relation to the experimental Q–Ab–Or–$H_2O$ (Tuttle and Bowen, 1958) or preferably Q–Ab–Or–An (von Platen, 1965) systems. The method is best suited to 1-feldspar-quartz bearing acidic volcanic rock suites, which show only limited chemical variation. Such suites are found in the Taupo region, for example, as groups (or clusters) of co-magmatic rhyolite lavas and domes which are associated with various eruptive loci within the four main volcanic centers of the Taupo Volcanic Zone (Ewart, in press). The same technique can also be used for some of the ignimbrite units (ash-flow tuffs) which were also erupted from the volcanic centers. In these examples, the ignimbrite unit, or the groups of rhyolite lavas and domes, are each believed to have been erupted from a particular high level magma chamber, and in addition, different samples frequently exhibit a variation of phenocryst content, that is, they represent progressive stages of crystallization from the magma. In the ignimbrites, the variation in crystal content will be frequently evident as a systematic vertical variation. In the rhyolite lavas and domes, the variations of phenocryst content occur dominantly between different flows rather than within individual flows.

Mineralogically, the Taupo rhyolitic eruptive rocks are characterized by phenocrystic plagioclase (usually andesine), normally quartz, plus small amounts of opaques, hypersthene ± hornblende ± biotite. The occurrence of plagioclase is in accord with the relatively high $Na_2O/K_2O$ ratios (see Ewart, 1963, 1965, for more detailed discussions). In only rare cases has crystallization proceeded far enough for a second feldspar (potash-rich) to precipitate.

In the following discussion, the method in question will be applied to two ignimbrites, the Matahina Ignimbrite (Bailey, 1965) and the Whakamaru Ignimbrite (Ewart, 1965). The procedure is as follows:

(a) The "average" chemical composition of the rock suite in question is obtained (assuming only limited variation of chemistry), and the normative feldspar and quartz components calculated. The Q, Ab, and Or are recalculated to 100 percent and plotted on the ternary diagram (figs. 1B and 2B). The appropriate boundary curves are also plotted, both for the simple ternary system (Tuttle and Bowen, 1958) and the quaternary system (von Platen, 1965,[1] using the appropriate boundary curve for the normative Ab/An ratio of the analysis).

(b) The amount of Ab or Q (depending on the location of the plotted composition relative to the various boundary curves) that will crystallize until the residual liquid reaches each of boundary curves is calculated. It is then assumed that both Ab and Q crystallize together, and the residual liquid follows the respective boundary curve to the minimum. The amount of both Ab and Q that will simultaneously crystallize until the liquid reaches the respective minima are then calculated. The results are plotted for each water pressure (for example, fig. 1), and

1 The diagrams published are for 2000 bars only.



the two points calculated for each boundary curve are joined. These lines effectively define the predicted amounts of Ab and Q that would progressively crystallize from a magma of given composition, under various

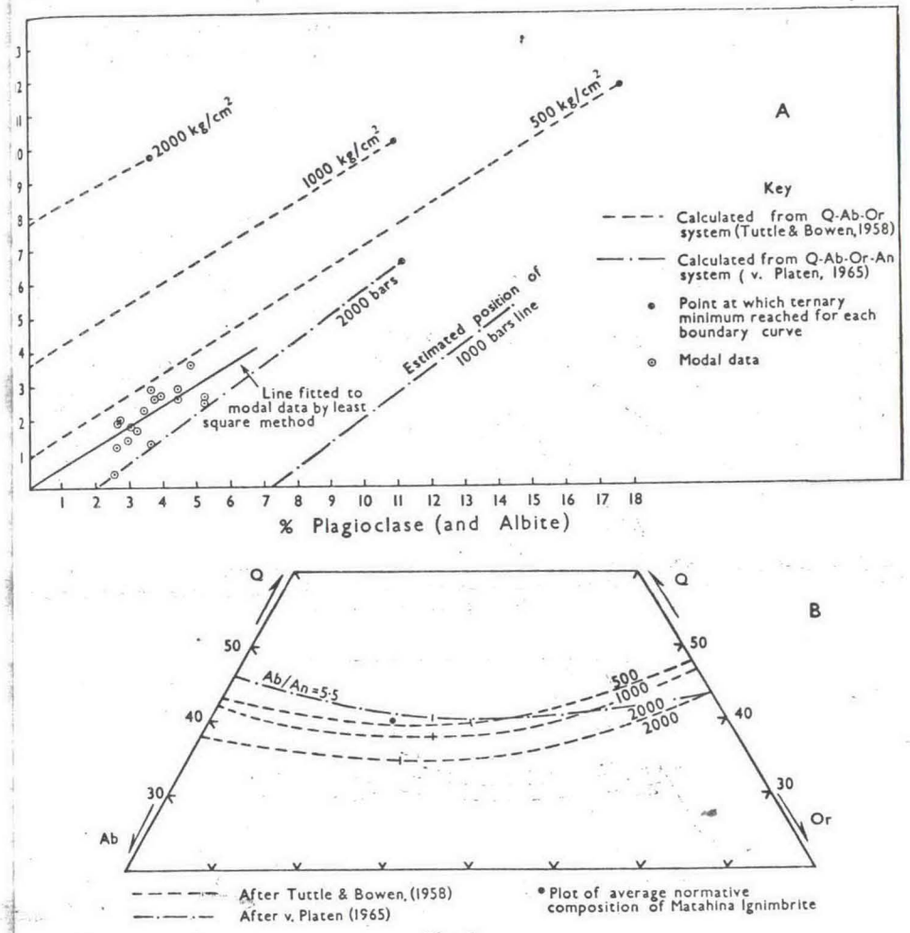


**Fig. 1**

A. Graph showing the calculated amounts of quartz and albite crystallizing under various water pressures compared to the modal (phenocrystic) quartz and plagioclase for the Matahina Ignimbrite. The theoretical amounts of quartz and albite were calculated from the starting composition Q = 39.8, Or = 21.4, Ab = 38.8, using the boundary curves in the quartz-feldspar system after Tuttle and Bowen (1958) and von Platen (1965); the latter data incorporates the effect of An. The points where the calculated lines intersect the quartz or plagioclase axes indicate the amount of quartz or plagioclase crystallized when the liquid reached the respective boundary curve.

B. The average normative composition (in terms of Q, Or, and Ab) of the Matahina Ignimbrite plotted in the ternary system Q–Or–Ab. The positions of the boundary curves (for different water pressures), used in the construction of the data for A, are also shown. The minimum on each boundary curve is shown by a dash.