The Geology of Istind, western Dronning Maud Land, and the Relationship between the Istind and Tindeklypa Formations

C.Z. van Zyl*

Geologist,
Fourteenth South African National
Antarctic Expedition

Istind Peak was was visited in November 1973 and successfully scaled. Attention was given to the relationship between the Tindeklypa and Istind Formations and to the stratigraphy of the latter. The stratigraphy and lithology are discussed and it is concluded that the Istind Formation is merely an upward continuation of the Tindeklypa Formation and that no angular unconformity exists between these two formations. It was also established that the igneous rocks occurring in the sequence are intrusive sills and not lava flows.

Istind-piek is in November 1973 besoek en suksesvol bestyg. Aandag is gegee aan die verhouding tussen die Formasies Tindeklypa en Istind en die stratigrafie van laasgenoemde is ondersoek. Die stratigrafie en litologie word bespreek en daar word tot die gevolgtrekking gekom dat die Formasie Istind bloot 'n opwaartse voortsetting van die Formasie Tindeklypa is en dat daar geen klinodiskordansie tussen die twee formasies bestaan nie. Daar is ook vasgestel dat die stollingsgesteentes wat in die suksessie voorkom, intrusiewe plate en nie lawa-uitvloeiings is nie.

Introduction

Since 1962 Istind (02° 22′ W, 72° 06′ S) has been investigated by geologists of seven South African National Antarctic Expeditions. Two formations have been tentatively recognized.

The Tindeklypa Formation was named after Tindeklypa Nunatak, located near the confluence of the Viddalen and the Jutulstraumen *(Neethling*, 1967). In the type area this formation comprises a massive boulder bed deposit with occasional sedimentary interbeds having a regional dip of 5° to 50° ESE *(Neethling*, 1970). According to *Neethling* (1970) this formation is unconformably overlain by a sequence of sediments and intercalated lava flows which he termed the Istind Formation. The contact between these two formations has been exploited by a dolerite sill of unknown age. *Neethling* (1970, p. 24) tentatively divided the Tindeklypa Formation into four conformable members:

(i) A basal lava-pebble conglomerate.
(ii) A lower, reddish-brown boulder bed.
(iii) A bedded sandy graywacke.
(iv) An upper greyish boulder bed.

He notes that members (ii) and (iv) consist of pebbles, cobbles and boulders of earlier Ahlmannrygg Group *(Neethling*, 1970) sedimentary and igneous rocks.

Butt (1962) postulated a glacial origin for the Tindeklypa Formation, but *Watters* (1969) and later workers regarded it as a typical volcanoclastic deposit.

According to *Butt* (1962) and *Neethling* (1967) the Istind Formation comprises a 350 m thick sedimentary-volcanogenic sequence exposed in the upper part of Istind Peak. *Neethling* (1970) gives the dip as 5-7° SE and concludes that the relation of this formation to the underlying Tindeklypa Formation is one of angular unconformity (1970, p. 25). *Paterson* (1972) points out that all the steep dips (5-50°) in the Tindeklypa Formation were measured at Peak 1599 and not on the Istind main peak where contact between the two formations exists, and that an angular unconformity has therefore not been proved conclusively.

The igneous rock cropping out about 400 m below the summit has been described in a number of ways: *Butt* (1962) regarded the denser part as an igneous *intrusive* of gabbroic composition and the underlying amygdaloidal part as a "highly sheared amygdaloidal lava" of different age. According to *Bastin* (1966) this igneous rock is a flat-lying diabase sill which intruded parallel to the bedding with formation of gas bubbles (amygdales) in the contact zones. *Neethling* (1970) on the other hand describes it as a thick *basal lava flow* with a dense core. *Watters* (1969) apparently also regarded the intercalated igneous rocks at Istind as intercalated *flows*.

Because of the relatively inaccessible nature of the exposed face of Istind, all these investigations were done from a considerable distance and are therefore sketchy and speculative. In November 1973 the nunatak was successfully scaled and the geology was investigated with three objectives in mind, *viz* to test the validity of the proposed angular unconformity between the Tindeklypa and Istind Formations; to describe the lithology from the bottom to the top; and to clarify the relationship between the igneous rocks and the sediments.

*Present Address: P.O. Box 42, Kakamas 8870

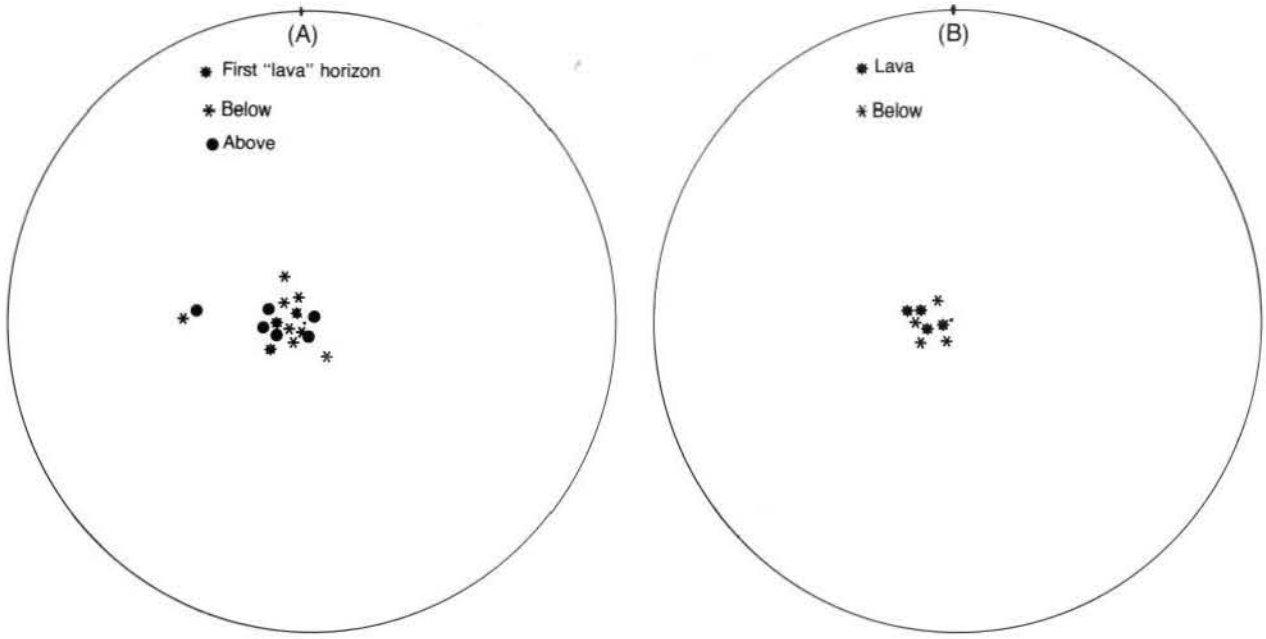

Fig. 2. Lower hemisphere plots of poles to bedding planes. A – Istind; B – Peak 1320.

could be the equivalent of either the red agglomerate or the reddish tuffaceous quartzite as observed at Istind. Thickness 25 m.

(viii) Lava, 25 m thick.

These "lavas" at Peak 1320 are without doubt the same rocks as the amygdaloidal igneous rocks occurring as sills in the sequence at Istind.

Attitude of the beds

In order to test the validity of the proposed angular unconformity between the Tindeklypa and Istind Formations *(Neethling*, 1970) the attitudes of beds were determined at different levels below and above the proposed contact, i.e. the basal "lava" horizon at Istind Peak. The only accurate way to do this was by the technique described by *Phillips* (1967) using two or more apparent dips. In the more tuffaceous zones occurring at different stratigraphic levels in the agglomerate the traces of bedding-planes were clearly discernible and the determination of the attitude of the agglomerate consequently did not prove to be as problematical as was expected. In the amygdaloidal sills, flow layers, usually emphasized by the occurrence of vesicles along them, facilitated the necessary measurements.

From Fig. 2 it is clear that there is no angular unconformity between the sequence below the basal "lava" and that above it. The average dip is 3° ESE (3°/100°). The beds at Peak 1320 show the same attitude.

Conclusions

The Istind Formation is merely an upward continuation of the Tindeklypa Formation. The sequence at Istind Peak is mainly volcanogenic and true volcanoclastic deposits (i.e. agglomerates and tuffs) occur from the bottom almost to the very summit. In the higher part true fluvial sediments become more frequent indicating periods of volcanic quiescence. These sediments were deposited in a high-energy shallow-water environment as is shown by the cross-bedding, ripple marks and mud-cracks.

No angular unconformity exists at Istind; the entire sequence dips 2-5° ESE.

The "lavas" intruded as sills and are not extrusive flows. These intrusions usually follow the bedding of the older sediments, but occasionally cut across it.

The age of these igneous rocks has not been determined reliably and their relative position in the general stratigraphy of western Queen Maud Land remains obscure. A $^{40}Ar/^{39}Ar$ analysis showed an apparent age of 603 m.y. (L.G. Wolmarans, personal communication, 1974) but this is caused by a later period of intense hydrothermal activity. In hand specimen these rocks are very similar to lavas from a number of outcrops, e.g. at Peak 1599 and the Straumsnutane, but any correlation on purely lithological grounds serves no real purpose and only adds unnecessarily to the already wide array of speculations.

The sequence at Peak 1320 is undoubtedly a lateral extension of the same rocks as at Istind. The thicknesses of the individual units differ, but the fit, as can be seen from the two stratigraphic columns (Fig. 1), is nevertheless remarkable. The sequence at Peak 1320 is at a lower elevation as a result of down-faulting *(Paterson*, 1972, p. 24).

In the light of all this it is clear that the term Istind Formation should be abandoned.

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