Dippin Head

Highlights

This site has exposures of the large alkaline Dippin Sill which contains crinanite, teschenite and pegmatite components and baked Triassic country rock. Primary nepheline, present in some of the components, indicates the undersaturated nature of some of the margins.

Introduction

The Dippin Head site represents an important locality for the exposure of the Dippin Sill — a basic, compositionally variable intrusion. It is an important member of the suite of minor intrusions seen in south-east Arran. The sill lies within baked Triassic marls and is intruded at this locality by a large doleritic dyke (Figure 6.7).

The petrology of the sill has been described in a detailed study by Gibb and Henderson (1978a; 1978b), who proposed a model for the petro-genesis of the magma which fed the intrusion. An earlier description of the sill is also contained in the Arran Memoir (Tyrrell, 1928).

Description

The Dippin Sill crops out at Dippin Head [NS 050 222] and extends beyond the limits of the site between Cnoc na Comhairle [NS 036 240] and Cnocan Biorach [NS 034 222] and beneath much of the ground to the west. At Dippin Head, the sill attains a thickness of approximately 36 m and overlies highly baked Triassic marls. Here the sill is intruded by a thick, sparsely feldspar-phyric dolerite dyke with conspicuous tachylitic margins. Both intrusions display columnar jointing, which is vertical in the sill and horizontal in the dyke. The sill has the structure of a slightly transgressive sheet dipping to the south-east and thinning to the south-west, west and north. A thickness of 42.8 m was recorded from a borehole, in a stream at [NS 043 228] (Gibb and Henderson, 1978a), which intersected both the roof and the floor of the intrusion.

Gibb and Henderson (1978a) described four main rock types within the sill, each variety having sharp, but unchilled, internal contacts, suggesting that the sill was probably intruded as a single event. These varieties and their petrological characteristics are listed in (Table 6.2). Analcite, common in this and other similar intrusions, occurs in part after primary nepheline.

(Table 6.2) Petrological variation within the Dippin Sill (based on Gibb and Henderson, 1978b, figure 4)

Rock type	Position within sill	Petrological features
(a) Crinanite	Central = forms the bulk of the intrusion	Plagioclase, analcite, olivine, ophitic Al-, Ti-rich augite. Zeolites. Analcite, secondary after nepheline and of hydrothermal origin. Olivine up to 12 vol.% about 10–15 m above base.
(b) Teschenite	Marginal facies = fine-grained margins showing quench textures	Lacks fresh olivine, substantial amounts of analcite, zeolites and calcite. Margins have skeletal Ti-augites.
(c) Augite teschenite	Patches within crinanites, especially towards base.	Augite, plagioclase, analcite. Alignment of augite suggests cumulate texture. Fe-Ti oxides more abundant than in crinanite.

(d) Pegmatite(i)	At several horizons throughout sill, centimetres to metres in thickness	Brown augite with emerald-green rims (Na-rich), plagioclase, analcite, Fe-oxides, apatite, rare blue riebeckitic amphibole and rare olivine pseudomorphs. Variant of augite teschenite.
(e)Pegmatite (ii)	As pegmatite (i)	Mineralogically as (i) but has less pyroxene and is much coarser grained. Skeletal magnetite and ophitic augite, rather than euhedral as in (i).

The large dolerite dyke at the north end of the cliff near the coast has good tachylitic margins against the sill rocks. It has developed a strong, fiat-lying, columnar jointing.

Interpretation

Large basic alkaline sheets occur in Arran and elsewhere in the BTVP (Rubha Hunish, Skye, Shiant Isles). The one which is admirably exposed within this site, the Dippin Sill, is an excellent example of the characteristic petrological features of these intrusions.

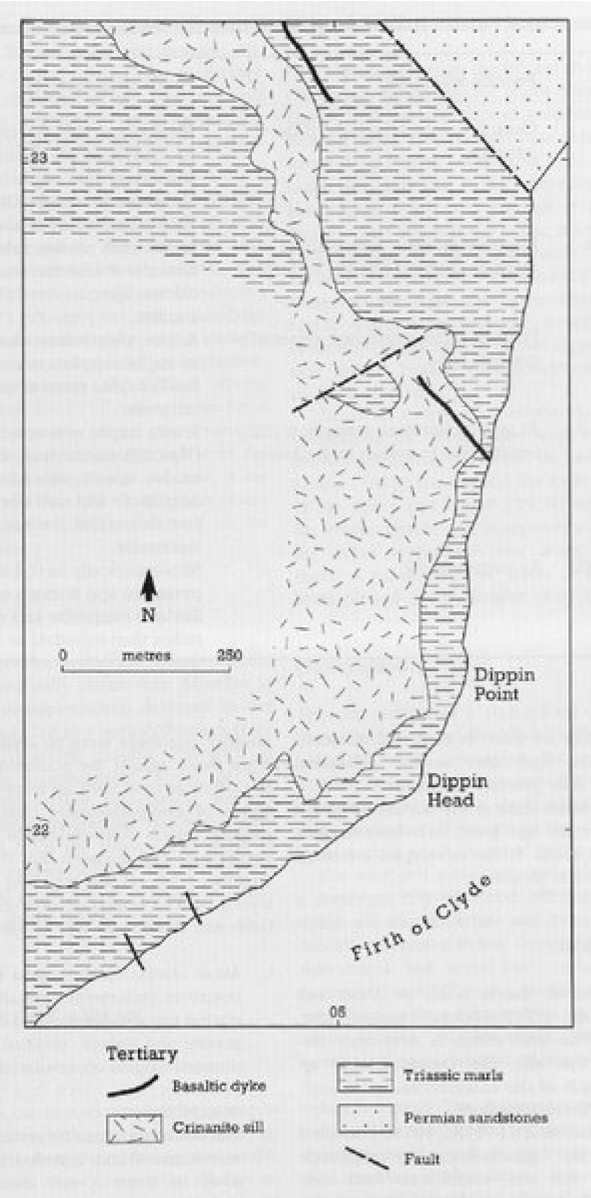
Gibb and Henderson's (1978a; 1978b) detailed mineralogical and geochemical investigations were carried out on continuous drill-core samples obtained from a locality inland from the site. They showed that the distinctive rock types were generally sharply defined against one another, but there were no chilled contacts apart from those against the sediments; consequently, the sill must have built up from the injection of a series of compositionally contrasted pulses of magma which followed each other in rapid succession. This suggests that the source magma chamber was probably stratified at the time of sill injection. The sequence of events envisaged by Gibb and Henderson was as follows:

1. Alkali olivine basalt magma in a deep crustal reservoir underwent crystallization. Olivines settled towards the base of the magma under gravity and lighter, residual and more fractionated magma accumulated towards the top of the reservoir, which thus became compositionally zoned.
2. Fractionated magma from the top of the body was released and intruded at a high crustal level to form a sill. Reaction with the sediments modified the first-injected magma.
3. Successively less-fractionated, increasingly olivine-rich magmas were subsequently injected into the central parts of the sill, where some *in situ* fractionation and flowage differentiation occurred, giving rise to further compositional variation in the high-level sill intrusion. The pegmatitic areas formed by segregation of residual magma after emplacement.
4. The sill is therefore important because it provides evidence for magmatic fractionation both prior to intrusion and also within the sill, after the injection of the pulses of closely-related, but compositionally differing, magmas. Henderson and Gibb's (1977) petrographic and mineralogical studies clearly show that some of the analcite in the sill is secondary after original nepheline. Analcite is very common in alkaline olivine dolerites throughout the BTVP, where it has been considered as a primary phase (for example, Harker, 1904). This is demonstrably not so in the Dippin Sill and it is likely that at least some analcite in other similar sills is of replacement origin, after original nepheline (as well as, for example, plagioclase).

Conclusions

The Dippin Sill shows considerable compositional variation from essentially olivine-free dolerites at the margins to olivine-enriched dolerites in the central parts. It was fed in a series of pulses from a compositionally zoned magma chamber at depth and, after emplacement, some of the magma underwent further segregation, for example, forming small pegmatitic patches. Neph-eline crystallized from the magma and some of this has survived replacement by analcite; preservation of original nepheline is unusual in alkali-olivine dolerites in the BTVP.

[References](#)



(Figure 6.7) Geological map of the Dippin Head site (adapted from the British Geological Survey I:50 000 Special District Sheet, Arran).

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