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# Raven Gill

[NS 9204 1989]

## Introduction

Raven Gill is the type locality for the Raven Gill Formation, a faulted slice of Arenig rocks within the Leadhills Imbricate Zone, and its interpretation is critical to understanding the plate tectonic history of the Southern Uplands.

Raven Gill lies in a zone of complex geology along one of the major strike-parallel faults in the Southern Uplands, the Leadhills Fault. The stratigraphy within the Leadhills Imbricate Zone is unclear (see Floyd, 1996), but at Raven Gill and in the headwaters of the Snar Water, 6.5 km along strike to the south-west, conodont faunas indicate an Arenig age for part of the succession. The present faunal evidence indicates that, apart from the Arenig rocks in the Leadhills Imbricate Zone, there are no rocks in the Southern Uplands older than latest Llanvirn. The Raven Gill Formation is thus crucial for understanding the plate tectonic history of the Southern Uplands — a subject that continues to generate considerable controversy (see the set of papers introduced by McKerrow (1987) and also Armstrong *et al.* (1996) for more recent developments).

Peach and Horne (1899, p. 286) first described the section at the head of Raven Gill and recognized that the lavas, intrusive igneous rocks, radiolarian cherts and mudstones were Arenig in age. They listed a fauna from the mudstones comprising graptolites, lingulate brachiopods and what they questioningly termed 'annelid jaws'. The last of these proved to be conodonts (Smith, 1907), later described by Lamont and Lindström (1957) (see also Armstrong *et al.* (1990, 1999) and references therein) on the basis of extensive collections made by Lamont. The term 'Raven Gill Formation' was first published by Hepworth *et al.* (1982, p. 521) (see also Walton and Oliver, 1991, p. 170), and the formation was discussed in Floyd's (1996, p. 156) review.

## Description

Although the adjacent hillside is barren of outcrops, exposure is very good on the steep sides of the two upper branches of Raven Gill and more intermittent in and at the sides of the burn for some 75 m east of their confluence. The ridge between the two upper branches is a mass of lava or possibly a dolerite intrusion. On its northern side is lava and lava conglomerate, to the north of which, extending up the northern bank of the burn, is a steeply dipping sedimentary succession, although the contact between the two is not exposed. The sedimentary rocks comprise alternating packets of bedded radiolarian chert up to 2 m thick and brown-weathering mudstone up to 4 m thick. The chert beds are up to 15 cm thick, vary in colour from green to black and are commonly interbedded with yellow-weathering mudstone layers up to about 3 cm thick. The igneous rocks, cherts and mudstones all belong to the Raven Gill Formation, as defined by Hepworth *et al.* (1982, p. 521).

Lava crops out on the immediate south side of the southern branch and lavas or dolerite extend along the burn for some 30 m beyond the confluence, with greywacke cropping out on the southern bank. Recent work by Drs H.A. Armstrong, J.D. Floyd and A.W. Owen has revealed that, just below the confluence, large pockets of rottenstone in rather sheared greywacke may indicate a weathered conglomerate, and on the northern bank here there are alternations of greywacke, shales, microconglomerate and lava or thin basic intrusions. Detailed mapping of the site is required to clarify the relationships between the various rock units.

## Interpretation

The commonest of the fossils listed by Peach and Horne (1899, p. 288) from the brown mudstones are lingulate brachiopods of little stratigraphical value. The graptolites they recorded are too fragmentary to be identified taxonomically (Floyd, 1996, p. 157), and no new graptolites have been recovered. However, the abundant conodonts from the brown

mudstones described by Lamont and Lindstrom (1957) were re-identified by Löfgren (1978, p. 38) and include *Oepikodus evae*, the eponymous species of the lower to low-middle Arenig *evae* Zone. Smith's (1907) record of Arenig conodonts from the headwaters of the Snar Water has recently been confirmed by Armstrong *et al.* (1999) who have collected conodonts of the *evae* Zone there. Other conodont faunas from cherty mudstones in the Leadhills Imbricate Zone are interpreted as being from the Kirkton Formation and belong in the uppermost Llanvirn to basal Caradoc *Pygodus anserinus* Zone (Armstrong *et al.*, 1990, 1999; Floyd, 1996).

Thirlwall (in McKerrow *et al.*, 1985, p. 75) reported a Sm-Nd age of  $490 \pm 14$  Ma from 'basalts underlying Arenig cherts near Raven Gill'. This is broadly commensurate with the projected age of 485 Ma for the base of the Arenig given by Tucker and McKerrow (1995) but is less compatible with the late Tremadoc age of  $483 \pm 1$  Ma of Landing *et al.* (1997) and the early Arenig age of  $471 \pm 3$  of Compston and Williams (1992). Lambert *et al.* (1981) considered the lavas from a pipeline section near Raven Gill to have originated in an oceanic setting. However, a reassessment by Armstrong *et al.* (1996, p. 201) indicated that Lambert *et al.*'s data provide equivocal results, one sample suggesting an attenuated within-plate setting, the other a volcanic arc developed on continental lithosphere. The interpretation of more recent analyses of basic igneous rocks from the Leadhills Imbricate Zone in the Leadhills area is also equivocal (Phillips *et al.*, 1995). The cherts from Raven Gill have a continental margin geo-chemical signature (Armstrong *et al.*, 1999). The understanding of the origins and structural setting of the Raven Gill Formation is crucial to determining the plate tectonic origins and history of the northern belt of the Southern Uplands, but a consensual understanding has yet to be achieved.

## Conclusions

This site is the type locality for the Raven Gill Formation, the oldest unit in the Southern Uplands. It lies in an extensive band of very complex geology, the Leadhills Imbricate Zone, and its interpretation is critical to the continuing controversy surrounding the geological history of the Southern Uplands. It has yielded a rich fauna of conodonts belonging to the *Oepikodus evae* Zone, indicating that the formation is early to mid-Arenig in age.

## [References](#)