

Three types of volcanic rocks can be distinguished in the field: sheet volcanics, pillow lavas, and volcanic breccias. "Sheet volcanics" is the name used here to describe tabular bodies of volcanic or hypabyssal rock. Only one sheet about 100ft thick has been identified as a tabular body in the Goat Formation. Well formed pillow lavas are abundant in the stratigraphically higher parts of the formation, and are very well exposed at 398914. Most outcrops of pillow lavas show some evidence of penecontemporaneous movement, such as zones of brecciation and highly contorted interlayered sedimentary rocks. With increase in deformation the pillow lavas grade into volcanic breccias. Volcanic breccia is the most common rock type in the formation. Outcrops typically show an ill-defined but unmistakable bedding with individual beds up to 50ft thick, composed of poorly sorted fragments of fine-grained lavas. The fragments range in size from sand up to boulders several feet across, and fragments of pillows and boulders comprising a number of cemented pillows are common. Less typically the volcanic breccia may be composed of fragments no larger than grit, but these, like the coarser breccia, are also composed of spilite fragments. With further decrease in particle size the volcanic breccias grade into sandstones.

The sedimentary member, composed largely of massive or graded coarse-grained sandstones and massive black argillites, is lithologically similar to the Pelorus Group sandstones. Penecontemporaneous intraformational folding is well exposed in several places.

Petrography: The sheet volcanics (10930¹ and 10931) are hypautomorphic granular albitised rocks with large (4mm long) subhedral tabular laths of altered plagioclase (now albite with abundant inclusions) making up 60 percent of the rock, subhedral titaniferous pleochroic augite, 20 percent, altered ilmenite (now leucoxene and hematite) about 5 to 10 percent, and a chloritic mesostasis making up 5 to 10 percent. In hand specimen their most distinctive feature is ophimottling. The pillow lavas and fragments from the volcanic breccias are all fine-grained spilites generally with a variolitic (10932) or an intersertal (10933) texture. In 10932 crystallisation of original glass has given dendritic crystal growth which cuts through the earlier varioles of radiating albite aggregates. The matrix of the rocks is usually packed with small granules of hematite. In 10933 and 10932 a small amount of weakly pleochroic (probably titaniferous) augite is present but in most the ferromagnesian minerals are altered to chlorite and/or actinolite. Altered titanomagnetite is a common accessory. The sedimentary rocks are lithic or quartzofeldspathic sandwacks. Lithic fragments are mainly volcanic-derived and have a similar texture to the pillow lavas and fragments from the volcanic breccias. In 10934 there is a higher proportion of quartz (about 25 percent) than is usual in sediments of the Red Hill area, but otherwise the sandstones are petrographically similar to those of the Pelorus Group. Epidote as an authigenic mineral is rare, however; the commonest recrystallisation product is pumpellyite.

Distribution: The Goat Formation has been examined closely only in the vicinity of Mt Ellis, but is presumed to continue northward into the headwaters of the right branch of the Wairoa River. Metamorphic rocks near the north-eastern contact of the Red Hill Complex are probably derived from basic volcanics and, together with associated sedimentary rocks, are placed in the Goat Formation. At grid ref. 445780 volcanic rocks are exposed in the scree-covered slopes below the eastern contact of the Complex. The rocks are volcanic breccias similar to those of the Goat Formation, with which they are correlated.

Depositional Environment: The lithological similarity between the sedimentary rocks of the Goat Formation and the Pelorus Group suggests a comparable depositional environment, which because of the absence of fossils, abundance of graded beds, and considerable thickness probably entails rapid accumulation in deep

1. Numbers refer to the petrographic collection of Victoria University of Wellington.