(b) Zone of argillization: Rhyolite glass is changed to montmorillonitic clays. Plagioclase crystals are sometimes unaltered but are sometimes replaced by calcite.

(c) Zone of zeolitization: This is superimposed on the zone of argillization and is subdivided into an upper and a lower zone. In the upper zone the lime-soda zeolite "ptilolite", structurally indistinguishable from mordenite, is characteristic, and fills vesicles in pumice. In some cases it is associated with minor heulandite. Plagioclase phenocrysts are practically unaltered. In the lower zeolite zone wairakite (calcium analcime) replaces andesine and also fills veins and cavities by direct crystallization from solution.

Laumontite has subsequently been found by STEINER (personal communication) in a zone between ptilolite and wairakite at a depth between 500 and 900 ft where temperatures ranging from 195 to 220°C have been measured. It has also been found at greater depth below the wairakite zone in a deep drill-hole where a reversal of the temperature gradient appears to occur.

(d) Feldspathization zone: An upper subzone is characterized by albitization, and a lower one by adularia replacing plagioclase. Secondary sphene (titanomorphite) is scattered through the rocks and in bore no. 11 adularia and sphene are accompanied by prehnite through a short vertical range. Calcite is locally precipitated, and the alteration of plagioclase to calcite and albite was observed.

(e) Zone of hydromica: In this zone, which exists below about 2000 ft, primary plagioclase is replaced by a hydromica as a result of leaching of alkalis by carbon dioxide solutions entering the zone from below.

The concentrations of sodium, potassium and calcium in the waters collected from bores at various depths (ELLIS and WILSON, 1955; ELLIS, 1958) correlate very well with this sequence of alteration. The hot solutions in the deepest zones tapped have a high concentration of potassium, which is progressively lowered by the formation of adularia from the original plagioclase. The concentrations of sodium and calcium are increased correspondingly until in the zone of zeolite formation some of these ions are again precipitated. By this stage the atomic ratios Na/K and Ca/K have increased from about 9 and 0·06 in the hydromica zone, to 20 and 0·15, respectively. The pervading solutions are approximately 0·05 N in sodium chloride, saturated with silica, and their pH is controlled by the bicarbonate–carbon dioxide system. Under pressure deep within the area the waters contain sufficient carbon dioxide to make them slightly acid with respect to pure water at the same temperature, e.g. at 250°C, pH = 5·0 (approx.) and for pure water pH = 5·7 (approx.). At lower pressures towards the surface the carbon dioxide is lost from solution and the waters become slightly alkaline with bicarbonate.

3.2.2. *Other active thermal areas.* The recent recognition of wairakite from The Geysers, California (STEINER, 1958) may be noted.

Some data from drill cores from the Upper Basin, Yellowstone National Park (FENNER, 1936) are included in Table 1. The introduction of potash feldspar in the lower levels is noteworthy, as at Wairakei.

WEED (1900) described a close association of quartz, stilbite, calcite and a little opal in veins from which the Boulder hot springs, Montana, now issue at temperatures up to 73°C. Similarly the Hunters hot springs (WEED, 1904) containing