DEPARTMENT OF MINES AND ENERGY
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# PETROGRAPHY OF A SPECIMEN OF DRILL CORE FROM KUMBARI NO. 1, WARBURTON BASIN

GEOLOGICAL SURVEY

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# PETROGRAPHY OF A SPECIMEN OF DRILL CORE FROM KUMBARI NO. 1, WARBURTON BASIN


## ABSTRACT

The specimen is a siltstone with a shale band and a quartz-rich band. It has not been affected by any regional deformation and such recrystallisation as has occurred may be ascribed to burial metamorphism in the prehnite-pumpellyite facies.


## INTRODUCTION

A thin section of core from 5534' in Kumbarie No. 1, Warbuton Basin, was received from Mr. Colin Gatehouse for petrographic examination. The core specimen had been scanned by X-ray diffraction and the following phases had been detected, with semi-quantitative abundances.

| Mineral | Semi-quantitative abundance |
|---|---|
| Quartz | Dominant |
| Muscovite (probably including illite) | Sub-dominant |
| Cronstedtite (a chamositic chlorite) | Accessory |
| Potash feldspar | Trace |

The sediment does not appear to have undergone any metamorphic recrystallisation of higher than burial grade and petrographic evidence is necessary to indicate whether such minerals as potash feldspar and muscovite are detrital rather than the product of post-depositional processes.

## PETROGRAPHY

Specimen 6940 RS 3, Kumbari 1, 5534', TS C33625S.

Rock Name Banded siltstone

Thin section

Most of the thin section is composed of a homogeneous, fine-grained siltstone but one end contains a band of coarser-grained quartz followed by a shale band. Variation in the rock types represented in the specimen may account for the apparent difference in the mineralogy identified by the X-ray diffraction scan of RS 4 and the microscopic examination of RS 3.

No potassium feldspar was identified optically although a trace (≈ 5%) was recorded on the X-RD scan. Untwinned or very fine grained feldspar is often not detectable optically. In the clay fraction identification by optical and X-ray methods differ somewhat. Most of the fine grained material with low birefringence is identified optically as kaolinite although this is not registered by diffracted X-rays. Possibly it is too poorly crystalline to give an identifiable pattern. No mineral with the optical properties of cronstedtite is identifiable under the microscope. A mineral resembling chamosite is abundant in the clay fraction and sometimes occurs as coarser grains. It is greenish grey in colour and appears to be isotropic. It is probably not well-ordered crystallographically.

Both optical and X-ray identification are in agreement on the major phases present, quartz and muscovite/illite.

A few minor phases are below the X-RD detection limit.

The minerals identifiable optically are quartz, muscovite, illite, kaolinite, chlorite, zircon, tourmaline and siderite.

Quartz occurs as detrital clasts, as the filling of fine veinlets and probably as a cement impregnating the clays of the matrix. The shape of detrital quartz grains is a result of processes of authigenic growth and corrosion rather than of sedimentation. The sediment is matrix-supported and, even in the quartz-rich band, the grains are rarely in contact. There is usually a layer of matrix between grains in close proximity. In the main part of the siltstone the quartz is scattered and relatively sparse. In the shale, quartz is almost completely absent. There is no observable preferred orientation of the quartz grains.

Vein quartz occurs in relatively coarse grains at each end of the thin section where the core specimen has apparently fractured along the veins. Finer veinlets cut the section with no obvious preferred orientation.

It is probably the quartz impregnating the matrix which makes the mineral the dominant phase recorded by X-RD. It is not identifiable optically at this level of abundance.

Detrital muscovite flakes of relatively coarse grain size are common in the siltstone and often show a strict preferred orientation. Other coarse flakes are discordant in their orientation and it is not always possible to say whether they are of detrital or authigenic origin. Fine mica flakes with a random orientation are almost certainly of authigenic origin and are abundant in the matrix of the sediment.

The illite recognised by the X-ray diffraction scan is probably partly included within the flakes of muscovite but partly forms fine flakes in the matrix independently of muscovite. Many such flakes with lower birefringence than the muscovite but higher than the other clays are visible. Much of this material is random in orientation.

A large mass of material, perhaps the major constituent of the sediment, is of low birefringence and a flaky texture. It is the kind of material usually identified optically as kaolinitic clay but has not been registered as such by the X-ray diffraction scan. The X-RD is the superior technique for this type of identification, unless the material is amorphous. It may be partly chloritic and partly composed of illite in flakes too thin to show high polarisation colours.

A chlorite is certainly present as a fairly substantial component of the sediment. As noted above, it is not recognisable optically as cronstedtite and much of it may not be of good crystal structure. Because of low or absent birefringence it appears optically to be akin to chamosite. It shows no preferred orientation.

Rounded grains of zircon and rather corroded grains of tourmaline are accessory components.

Grains of carbonate with veins and fractures outlined in limonitic stain are distributed irregularly throughout the specimen. They are probably siderite and are almost certainly of concretionary origin and of post-diagenetic age.

Comment

The diagnostic minerals in this specimen for the determination of metamorphic grade are quartz, potash feldspar, muscovite and chlorite. Of these, quartz and muscovite are present as detrital clasts but also as phases involved in post-sedimentation processes so that they are valid indications of the conditions of temperature and pressure prevailing in the later history of the rock. No indicators of retrogressive metamorphism such as relict crystals or pseudomorphous replacement are evident and the present assemblage probably represents the maximum temperature and pressure reached.

As far as the siltstone RS 3 is concerned the critical phase is the chlorite since the reaction muscovite + quartz → potash feldspar + an appropriate alumino-silicate can occur between about 580°C at 1 kb and about 770°C at 10 kb.

Chlorite is not a sensitive indicator of metamorphic grade and uncertainty as to the nature of the chlorite in this instance makes it even less precise an indicator. However, the absence of the zeolites on the one hand and of clinozoisite on the other limits the possible conditions of metamorphism to the prehnite-pumpellyite facies.

This environment, it is reasonable to conclude, suggests that the rock has not suffered any higher grade of metamorphism than that of burial. Support for the suggestion is found in the absence of any preferred orientation in the authigenic minerals and in the preservation of bedding in the rock as a whole and in detrital muscovite in particular. Such recrystallisation as has taken place has been under conditions of hydrostatic containing pressure rather than directional stress applied in a regional deformation.

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