Clarendon Direct Application Phosphate Rock

By Dr Bert Quin

Overview

The Clarendon phosphate rock deposit, close to SH1 about 35km south of Dunedin, originated (approximately 25 million years ago) as marine sedimentary deposits. Dissolved orthophosphate in the cold southern water currents began to precipitate out on the sea floor as hydroxy apatite when these cold currents ran into warmer coastal waters along the east coast of the southern North Island and down the South Island.

The Origin of the Clarendon Phosphate Deposits

The high concentrations of dissolved phosphate (believed to originate from volcanic activity deep in the Southern Ocean), plus the rise in sea temperature, also supported the huge growth of plankton, in turn feeding other marine animals. The shells and skeletons of these sea creatures (all comprising calcium phosphate) added to that from plankton and chemically precipitated phosphate to form layers of phosphate-rich sands and nodules on the sea floor.

Some of these deposits are still there and some (like the Chatham Rise phosphorite nodules) are still in formation and are categorised as highly reactive. Others lie buried by subsequent non-phosphatic sediments on the sea floor. And some, like Clarendon, have been pushed upwards by tectonic earth movements and are now above the current sea-level.

Some on-land deposits are still chemically similar to how they first formed on the sea floor and can be quite reactive; others (like Clarendon) have to some degree been chemically and physically altered by interaction with or compaction under a variety of other minerals (including volcanic ash and lava).

These alterations certainly don't exclude Clarendon and other similar deposits from being used as fertiliser P, but do impose some limitations which farmers need to be aware of to get the best out of it.

Past Use of Clarendon Phosphate Rock as a P Fertiliser

The Clarendon phosphate has been selectively mined off and on for over a century. The peak of usage was early last century then again during WW2, when New Zealand's access to Pacific island phosphates was interrupted.

Approximately 170,000t has been mined in total, used partly for direct application and partly added during the manufacture of single superphosphate at Ravensbourne.

2026 – A New Beginning for Clarendon

The Clarendon phosphate deposit contains three phosphate-bearing zones. The uppermost of these, the Kapiti sandstone, is the material that is now being quarried.

It contains variable levels of phosphate, mostly between 5 and 7% P. It also contains about 1% potassium (K) from glauconite, over 10% calcium (Ca), up to 2% magnesium (Mg), and about 13% silica. Note that it contains little sulphur (S), so this will need to be added if required for maintenance.

After quarrying, it is sized through two stages of crushing for use by direct application. It is not chemically processed at all. As a natural product, it is subject to variations in quality; the consistency will improve as larger quantities are quarried.

Reactivity and Classification

Because of the geological and geochemical alteration of the Clarendon phosphate since it was deposited on the sea floor, it is probably not quite as reactive as it was initially.

Based on its citric acid solubility and other chemical properties it is assessed as being of medium reactivity, and in New Zealand would be classified as a DAPR (direct application phosphate rock), rather than an RPR (reactive phosphate rock).

In addition, having a total P content less than 10% P precludes it being registered as an RPR under the NZ superphosphate industry's Fertmark scheme.

Agronomic Use and Suitability

Clarendon phosphate is most suitable for use as a direct application phosphate for maintaining long-term pasture production (typically blended with other required nutrients according to the needs of specific farms), on soils with pH levels of 5.8 or less.

The acid in the soil slowly dissolves the phosphate rock into plant-available form. During this process, soil acidity is consumed, off-setting the amount of lime required to maintain a given soil pH.

Application Strategy

The key proviso for its successful use in this way is that the product be finely ground (ideally predominately to less than 60 mesh or 0.25mm) to assist its dissolution in the soil.

It would be most suited to:

- (i) heavier applications every 3 years or so, or
- (ii) a heavy application followed by annual maintenance applications, or
- (iii) being mixed with soluble phosphate.

The long-term pasture yield achievable is likely to at least 95% of that achieved with RPR or superphosphate (assuming application of other required nutrients such as sulphur).

Environmental Performance

Because of its sustained-release character and high density, P losses by run-off and leaching will be minimal, and considerably lower than occurs with soluble manufactured phosphate fertilisers.