Biggar Archaeology group

Bringing the past to the present

Clydesdale Project

Daer Valley Excavation 2010 - 2011

Lithics

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Of the lithic materials recovered in the Daer excavations, it is no surprise that the locally available Radiolarian Chert is by far the most abundant. This paper describes the geology of the Chert and suggests some possible sources for the Daer material.

Fliint is present at Daer in almost all the metre squares excavated – mostly in small numbers – while only rare specimens of pitchstone have been recovered.

Chert

Geologically speaking, the term “chert” is used to refer generally to all rocks composed primarily of microcrystalline, cryptocrystalline and micro fibrous quartz, such as flint, chalcedony, agate, jasper etc. However, the variety known as radiolarian chert which occurs in the Daer valley excavations, occurs only in the Southern Uplands of Scotland. It formed in a deep water oceanic context when the siliceous skeletons of radiolarians (amoeboid protozoa) and windblown fine-grained sediment settled on the ocean floor and, over time, turned to rock. Such deposits build up very slowly - only about 1 millimetre collecting in 1000 years.

In the current excavation in Daer Forest, the chert occurs as two main varieties. The first of these has a rough or hackly fracture and is generally in shades of grey, medium dark grey [N 3][1] to medium grey [N 5], in colour. In a number of cases, the chert of this type shows traces of the original bedding, with alternating fine-grained and coarser-grained laminae. The second variety has a smooth, waxy or resinous finish and, commonly, a conchoidal fracture. It ranges in colour through olive grey [5 Y 3/2] and light olive grey [5 Y 5/2] to dark greenish grey [5 GY 4/1] or olive black [5 Y 2/1]. In the 4 most prolific sites - Sites 86, 87, 89 and 99, that contain a total number of 11 258 specimens of the above types that exceed 10mm in length[2], the rough-fracturing chert is a little less than twice as abundant as the smooth-fracturing variety.

Alteration and/or weathering of both main types of chert occurs, either dispersed through the specimen or as a distinct pale buff zone that was the original edge of the chert nodule or bed. This feature is more widespread in the case of the rough-fracturing chert. While it is reasonable to assume that all the chert specimens contain radiolarian skeletons, these are generally distinguishable - as spheres c.0.1-0.2mm in diameter - only in the parts where the pale alteration has occurred. It would appear that the siliceous skeletons of these organisms were more resistant to the diagenetic processes involved.

1 To achieve consistency, the colours, annotated in square brackets, used throughout the text are as defined in the ‘Rock Colour Chart’, prepared by the Geological Society of America, Boulder, Colorado.

2 Note: The classification of the chert specimens is based on their lithology and on their size - Large - greater than 25mm; Medium - 10-25 mm, Small - less than 10mm.
The small flakes cannot be readily classified and have been excluded from the calculations.

Less abundant than either of the above types is what is here termed ‘grey chert’. This is mostly light brownish grey [5 YR 6/1] in colour and occurs as both rough and smooth fracturing variants. The possibility cannot be excluded that they are actually extensively altered examples of the two main types of the normal radiolarian chert. It is hoped that this issue will be resolved during the field survey. Radiolarian skeletons are visible throughout almost all specimens of the ‘grey chert’.

Although present in most metre grid squares, the ‘grey chert’ usually occurs in small numbers. Thus, of a total of 11 258 specimens of chert recovered at the above sites, only 1175, or 10.4 %, were of the grey variety. However, a striking exception is the assemblage recovered from a charcoal-rich feature in grid squares 6/N2 and 7/N2 of Site 89 in which ‘grey chert’ predominated in all size ranges of an assemblage that included 3 scrapers.

In many of the metre grid squares, a small number of specimens of the smooth-fracturing variety have the olive grey or dark greenish grey coloration partly replaced by greyish brown [5 YR 3/2] or moderate brown [5 YR 3/4]. In a few cases, the replacement is complete; producing what in this study is referred to as ‘red chert’.

The principal source of information regarding the nature and distribution of naturally occurring radiolarian chert is the monumental memoir of the Geological Survey by B.N. Peach and J. Horne (1899). On page 38 of their account, they describe the rock succession as it is present in ‘The Northern Belt’, that is, in the Leadhills to Abington area, as follows.

The Radiolarian Cherts – The Northern Belt

Rocks

The lowest visible strata are of volcanic origin, comprising lavas of various types (diabase, “diabase-porphyrite,” and mica-andesite), together with agglomerates and tuffs, of which perhaps the most interesting is the augite-andesite tuff of Bail Hill, Sanquhar. These are traversed by intrusive igneous materials, including dolerites and gabbros.

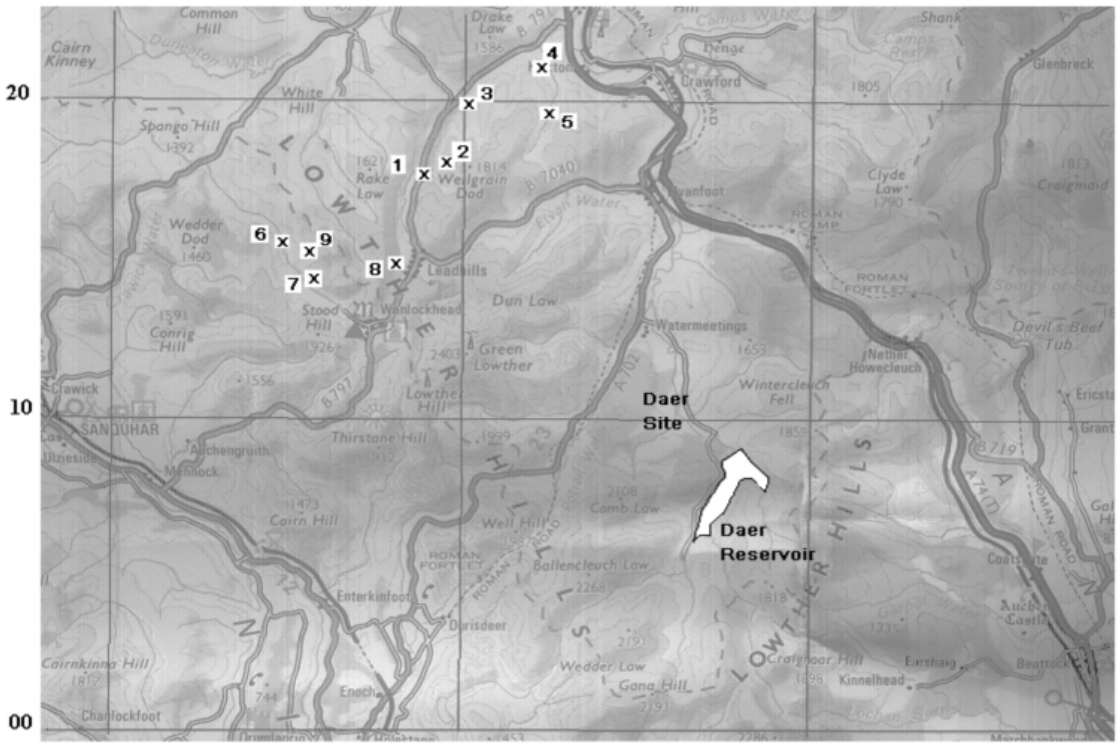
Overlying the volcanic series is an important development of cherts and mudstones, which, where typically developed in the Abington area, may be grouped in three sub-zones. The lowest of these is composed of red or chocolate-coloured cherts embedded in a fine ashy matrix. possibly of volcanic origin, which, when the matrix is exposed to weathering, bleaches to a white colour. The middle and upper sub-zones consist of green and grey cherts respectively, which occur as elongated flattened nodules from a few inches to a few feet across. Frequently they coalesce so as to form a more or less persistent bed. These banded cherts, the upper surfaces of which are often mammillated or botryoidally, vary in thickness from a few inches to a foot or more, and give rise to a remarkable ribbed contour which is a characteristic feature of the series. They are associated with green, grey, and red mudstones, sometimes, several inches thick, which by the admixture of siliceous material pass laterally into chert: In one or two sections a thin seam or film of black shale is intercalated between the overlying mudstones and cherts and the underlying volcanic rocks.

Fossils

The cherts are abundantly charged with radiolarian (Plate 1). From the researches of Dr. Hinde, in whose hands the collection of cherts made by the Geological Survey was placed for examination, it appears that, in thin sections of the unstained rock, the organic remains, when viewed under the microscope, look like larger and smaller circles filled with somewhat lighter material than the surrounding matrix.

Peach and Horne concluded that the rocks had been laid down in an oceanic environment. They listed a number of localities where the Radiolarian Chert could be examined. Those that lie closest to the Daer Forest excavation are shown on the sketch plan. It seems reasonable to suppose that the rough-fracturing grey chert, the smooth-fracturing olive or greenish grey cherts and the red chert correspond seriatim with the grey, green and red cherts recognised by Peach and Horne. It is hoped that this can be confirmed by an examination of the outcrops.

The Radiolarian Chert formation is generally about 70 metres thick but its outcrop is repeated by folding and faulting. It occurs in elongated bodies along the northern edge of the Southern Uplands. The Leadhills outcrop extends north-eastwards into the lands of Burnetland, near Broughton, where, in prehistoric times, the chert was worked in a number of quarries. An excavation in one of these was carried out by the Biggar Archaeological Group in 2005.



Map showing localities where strata of the Radiolarian Chert are exposed.
From Peach and Horne, 1899.

Pl. 1

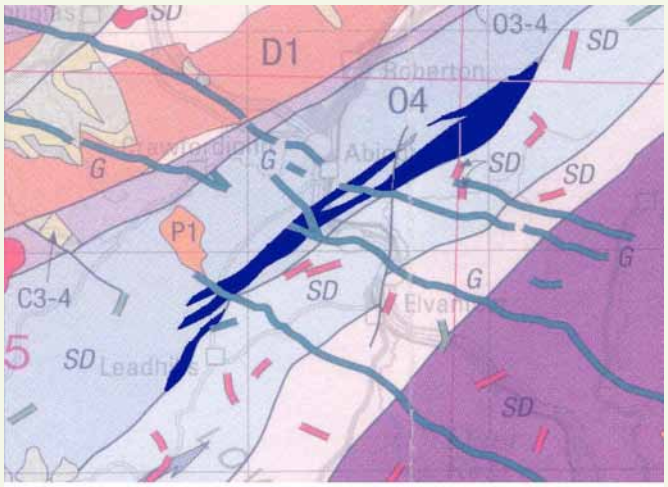


Fig. 1. Sketch map illustrating outcrop of strata with radiolarian chert (dark blue).

From 'Bedrock Geology - UK North', British Geological Survey.

Plate 1 shows an example of the most typical coloured chert being blue / grey. The left half has numerous speckles which are fossilised radiolaria. These are also included in the centrally weathered band but are absent in the other half which is fairly homogenous. The sample is about 50mm in size and would have been of knapping quality.

In more recent years, the complicated rocks of the Southern Uplands have been the subject of studies involving systematic field mapping, stream sediment sampling and whole-rock geochemical analysis by the British Geological Survey and university researchers. A useful summary of the work is provided by Smith and others (2001)[3]. The Radiolarian Cherts, which are now assigned to the Ravensgill Formation of the Crawford Group, are considered to be of Arenig (early Ordovician) date on the basis of their conodont faunas. This is consistent with a Sm-Nd isotopic age of 490 ± 14 Ma obtained from the underlying basaltic lavas. The Crawford Group cherts have been shown to possess rare earth element (REE) characteristics typical of cherts deposited in a continental margin setting.

3 R. A. Smith, E. R. Phillips, J. D. Floyd, H. F. Barron and E. A. Pickett, 2001 (for 2000). The Northern Belt 100 years on: a revised model of the Ordovician tracts near Leadhills, Scotland, Trans. Roy. Soc. Edinb, 91, 421-434.

Flint

A few flakes of very pale grey or brown flint occur as chunks and struck flakes in most assemblages, in a number of cases being formed into microliths. In a few cases, it is evident that the flint specimens formed part of - or had been struck from -a water-worn pebble. It is likely that all the flint - which does not occur in situ in Scotland - had originated in beach shingle or river gravel.

Pitchstone

Pitchstone is a volcanic glass that occurs at a number of localities on Arran. As described by Ballin and Faithfull , the pitchstone of Arran occurs in four main variants. At Daer, two of these are present - the Corriegills type, which shows pale and dark grey flow-lamination and a dark grey, almost black type with a resinous finish. The flow-lamination arises when the still mobile glass begins to devitrify forming minute crystals. The lamination may form into folds. At some outcrops, the pitchstone is porphyritic and contains a few or abundant phenocrysts of quartz, feldspar and the so-called 'dark' minerals such as amphiboles and pyroxenes.

Both the dark grey and the light grey variants of pitchstone have been recovered in the Daer Forest excavation.

Reference

Peach, B. N. and Horne, J.1899. The Silurian Rocks of Great Britain, Volume 1: Scotland. Mem. Geol. Surv. Gt. Brit..