implication is that the rocks had not been previously involved in metamorphism or else they would have been previously dehydrated and this would not promote a high P_{H_2O}. If the Sittampundi complex is Archaean in emplacement and part of an early anorthositic episode as seen in Greenland, the Limpopo orogenic belt of Africa, Malagasy, and elsewhere (Windley, 1973) then it becomes important to date the age of the metamorphism as it will enable the time by which the crust in this part of India had assumed a minimum thickness of about 30 km to be estimated.

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Intergrowth of prehnite and biotite

INTERGROWTHS of prehnite and biotite, or of prehnite and chlorite, occur in the metagabbro of the Tantalite Valley Complex, SW. Africa (Moore, 1973, 1975).

The metagabbro consists essentially of *c.* 56 % plagioclase, An 75–50, 39 % amphibole, and smaller amounts of biotite, quartz, opaque minerals, sphene, chlorite, epidote, and saussurite after plagioclase, in an original igneous texture that is equigranular and coarsely ophitic. The metagabbro intruded a zone of deformed gneisses, producing a contact metamorphic aureole, and was completely altered to metagabbro by hydration metamorphism before being intruded by gabbronorite that has almost unaltered plagioclase and pyroxene. Later deformation along a shear zone has resulted in folding, shearing, and some partial melting of the surrounding gneisses but the metagabbro and its aureole have acted as a resistant body within the less competent gneisses (Moore, 1973, 1975).

The biotite of both gabbroids is interstitial but only that of the metagabbro contains prehnite. In the biotite, partly chloritized biotite and chlorite, the prehnite occurs as lens-like inclusions with the {0001} cleavages of the host parallel to the {001} prehnite. In considering the origin of this mineral association the following three factors are relevant: The recorded occurrences (Wells and Bishop, 1955; Hall, 1965) are all in altered rocks ranging in composition from gabbroic/dioritic (appinite) to ultramafic (hornblendite) all with amphibole as the dominant mafic phase and plagioclase that shows alteration to secondary minerals. The composition of biotite and prehnite (Table I) is such that Ca must be added to biotite to form prehnite; the lens-like form of the prehnite suggests that it forced the biotite apart along {0001} indicating that there was an increase in the total volume and thus eliminating any suggestion that the prehnite is a metasomatic replacement of the biotite based on (Ca_2Al) substitution for $K(Mg, Fe)_3$, which would result in a net decrease in volume. The biotite is crystallized from a magma but the prehnite is unlikely to be of primary igneous origin; not only is it not found in biotites of unaltered igneous rocks (e.g. the gabbronorite) but Liou (1971) has shown prehnite has an upper thermal stability limit at approximately 393 to 403 °C (between 3 and 5 kb P_{H_2O}).

From the above it is concluded that the prehnite developed during the hydration metamorphism of the metagabbro during which pyroxenes were completely altered to amphibole (hornblende, with some cummingtonite and actinolite) and the plagioclase was partly replaced by epidote and saussurite. Although prehnite is regarded as a common product of the metamorphic breakdown of plagioclase (Deer *et al.*, 1963) none has been recognized within the plagioclase. The reactions that are responsible for the production of the prehnite are probably complex and plagioclase, an obvious source of Ca and Al, may not be the source in view of the absence of prehnite in plagioclase. The prehnite may be related rather to the formation of the hornblende from the pyroxene since hornblende requires only half the CaO content of an equivalent clinopyroxene.

Apart from its presence in the biotite, prehnite has not been observed elsewhere in the Tantalite Valley metagabbro so that its intimate association with the biotite, chemically so different, is explained by regarding the (0001) surfaces as providing suitable nucleation sites for the growth of prehnite during the hydration metamorphism. Possibly the prehnite grows with an epitaxial relationship towards the host biotite, as can be seen by the regular crystallographic orientation, and the most favourable nucleation sites are those in which the biotite (Si, Al) sheets are on both sides of the developing prehnite, which also has a layer-type structure (Deer *et al.*, 1963). This implies that Ca^{2+} ions, in spite of their relatively large size, are mobile during the hydrous metamorphic (or deuteric) alteration of the gabbroid body.

Thus it is concluded that prehnite lenses within biotite result from hydrous metamorphic, or deuteric, alteration of Ca-bearing plagioclase+calcic amphibole–

TABLE I

	1	2	3	4	5	6
SiO_2	41·56	41·03	37·27	26·43	43·19	47·15
Al_2O_3	24·29	24·12	16·87	19·23	11·97	34·66
TiO_2	0·03	0·02	1·83	0·06	0·45	0·03
Fe_2O_3	0·00	0·00	6·21	26·99	0·00	0·00
MgO	0·06	0·22	12·15	17·48	10·32	0·02
FeO	0·20	1·12	12·44	0·00	16·70	0·20
MnO	0·00	0·00	0·14	0·16	0·27	0·00
CaO	26·30	26·25	0·15	0·03	11·67	16·33
Na_2O	0·00	0·03	0·27	0·00	1·23	2·41
K_2O	0·00	0·00	8·53	0·04	0·41	0·05
Cr_2O_3	0·69	0·53	0·35	0·03	0·08	0·00
Total	93·13	93·32	96·21	90·45	96·29	100·85
Mineral formulae						
Si	6·153	6·097	5·752	5·521	6·542	8·588
Al	0·000	0·000	2·248	4·734	1·458	7·412
ΣZ	6·153	6·097	8·000	14·51*	8·000	16·000
Al	4·238	4·224	0·820	0·000	0·679	0·029
Ti	0·003	0·002	0·212	0·000	0·051	0·004
Fe^{3+}	0·000	0·000	0·721	0·000	0·000	0·000
Mg	0·013	0·049	2·795	5·442	2·330	0·005
Fe^{2+}	0·025	0·139	1·606	0·000	2·115	0·030
Mn	0·000	0·000	0·018	0·028	0·035	0·000
Ca	4·172	4·179	0·025	0·007	1·894	3·187
Na	0·000	0·009	0·081	0·000	0·361	0·851
K	0·000	0·000	1·679	0·011	0·079	0·012
Cr	0·081	0·062	0·043	0·005	0·010	0·000
Sum	8·532	8·665	8·000	5·493	7·554	4·119

* Includes Ti 0·009 and Fe^{3+} 4·243.

1. Prehnite in biotite 3. Water and volatiles by difference: 6·87 %.
2. Prehnite in chlorite 4. Water and volatiles by difference: 6·68 %.
3. Biotite. Water and volatiles by difference: 3·79 %.
4. Chlorite. Water and volatiles by difference: 9·55 %.
5. Hornblende in same thin section as 1, 2, 3, and 4. Water and volatiles by difference: 3·71 %.
6. Plagioclase in same thin section as above. Analysis is of an area free of epidote and saussurite alteration.

Analyses 1–6 by A. C. Moore using Cambridge Microscan 5 electron probe, Department of Geochemistry, University of Cape Town.

Mineral formulae are calculated as follows: 1 and 2 on the basis of 23 oxygen; 3 on the basis of 16 cations and with Fe^{3+} determined using charge balance; 4 on the basis of 20 cations and with Fe^{3+} determined using charge balance; 5 and 6 on the basis of 23 and 32 oxygen respectively.

clinopyroxene-bearing rocks within the prehnite stability field. This conclusion is contrary to previously published views (Wells and Bishop, 1955; Hall, 1965) in which K-metasomatism was invoked to explain the association, but agrees with Phillips and Rickwood (1975).

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The Avondale (New Zealand) meteorite discredited

AT about midday on 9 October 1956 Mrs. M. Munyard of Avondale, Auckland, was nearly struck by a falling object while weeding in her garden. The object flashed across her right shoulder and face and struck the ground near her feet. The fall was accompanied by a whining sound and a loud bang. After the incident had been described to a neighbour, the garden was searched and a small dark-grey fragment, just under 10 mm in diameter, was found in the area of the fall. The fragment was sent to Auckland University for examination and a thin section was made from part of the sample, leaving a piece about 6 mm in diameter. Both thin section and remaining fragment were sent to the Australian National University where it was identified as a metal-free chondrite. Because of the very small size of the fragment, and the absence at that time of any suitable non-destructive method of analysis, identification was based on physical appearance.

The 'meteorite' was reported in a local journal (Warner, 1957) but further examination being impossible, the fall was not reported outside New Zealand. However, early in 1974 interest in the Avondale 'meteorite' was renewed during the preparation of an article on New Zealand meteorites (Gregg, 1974) and I learned of the existence of the