evidence on zeolite stability. It is known (Yoder, 1953) that analcime is stable to about 570°C at 2000 bars in the absence of free silica and may thus form at much higher temperatures than in the presence of quartz (see later). Experimental evidence is inadequate to interpret the occurrence of phillipsite in the mesostasis of apparently fresh basanites (Coombs in Brown, 1955, p. 370) but thomsonite appears to break down to anorthite near 300°C (Fyfe, 1955) and can be interpreted as either metamorphic, as in the Otama metagabbros, or low-temperature, late stage hydrothermal as in the case of groundmass thomsonite in the Waihola theralite (Hutton, in Benson, 1942). Povarennykh (1954) has discussed how the relative proportions of nepheline, albite and anorthite in feldspathoidal rocks control the proportions of natrolite, analcime and thomsonite in their zeolitic alteration products.

In the later hydrothermal stage in pegmatites of quartzose rocks on the other hand, the typical zeolites are the laumontite–heulandite–stilbite group (e.g. Richmond, 1937; Whitehouse, 1937), while Harris and Brindley (1954) have described an interesting case of the natural devitrification of a highly siliceous pitchstone glass to mordenite. Similarly Hayashi and Sudo (1957) have recognized mordenite and opal in the bentonitic hydrothermal alteration products of Japanese rhyolite tuffs. Such examples provide further evidence for the silica-content correlation described above.

3.7. *Conclusion*

Similar recurring assemblages in a variety of environments of widely differing age support the validity of the zeolite facies concept and we consider that it may be extended, in the form of mineral facies rather than of metamorphic facies, to the zone of diagenesis with its heulandite–quartz–montmorillonoid assemblages as well as to the fillings of many veins and amygdales. Nevertheless as stated above low-temperature conditions are probably particularly conducive of non-equilibrium and some of the parageneses, especially those with phases such as mordenite and epistilbite, are probably to be regarded as metastable.

Occurrences in hydrothermal areas, like that of phillipsite in marine sediments (Murray and Renard, 1891; Goldberg and Arrhenius, 1958), provide some information on actual temperatures and pressures of formation. These data are summarized in Table 1.

4. Theoretical Considerations on Zeolite Stability (A. J. E., W. S. F.)

The broad pattern of progressive regional metamorphism is one of increasing dehydration as the mineral assemblages of low grade rocks pass to the less hydrated high grade assemblages. Coupled with this dehydration is a tendency for phases to increase in density, even more than is implied by dehydration. The general features are consistent with those which would be deduced if the rocks were subjected to increasing temperatures at steadily increasing pressures.

On grounds of entropy, the stable mineral assemblage at low temperatures must be the one with the maximum possible hydration and it will consist largely of clay minerals and zeolites. That such assemblages are commonly developed, at