

compatible with the conclusion that although the altered rocks deviate notably from their original composition, the metasomatism is complementary and it is unlikely that material was brought in from outside the sedimentary pile.

The sequence of mineralogical changes (Fig. 2) may be summarized as follows:

- (1) Alteration of glass in tuffs to heulandite or analcime.
- (2a) Replacement of the assemblage analcime-quartz by albite-quartz.
- (2b) Replacement of heulandite by laumontite, and of detrital calciferous plagioclase by albite and laumontite.
- (3) Substitution of pumpellyite and prehnite for laumontite.
- (4) Post-tectonic precipitation of stilbite in joints.

It is not possible in the Taringatura district to map sharply-defined zones dependent on the stage of alteration, although beds above the present 17,000 ft level are dominantly in a *heulandite-analcime stage* whereas those below 17,000 ft are dominantly in a *laumontite stage*, while a *prehnite-pumpellyite stage* appears spasmodically towards the base. Observed assemblages of coexisting non-detrital minerals from Taringatura include the following. In each case scaly phyllosilicates of various shades from green to brown and of moderate to high birefringence are further possible phases.

Stage 1 (heulandite-analcime stage):

heulandite-montmorillonoid-quartz
 heulandite-quartz-celadonite
 analcime-quartz-celadonite
 heulandite-quartz-celadonite-sphene.

Stage 2 (laumontite stage):

laumontite-albite-quartz-celadonite-sphene
 laumontite-albite-adularia-quartz-celadonite
 quartz-albite-adularia-montmorillonoid-sphene.

Stage 2 or 3:

albite-quartz-chlorite-sphene
 albite-chlorite-calcite-sphene.

Stage 3 (prehnite-pumpellyite stage):

quartz-albite-adularia-pumpellyite
 albite-chlorite-pumpellyite-sphene
 albite-chlorite-prehnite-quartz.

Discussion. The relation of alteration to depth and hence by inference to temperature, seems clear, although the gross overlapping of zones is to be emphasized. The sequence heulandite, laumontite, pumpellyite, prehnite, epidote is one of decreasing hydration accompanied by release of silica as indicated in Fig. 3, although in the case of the non-zeolites dehydration is complicated by changes in the alumina content which must involve reactions with aluminous minerals such