DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 87/106
TEXTURES, MINERALS AND ORGANIC REMAINS IN MARBLES FROM KAPUNDA

GEOLOGICAL SURVEY

by

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SEPTEMBER, 1987

DME.454/82

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Report Bk. No. 87/106
DME No. 454/82
Disk No. 4

Pet. Rpt. No. 15/87
1:100 000 Sheet 6629

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ABSTRACT

Two specimens of marble from Kapunda were deformed and strongly foliated by a low temperature - high stress episode of regional metamorphism. The oriented fabric was destroyed by recrystallisation at a higher temperature in a third specimen of marble. It is suggested that the latter rock was closer to a post-tectonic intrusive than the former rocks. Organic matter has been preserved in a carbonised form in both types of marble but the shape of the organic remains has been destroyed.

INTRODUCTION

Thin sections of three specimens of marble from Kapunda were received from Barry Cooper of the Regional Geology Branch. Particular interest was expressed in locating any traces of organic remains, in the mineralogy with emphasis on metallic minerals and in the metamorphism of the rocks.

PETROGRAPHY

Specimen 6629 RS 65, TS C 4872, 8 m above 6629 RS 64

Thin section - Rowett's No. 1 Marble Quarry, Section 7600 Hundred Kapunda

The specimen is a fine-grained, slightly silty unstained carbonate in which grains display a strong preferred orientation. A contorted banding is outlined by grain-size variation and minor changes in mineralogy.

The carbonate averages about 0.1 mm in grain size but coarser grains up to 1.5 mm and finer grains down to about 0.01 mm occur in contorted bands. Grains tend to be strongly elongated and preferentially oriented in a direction which is superimposed on the contorted banding. Elongation and preferred

orientation are less marked in coarse grains where recrystallisation may have persisted after the release of the main applied stress. All grains tend to be closely interlocked.

The silicate fraction of the rock amounts to less than 10% overall but in some bands, notably those of finer grain size, the proportion rises locally to over 50%. Quartz is by far the major component of this fraction and consists of grains in the 0.1 mm range which show elongation and preferred orientation to a somewhat lesser degree than the carbonate component. Some quartz is recrystallised interstitially to the dolomite. Many grains are strain-free but others display strain polarisation in undulose extinction.

A few silicate grains are recognisable as plagioclase through traces of polysynthetic twinning but many more grains consist of a turbid mass of clay minerals and are probably altered feldspars of unknown initial composition.

Fine flakes of mica are widespread but not abundant except in parts of the silty bands. The mica is a very pale, weakly pleochroic type with a rather altered appearance in places. It is probably phlogopite but may initially have been muscovite. It may now be partially altering towards a clay mineral.

Other silicates present are rare, fragmented and leucoxenised sphene and very rare grains of tourmaline.

The fine, silty bands are also distinguished by the presence of limonite and a dark, amorphous, interstitial material. The limonite is partly interstitial and has penetrated cleavage and twin planes as well as grain boundaries as a yellow-brown stain. It also occurs as pseudomorphs, probably after pyrite, up to 1 mm across and many times coarser than the silt. The pyrite was almost certainly diagenetic in origin. A few opaque grains which may have been pyrite occur outside the silty bands. The dark, amorphous interstitial material may be organic in origin. This is the only evidence of organic remains in the rock and probably does not retain the form of any individual micro-organisms which may originally have been present. There is no evidence of any macro-fossils.

Comment

The contorted banding may be the product of original bedding in a sediment composed mainly of carbonate but with silty beds made up partly of silicate minerals with some organic matter. Diagenetic pyrite developed in the reducing environment provided by the decomposition of the organisms.

The specimen examined is the result of strong deformation and consequent recrystallisation of the carbonate sediment. At first the rock was deformed to the extent that the bedding became almost isoclinally folded. The whole rock mass then recrystallised under stress sufficiently high to product a foliated fabric with a very strong preferred orientation of elongated grains. Minor recrystallisation persisted after the stress was relaxed.

Any macrofossils would have been obliterated during this recrystallisation but carbonised organic matter persisted in the interstices of the silty bands.

Because of the preservation of what appears to be bedding and the apparent absence of significant reaction between carbonate and silicate material, the temperature of the metamorphism may be presumed to have remained relatively low.

Specimen 6629 RS 68, TS C 48473, 19 m above 6629 RS 67

Thin section - Quarry with historic quarry, Section 11, Hundred Kapunda.

The specimen is similar in essentials to 6629 RS 65. It differs in two respects, relating more to the original sedimentation than to subsequent recrystallisation. The differences are in grain size and in mineralogy but are relatively minor and of degree rather than in kind.

The average grain size of the carbonate is lower than that of RS 65 and there is sharper distinction between coarse-grained bands and the average fine silt grade. Coarse crystals are up to 2 mm and fine grains are as little as a few microns across. Strong elongation in the silty grains and weaker elongation in the coarser grains are evident. Deformation of the bands has extended to the detachment of some parts of coarse bands which are now surrounded by fine grains.

Compositionally the rock is poorer in silicates than RS 65 but richer in interstitial dark, amorphous material. However, the greater abundance of probable organic matter has not led to the development of diagenetic pyrite.

Comment

The history of the rock, and its composition are little different from that of RS 65. The preservation of individual fossil remains is equally unlikely but carbonised organic matter has been preserved. The metamorphism appears to have been high in stress but low in temperature.

Specimen 6629 RS 71, TS C 48474

Thin section - Burrow Pit, Section 1520, Hundred Kapunda.

The specimen is a recrystallised carbonate but is otherwise dissimilar to 6629 RS 65 and 68.

The rock consists almost entirely of a closely-interlocked mosaic of coarse-grained dolomite. Grains are up to 4 mm across and the average is in the order of 1 mm. diameter. On the scale of the thin section grain elongation and a preferential orientation are not apparent.

Fine flakes of mica, possibly phlogopite, are not abundant overall but are concentrated in small patches, both as interstitial grains and as inclusions in coarse dolomite.

A mineral not encountered in the other specimens examined is an amphibole, probably tremolite. Uncertainty is due to a relatively poorly crystalline state. The mineral appears to be altering. One alteration product is carbonate. The significance of the tremolite is as a possible reaction product of dolomite and silica.

Another difference between specimens 6629 RS 68 and 71 is that the opaque material of probable organic origin has been remobilised in RS 71 to form clusters of granules rather than formless interstitial material. Groups of granules form trails and loops which are probably the traces of grain boundaries although often the original grains no longer exist. The material forming the opaque grains is very dark and probably rich in carbon,if not totally carbonised.

Rare interstital grains of quartz are present.

Comment

The coarsely recrystallised carbonate, the absence of preferred orientation, the redistribution of opaque material and the presence of tremolite all indicate a higher level of thermal metamorphism in specimen RS 71 than in RS65 or 68. This must have taken place after the regional dynamic metamorphism, at relatively lower temperatures, which produced foliation in RS 65 and 68. It is likely that a post-tectonic igneous body was intruded closer to RS 71 than RS 65 and 68. Minor recrystallisation of coarser grains in the latter two samples may possibly be attributed to the same intrusive activity since the coarser grains tend to be less preferentially orientated than the finer grains.

It is even less probable that the form of organic remains would be preserved in this specimen than in the less thermally altered rocks.

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