CRAWTON
LAVAS AND CONGLOMERATES OF THE LOWER ORS

by
N. H. TREWIN

PURPOSE
To examine the lavas and conglomerates of the Crawton Group of the Lower ORS.

ACCESS
Crawton is situated 7 km (4 miles) south of Stonehaven along the A92 road. Turn off the A92 at [NO 873 810] along a single track road with passing places to Crawton. There is a small car park near the end of the road with turning space for a minibus if not too congested. The excursion involves fairly easy walking on path and shore but with some steep grassy slopes which can be slippery when wet. Allow approximately two hours for the excursion. The area is covered by 0.S. 1:50,000 sheet 45 (Stonehaven) and Geological Survey 1:50,000 sheet 67 (Stonehaven).

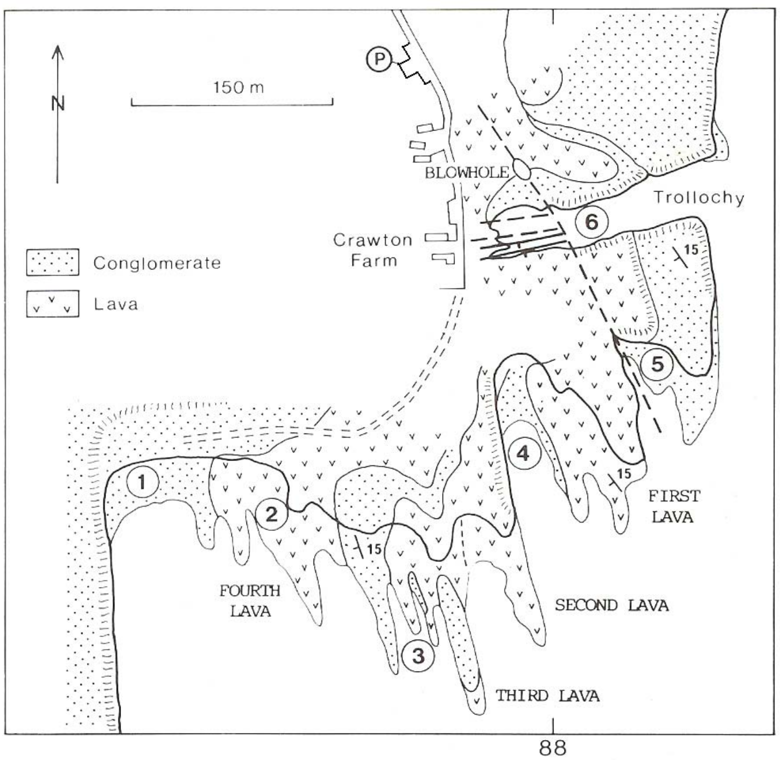

Fig. 1. Locality map of Crawton area.

INTRODUCTION

The Crawton Group of the Lower ORS comprises a series of conglomerates of alluvial fan origin, together with the Crawton Volcanic Formation which marks he top of the Group. The volcanics consist of lavas of olivine basalt and distinctive porphyritic andesites with tabular feldspar phenocrysts. The conglomerates of the Lower ORS of the Strathmore Syncline contain some clasts which can certainly be matched with lithologies in the Highland Border Complex, and possibly also the local Dalradian seen north of the Highland Boundary Fault (see also Exc. 23, Loc. 5). Many basement-derived clasts in the conglomerates are apparently not sourced from this area and provide evidence for a southerly source for much of the conglomeratic material (Bluck 1984). Further evidence for a southerly source contribution is provided by pebble imbrication directions which indicate transport from the SE for much of the lower part of the Lower ORS. At Crawton a component from the SW is present and at other places transport from the NE is indicated. Possibly the area was close to the convergence of transport from a variety of directions. There is a strong possibility that many of the quartzitic clasts have a polycyclic history, being derived from older conglomerates. Proof of reworking is provided by rare examples of reworked lithified conglomerate with clasts of quartzite and acid volcanics (Downie 1982).

It is possible that the Dalradian basement to the north was largely covered by conglomerates which were being reworked into the Strathmore Syncline, which would account for the absence (Bluck 1984) or rarity (this interpretation) of Dalradian-derived clasts in the lower part of the Lower ORS. These lavas form part of a dominantly calc-silicate suite of volcanics similar to those of modern continental margins (Thirlwall 1981) and my be related to late Silurian or early Devonian subduction activity. The Strathmore area also received volcanic detritus from the Ochil-Sidlaw volcanic area to the south (Bluck 1983), as well as from north of the Highland Boundary Fault, and thus lay between two volcanic chains, and may have resembled an interarc basin.

Clearly the paleogeography of the area is more complex than the previously assumed simple model involving sediment derivation from the “highlands to the NW”. Further discussion is given in Bluck (1984) and the Geological History section of this volume. Hopefully further research on the agesand compositions of clastsin the conglomerates will provide more evidence on the tectonic and sedimentation history of the Lower ORS. Arguments will continue on the relative position of the Grampian Dalradian Block to the depositional area of the Strathmore Syncline; The reworking and origin of any superficial cover this block may have possessed; and the nature of any primary southerly source area.

Locality 1 **[NO 877 796]**

From the parking area follow the track southwards, past the ruins of the fishers’ houses, and down into Crawton Bay. The promontories are formed of the lavas in the succession, whilst the conglomerates are more susceptible to marine erosion and form the bays. Major joints and small faults also have a strong influence on the coastal morphology.

The west side of the bay is marked by a vertical cliff of conglomerates which shows some crude bedding marked by variation in pebble and boulder size. At the top of the cliff in the angle at the back of the beach, a sandier facies is present showing cross-bedding with an apparent seawards dip. This half of the cliff above the grassy ledges forms part of a seaward dipping fan with slightly steeper apparent dip than the underlying conglomerates. The conglomerates contain rounded pebbles and boulders over 50cm in diameter. These boulders were rapidly rounded by stream transport as bedload. The finer-grained material, mainly coarse sand to small pebbles, is not so well rounded. Most of the conglomerate is clast-supported and has a coarse sandy matrix. Volcanic debris is abundant, with massive, porphyritic and vesicular lava types represented. Other lithologies present include quartzites, granitic rocks, metagreywackes, jasper and “greenstone”. The jasper and “greenstone” pebbles are clearly derived from rocks similar to the Highland Border Complex. The metagreywackes have spaced cleavage and strongly resemble Dalradian lithologies seen on the Stonehaven excursion to the north of the Highland Boundary Fault.

The beach is composed of pebbles and boulders largely derived from the ORS. A good storm beach is developed which merges with vegetated talus from the cliff.

Locality 2 **[NO 878 796]**

The topmost lava (4th) seen is a purplish massive basalt with scattered vesicles which are occasionally over 10 cm in diameter. Vesicles are generally filled with calcite and quartz, but brick red stilbite is also present. The margins of this lava are not normally exposed.

Locality 3 **[NO 879 795]**

The ridge of conglomerate exposed on the beach provides a good opportunity to examine the range of lava types present. At this locality lava clasts are less abundant, and there are prominent boulders up to 1 m in diameter of a finegrained pinkish granite. The large maximum size and range of sizes indicates that they were derived from a local source. Boulders and pebbles of quartzite, jasper, banded chert, greenstone, felsite and metagreywacke are also present.

A few metres beyond the conglomerate ridge the top of the next lava (3rd) is exposed, and the relation with the overlying conglomerate is seen. The lava is both vesicular and porphyritic at the top with lath-shaped feldspars some 20 mm long and 2-3 mm thick. These phenocrysts display impressive flow orientation, particularly in the main body of the flow.

The top of the lava is irregular and was eroded prior to deposition of the conglomerate. Erosion hollows, some resembling small potholes, are filled with conglomerate. The contact is well exposed in the wall of the narrow jointcontrolled gully which cuts the lava and conglomerate. The promontory formed by the third lava is capped by conglomerate overlying the lava. The junction between the third and second lavas can usually be located at beach level at the base of the cliff forming the eastern side of this promontory. The junction is marked by thin, impersistent red mudstones and blocks of altered lava, the reddening being evidence of a phase of subaerial weathering to produce a 'red bole'. Ascend the cliff by the ridge formed by the conglomerate on top of the lava and follow the cliff edge to the next point, noting the promontories formed by the four lava flows.

Coarse conglomerates of the Crawton Group of the Lower ORS resting on the third lava of the Crawton sequence at locality 3.

Locality 4 **[NO 880 796]**

At the point descend a grassy slope onto the top surface of the lowest (1st) lava flow and follow the dip surface down into the small bay. The western wall of the bay shows the porphyritic second lava with very well developed flow orientation of feldspar phenocrysts. A thin conglomerate is present in the bay which rests on the slaggy top of the lowest lava flow. This lava is porphyritic and vesicular at the top, with vesicles filled with calcite and a green chlorite. Follow the top of the lava around into a small gully eroded along a prominent joint.

Locality 5 **[NO 8805 7970]**

The subhorizontal surface within the gully shows cross-sections through columnar jointing which affects the central part of the lava flow and formed during cooling of the lava. The columns are generally 30-60 cm in diameter, and have weathered in a curious manner with the result that the softer centres have been hollowed out, and the column margins stand up as ridges. The columnar jointing is not well developed throughout the flow and in vertical sections as on the west wall of the gully, it is seen to form downward-divergent fans when viewed from the conglomerate surface on the east of the gully. At this point the base of the lowest lava can be seen to be more vesicular and have disoriented feldspar phenocrysts. Patches of laminated sandstones and mudstones underlie the lava and these have been disrupted in places and baked by the lava. Return to the gully and walk over to the southern edge of the vertical-sided inlet known as Trollochy.

Locality 6 **[NO 880 798]**

Looking across Trollochy, the opposite cliff is formed of conglomerates with a crude stratification defined by changes in grain size. There are some lenticular sandstones included in the conglomerates, one of which is seen near the foot of the cliff beneath the waterfall. These sandstones show inclined bedding and trough cross-bedding and are better sorted than the conglomerate matrix. They probably represent sandy accretion deposits on the sides of gravel bars on an alluvial fan, and were deposited during periods of low water level and reduced stream power. They would normally have been eroded and destroyed during periods of more violent stream flow when the conglomerates were deposited, but a few examples escaped destruction.

Trollochy is eroded along a series of joints and minor faults which each throw down to the south, as can be seen by following the base of the lowest lava around the head of the inlet. A prominent joint trending NNW-SSE has also been exploited by the sea and along its line a blowhole used to function, but it is blocked by debris at present. The stream that forms the waterfall follows a post-glacial course (MacGregor 1968). The old course lay along the line of the blowhole and is blocked by boulder clay.

Walk around the head of Trollochy and enter the Fowlsheugh Nature Reserve **(R.S.P.B., No dogs!).** Here the blocked blowhole can be seen and a steep grassy slope allows access to the beach. At the beach the details of the faulting and the sequence of laminated and cross-bedded sandstones and mudstones underlying the lowest lava flow can be seen. One of the sandstone lenses within the conglomerate is well exposed on the north side of the. bay and was deposited on an inclined surface of conglomerate probably representing the side of a gravel bar. Other examples of inclined bedding can be seen in the conglomerates here. The conglomerates were probably deposited as coarse gravel braid bars on large alluvial fans subject to periodic violent stream flow. On the reef exposed within Trollochy one bed of conglomerate has a cement of pink micritic calcite which shows solution weathering features. This bed, which can also be found at a higher level on the north side of Trollochy, was deposited with an open texture and was subsequently cemented by carbonate. The carbonate was probably deposited close to the alluvial fan surface due to evaporative concentration in a semi-arid climate.

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