The advantage of this method is that both mineralogy and chemistry are simultaneously considered. Furthermore, with refinements of the experimental data, it is conceivably possible that progressive changes of water pressure could be evaluated by this type of approach. Conversely, if an independent method of estimating water pressure were available, it should be possible to evaluate whether the magmas were saturated or not with respect to water. Data for the opaque minerals in many of the Taupo rhyolitic rocks (for example, Ewart, 1967) indicate that the magmas from which they were derived were almost certainly not saturated with respect to water. This uncertainty is probably the most important reason why the present experimental data cannot be used quantitatively. It is perhaps pertinent to note here that unpublished data of residual glasses from a number of rhyolitic samples from the Taupo Volcanic Zone seem to show better agreement with the data of Tuttle and Bowen (1958) than that of von Platen (1965). The explanation may lie in low water content of the original magmas.

One final comment is also appropriate on the use of von Platen's data in the above discussions. During the progressive crystallization of a magma, it was assumed that the Ab/An ratio remained unchanged, that is, a boundary curve of constant Ab/An ratio was assumed. This obviously will not be the case, although in the examples discussed, in which the crystal contents were relatively low, the effect is not too drastic. The net effect, however, would be for progressively higher Ab/An ratios in the residual liquid as crystallization proceeded, that is, the data of Tuttle and Bowen would become more applicable during the later stages of crystallization.

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REPLY TO EWART'S DISCUSSION

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I am grateful to Dr. Ewart for his interesting comments with which I am largely in agreement and would like to take this opportunity mainly to make a few additional observations.

Ewart's new chemical data on comparative alkali contents of the Taupo obsidians and pumices demonstrate convincingly that significant leaching of alkalis did not occur during hydration of the pumices; my suggestion to the contrary, based on apparent disequilibria between plagioclase phenocrysts and groundmass glasses (Lipman, 1966, p. 812, 822), is clearly untenable. This absence of alkali modifications in the young but strongly hydrated Taupo pumices is especially interesting as several previous studies have shown inverse correlations between Na_2O and H_2O^+ contents in glassy rocks (Lipman, 1965, fig. 8; Aramaki and Lipman, 1965, fig. 2; Truesdell, 1966, fig. 8), a relation suggesting that alkali leaching occurred concurrently with hydration. Since non-hydrated glasses, no matter how old, seem to show no alkali modification, Ewart's data suggest instead that hydration, by disrupting the glass structure, is a necessary precondition for movement of alkalis, but that the two processes can occur at different rates and are not necessarily concurrent.

With respect to Ewart's second observation, on an additional method for estimation of water pressures, the higher pressures determined by reference to the experimental data of von Platen (1965) for the system Q–Or–Ab–An are clearly more applicable to the relatively calcic New Zealand rocks (Ab/An = 5.5) than are the much lower pressures indicated by reference to the simple ternary system studied by Tuttle and Bowen (1958). As rhyolitic portions of the Nevada ash-flow tuffs are characteristically very low in calcium (Ab/An = 10-100), the effect of the An component on water-pressure estimates for these rocks should be much smaller. This effect of calcium content on estimates of water pressure was discussed qualitatively in my paper (Lipman, 1966, p. 811-812), written prior to publication of von Platen's data. It might also be noted that Ewart's additional method for estimating water pressures is only partly independent of two I discussed. In effect, his graphical method adds the phenocrysts to melt compositions of the experimentally determined system. The same result could be achieved by the more conventional calculation of groundmass composition of the rock, starting from a bulk-rock chemical analysis and a modal-phenocryst analysis.

Finally, Ewart mentions that study of opaque oxides from the Taupo rhyolites suggests their magmas were probably undersaturated with H_2O; this is very interesting. Similar conclusions have recently been drawn by Carmichael (1967) for a varied group of rhyolite fluidal-flow rocks. The relation between water pressure and total pressure is, of crystallization again occurred at a water pressure of the order of 2000 bars. The effect of considering An is also strongly apparent.