

SOILS OF THE ROTORUA DISTRICT

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Over the whole of the Central North Island there is a mantle of volcanic ash deposited as a series of showers, each one generally only a few feet thick. Except on the steepest slopes the underlying rock is completely buried, and it is on the ash showers that the soils are formed.

The showers are geologically very recent, and the soils are not mature; in spite of the varying effects of climate and vegetation they still retain many of the characteristics of the ash showers from which they are derived.

In the Rotorua district there are three main surface ash showers:—

- a. The Taupo shower, mainly to the south.
- b. The Kaharoa shower, to the north.
- c. The Tarawera shower to the east.

The town of Rotorua is near to the edge of all these showers, and all of them are thin. In this immediate district, therefore, the soil profiles include some of the underlying showers, though they do not occur at the surface. The two main ones are:—

- d. The Mamaku shower.
- e. The Rotokawau shower.

I shall now describe broadly the characteristics of the soils developed from each of these showers.

A. SOILS DEVELOPED FROM THE TAUPO ASH

The material usually referred to as "Taupo pumice" is not a single ash shower, but is really a series of showers which reaches a maximum thickness, of about 30 feet, the thickest individual shower being about 15 feet. The series covers a greater surface than any of the other ash showers, and extends from near Gisborne to beyond-Ongarue, and from the Mata-mata—Tauranga (Kaimai) road to Hihitahi. It was ejected from vents in the Taupo region, though their exact location has not been discovered, and it seems likely that some of the earlier showers of the series originated further east towards Rangitaiki.

The pumice, which might be described as volcanic

froth, was ejected under huge pressure. by rhyolitic eruptions, liberated the gases it contained, solidified, and fell as the familiar light-weight vesicular rock fragments. The mechanics of its distribution over such a wide area are not fully understood, but it is thought that the eruption was short lived and extremely violent. Near to the vents the fragments fell in jumbled heaps, but further away the pumice deposits lie as a mantle of locally more or less uniform thickness over the old land surface, and show a characteristic vertical sorting according to particle size. Stones and gravels fell first, and were covered by the lighter and slower-falling coarse sands, and then by the fine sands and silts which settled slowly from the dust clouds as the eruption died down. Under normal conditions pumice weathers slowly, and there has been little breaking down of the particles since they were deposited. So the soils which formed directly on the Taupo ash shower have sandy silt topsoils, coarse sandy soils, and a substratum of pumice stones and gravels.

Profile.

5 inches blackish brown sandy silt.

6 inches yellowish dark brown sand.

7 inches yellow-grey gritty sand on greyish white pumice sandy gravels.

As these textures indicate, there is very little clay in these soils; they are not loams. Implements may be worked immediately after rain without difficulty; but the looseness and lack of "binding" in the topsoil present problems in consolidation after sowing. The soils are free draining, but under the usual rainfall (55 inches per year on 135 raindays) are not excessively droughty, since moisture is retained in the vesicles of the individual pumice particles.

During the eruption, or immediately afterwards, torrential rains fell on the light unconsolidated material, not yet stabilised by vegetation; and washed great quantities into the drainage channels and depressions, raising the valley floors, and overloading the streams which built up high-level terraces. Pumice particles float on water, so that ordinary "water-sorting" does not take place during deposition. -There is little bedding of coarse and fine layers in these deposits, therefore! and particles of all sizes are mixed together indiscriminately. Generally, there are pumice stones right to the surface in a coarse sandy matrix,

sometimes compacted. The soils are therefore coarse in texture—sands or stony sands—and droughty.

Profile.

- 5 inches blackish brown' sandy silt.
- 6 inches yellowish dark brown-sand.
- 7 inches yellow-grey gritty sand on greyish white pumice sandy gravels.

The outlet to Lake Taupo was blocked by the pumice, and the water rose about 100' feet before breaking through the blockage.

During the rise water-deposited material was laid over the ash showers wherever they were submerged; the deposits are mainly of coarse sands and gravels, both pumice and hard rhyolite, not graded for size or weight, loose and unconsolidated. So between the present lake level (1177 feet) and the 1270 feet contour there is a strip of soils which are coarser and more droughty than the normal shower soils above that contour.

Profile.

- 4 inches dark grey sands.
 - 3 inches medium grey sand.
 - 5 inches brown yellow stony sand, on yellow grey mixed (rhyolite and pumice) stony sands.
- Overloading of the Waikato caused more blocking further downstream and the flooding of the river valley and its tributaries. One of these blockages raised the water-level 70 feet and formed a lake in the Reporoa Valley which extended right up to Waitapu. Near the edges of this lake coarse pumice alluvium was deposited over the showers—very similar material to that deposited round Lake Taupo—but in the deeper parts, near to the centre of the valley, typical lake beds of fine sands, silts, and even clays were laid down. Hence a section through this valley shows normal shower-soils of sandy silts over sands and gravels above 1030 feet contour, gravelly sands on the valley sides below that contour, and fine sands and silts on the valley floor. In some places these are buried by recent coarse deposits of present-day streams.

Profile.

- 4 inches dark brown grey silt loam.
 - 3 inches grey yellow sand, loam on yellow-grey pumice sand.
- As the soils were stabilised and the supply of

waste diminished, the main rivers, returning to their normal gradients, quickly cut steep-sided valleys in the soft material of the deposited terraces. Within these valleys there are some small areas of young alluvial soils—mainly coarse stony sands or minor low-level river terraces.

Profile.

2 inches dark grey sand.

12 inches dark grey stony sand on yellowish brown sandy gravels, mixed pumice and hard rhyolite.

The history of post-shower vegetation is not fully known, but it is certain that there had previously been a great deal more forest than there was when the pakeha arrived. Possibly burning by the Maoris had destroyed large areas, and in the last 70 years the forest has been still further reduced by milling operations. So while most of the Taupo shower soils to the south of Rotorua now carry only bracken, tutu, and manuka scrub, they mainly show traces of forest humus in their profiles, though this has usually been modified by the subsequent vegetation. To the east, on the Kaingdroa. Plains where the climate is more severe, manuka, tussock grasses, and manao seem to have been the permanent vegetation. On the wash-filled flats, alluvial terraces, and lake beds there were mostly tussock grasses and stunted manuka, with manao in the cold, poorly-drained hollows.

The town of Rotorua is near the edge of the Taupo shower, and although the topsoils are the characteristic sandy silts, very little of the coarser part of the shower fell in this area. The topsoil, therefore, overlies other ash showers, and the soil profile is, a composite one. On the hills close to the town there are about six inches of Taupo sands and silts overlying about three feet of brownish yellow sand of the Mamaku shower. This is an old rhyolitic shower which apparently originated somewhere close to Rotorua and underlies the surface showers from Waitapu to Putaruru and north to the Bay of Plenty. Its upper layers are "fluffy," uncompacted fine sands, and its base is a thin band of coarse sand, about the texture of sugar.

Profile.

Taupo :

6 inches dark grey sandy silt.

Mamaku :

- 3 inches greyish yellow brown sand.
- 30 inches. yellow brown "fluffy" sand (fine).
- 5 inches greg yellow coarse "sugary" sand.

B. SOILS DERIVED FROM THE KAHAROA ASH SHOWER

The Kaharoa shower was ejected from vents somewhere to the south of Lake Rotoiti, possibly near to Mt. Tarawera. It consists of rhyolite pumice like the Taupo shower, but the fragments were more dense, less vesicular, and more resistant to weathering. Soil textures are coarser than those of the Taupo shower, there being very little silt.

The shape of the surface on which this shower fell is peculiar, for it is two-lobed; this may be due to a change in direction of the wind between two phases of the eruption. The shower extends northwards to Gate Pa, on the outskirts of Tauranga, and eastwards to Te Whaiti in the Urewera Country.

The easterly lobe extends from near Waiotapu to Te Whaiti, although over much of the area it is buried by Tarawera ash. It overlies the Taupo ash in the Murupara-Galatea area, where the buried Taupo topsoil indicates that the Kaharoa shower is considerably younger than the Taupo.

Profile.

5 inches dark grey sand.

18 inches fine gravels-white on sandy silt of Taupo shower.

The coarse textures and the more solid nature of the pumice particles mean that these soils are more droughty than corresponding soils of the Taupo shower, and at Galatea deep-rooted plants penetrate the unconsolidated Kaharoa gravels to reach the more moisture-retentive Taupo horizons.

The northern lobe covers all the country between Lakes Rotorua and Rotoiti and the Bay of Plenty coast. The ash is coarse, but differs from the eastern lobe in having no sorting of particles according to size; the deposits of the eastern lobe are sands on gravels, but those of the northern lobe are gravelly sands.

Profile.

3 inches black gravelly sand,

6 inches medium grey gravelly sand on yellow brown fine sand- (Mamaku).

Along the north end of Lake Rotorua, at the west end of Lake Rotoiti, and extending out on to the Kaharoa Plateau, there is a small basic shower which lies under the Kaharoa, but over the Mamaku shower. It was erupted from vents immediately to the south of Lake Rotoiti, the major one being Lake Rotokawau. This Rotokawau shower shows in the soil as a reddish dark brown sandy loam immediately under the Kaharoa surface layer, and where the Kaharoa is thin, as it is in the Hamurana-Ngongataha district, the sub-soils are formed from the Rotokawau.

C. SOILS DERIVED FROM THE TARAWERA SHOWER

In 1886 Mount Tarawera erupted violently, and, directed by a westerly wind, basic ash was deposited over the country to the north-east of the mountain, as far away as Whakatane. On Tarawera itself the ash is more than 60 feet thick, on the east side of Lake Rotoma about 12 inches, and at Te Teko about 6 inches. It consists of a basalt lapilli and coarse sands, which overlie the white gravels and sands of the Kaharoa shower.

When weathered these basket soils will be fertile, but so far weathering is only slight and the coarseness of their texture is their limiting factor.

Profile.

4 inches black gravel.

6 inches dark grey gravel on light 'grey gravelly sand (Kaharoa) .

While Tarawera was erupting basalt scoria, craters on the lowlands to the south were ejecting shattered rhyolite, which in falling was mixed with a small proportion of Tarawera basalt. This light grey fine sand fell to the west of the main Tarawera shower and is popularly known as "Rotomahana mud." It extends from Lake Rerewhakitū to the south to Rotoiti in the north, and its western limit is about a mile east of Rotorua town. With the admixture of basalt, these soils are quite rich in bases, but are low in organic matter.

Profile.

Up to 4 feet of fine sandy loam on buried Taupo-Mamaku soil profile.

I have tried to show in word and picture the diversity of soils which occur in this region. Too

often "pumice soils" are grouped together as one unit without sufficient thought. I hope that I have shown you that, because of differences in parent *material, in mode of deposition, and in the inter-relationship of the various ash shower horizons, there are many different types of pumice soil, each with its own particular characteristics and problems.