland.

Beds of the Woodlands Member are poorly exposed at Locality 11. They comprise dark grey, micaceous, glauconitic, subarkosic sandstones which commonly show a fine parallel lamination that is in part defined by entrained glauconite grains. Elsewhere in the quarry, these sandstones form thick beds with current-rippled tops. The Woodlands Member represents a renewed phase of arenaceous sediment supply to the basin, perhaps consequent upon a relative fall in sea level. A few hundred metres north-west of Locality 11, beds forming the upper 1.5m of the Woodlands Member are highly bioturbated and calcareous. This interval represents conditions of stillstand and sediment starvation, and was a prelude to the major shelf flooding event that initiated deposition of the Stockingford Shale Group.

Acknowledgements

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