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Clay Minerals from Permian Strata of Tasmania

By

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(WITH 1 TEXT FIGURE)

ABSTRACT

Detailed investigation of the Permian System in Tasmania has led to the identification of montmorillonite, nontronite and glauconite. Apart from the fact that these minerals have not been recorded previously in the Permian of Tasmania they have proved useful as stratigraphic marker minerals.

MONTMORILLONITE

While measuring detailed stratigraphic sections of the Berriedale Limestone, Brill noted several beds of tan, waxy-looking shale. The shale beds range from 6 inches to a fraction of an inch in thickness and are interbedded with mudstone and limestone. The shale weathers rapidly and for this reason is best observed in the relatively fresh exposures in limestone quarries. Figure 1 shows columnar sections of the principal limestone quarries in the Derwent River valley. At the Glenorchy quarry (Weily's Blue Stone Quarries Prop., Tolosa St.) at least 11 beds and perhaps 14 beds of tan shale may be seen.

These shales are unique in Tasmania but are similar to " metabentonites " of Paleozoic age in North America. These facts led Hale to test the shale by Differential Thermal Analysis and by X-Ray diffraction methods. The tests indicated that the chief component of the shale was the mineral montmorillonite. In most samples illite was admixed.

Samples were sent to Dr. R. E. Grim, University of Illinois, who states: " The clay mineral composition of the three samples is substantially the same. In each case, they are composed of a mixed layer sequence of montmorillonite and illite and I would estimate that the montmorillonite is slightly the more abundant.

A considerable study of bentonites from the Paleozoic in this country has shown about the same clay mineral composition as your samples.

I would say on the basis of these clay mineral analyses that the samples could well be bentonites."

The shale beds are relatively pure, contain no pebbles and in only a few places are fossils present. The fossils are delicate forms such as fenestellid fronds and paper thin crinoid plates. Many of the beds are very thin but seem to pinch and swell. Some show that fragments of the tan montmorillonite-shale are jumbled and mixed with darker illitic shale. If deposition took place close to wave base the sediment would tend to fill holes in the sea floor, and be winnowed off the higher areas. A change in wave base might break up slightly consolidated clay and mix it with the surrounding sediments. The normal clay mineral being derived from the surrounding land seems to have been illite; however, much of the mud-stone in the Berriedale Limestone seems to consist of rock-flour and is not clay.

Montmorillonite can form by residual weathering under various conditions (Ross and Hendricks, 1945). It has been found in glacial drift weathered under certain climatic conditions; it results from the weathering of basic igneous rocks; or it is an alteration product of volcanic dust.

The montmorillonite-bearing shales of the Berriedale Limestone are certainly not residual weathered glacial deposits. Their homogeneity and thinness precludes a glacial origin. No large areas of basic igneous rocks seem to have been available for weathering during Permian time and few fragments of basic rocks have been found in the Berriedale Limestone.

Montmorillonite-bearing shales resulting from the alteration of volcanic dust may contain shards of volcanic glass and usually contain minute, euhedral fragments of biotite, apatite, and zircon. The older the deposit the less likely that the shards will remain. Thin-sections of the Tasmanian shale were examined for shards, but none were seen. The presence of ice-rafted glacial debris in the Permian of Tasmania creates an unusual problem in connection with the presence of biotite, apatite and other igneous minerals. At least one fragment of euhedral apatite was found in a thin-section; however, there is the possibility that this could have been transported by an iceberg and dropped in the clay, instead of being wind borne.

The following facts favour the volcanic origin of the shale:—

(1) It occurs in thin, rather homogeneous beds;

(2) Although the surrounding beds are highly fossiliferous the shale is usually devoid of fossils, and where fossils occur they are few in number and represent delicate forms;

(3) The shale is megascopically identical with deposits of Paleozoic volcanic dust which occur in other parts of the world.

The montmorillonite-bearing shales have proved to be useful marker beds in the Berriedale Limestone (Fig. 1). The shale tends to weather rapidly and cannot be seen readily except in quarry faces where fresh rock has been exposed. In the limestone quarries near Dromedary and Granton in the Derwent Valley, the lower and upper marker beds, which are beds of shale separated by about 16 feet of limestone, can be traced for nearly 10 miles. Were exposures available, these beds undoubtedly could be traced farther.

There are beds of similar shale on Maria Island and at Friendly Beaches on the East Coast in a limestone formation that is coeval with the Berriedale. At present it is not possible to make a bed-for-bed correlation between the East Coast shales and those of the Derwent Valley. No shale of this type occurs in equivalent limestone beds near St. Marys.

The number of beds of montmorillonite-bearing shale is greater in the Glenorchy quarry than in the others. Although the exposure is greater, the number of shale beds per foot is also greater. The thickness of the beds is too variable to draw any conclusions as to the direction of thickening of the shales. It is tentatively suggested that the volcanic centre from which the dust was derived may have been somewhere east of Hobart.

A one inch bed of white montmorillonite-bearing clay occurs in the road cut at Elephant Pass, six miles east of St. Marys. This bed is in the Ferntree Mudstone and lies 73 feet below the Permian-Triassic contact. Montmorillonite has not been detected in clay beds of Ferntree age in other parts of the State. If this clay represents a fall of volcanic dust, the dust presumably had a source different from that which yielded the Berriedale deposits.

NONTRONITE

A brown, waxy-looking clay was found by Brill while measuring a detailed stratigraphic section of the Grange Mudstone (Grange Quarry, Sandy Bay Road). Subsequently the same type of clay was found in strata of approximately the same age as the Grange Mudstone about 7 miles west of Judbury. This locality is in a borrow pit next to the road at the top of the divide between the Russell River and Little Denison River. Here the clay is apple green and waxy-looking.

Differential Thermal Analyses of the mineral made by Hale show that it is chiefly the clay mineral nontronite. The mineral has not been known previously in the Tasmanian Permian.

The clay is not bedded at either locality. At the Grange quarry it occurs near the base of the face in stringers about ¼ inch wide. The stringers, which fill joints in the mudstone, cut diagonally across the bedding. At the Russell River locality, the clay forms small lumps and nodules about the size of a hen's egg. It seems to occur in joints in the mudstone.

At both localities the Permian mudstones are close to dolerite intrusions. It is possible that the nontronite resulted from alterations of montmorillonite or illite in the Permian strata by heat and aqueous solutions from the dolerite.

GLAUCONITE

Walker (1953) mapped a section through the Permian at Ray's Hill, St. Marys, and the topmost bed of this section was found to be a glauconitic sandstone containing up to about 20 per cent glauconite in the common rounded grains with microcrystalline texture and green colour.

Brill working at Elephant Pass, also near St. Marys, identified glauconite in a sandstone from the Permian section there although here the glauconite amounted to less than 20 per cent of the rock. He correlated this bed with the Risdon Sandstone member of the Ferntree Mudstone at the locality between Mts. Peter and Paul near Friendly Beaches. The Risdon of this area contains scattered grains of glauconite but its stratigraphic position can be definitely established from the succession. No means were previously available to correlate the St. Marys section to the Permian rocks of south-eastern Tasmania.

ACKNOWLEDGMENTS

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REFERENCES

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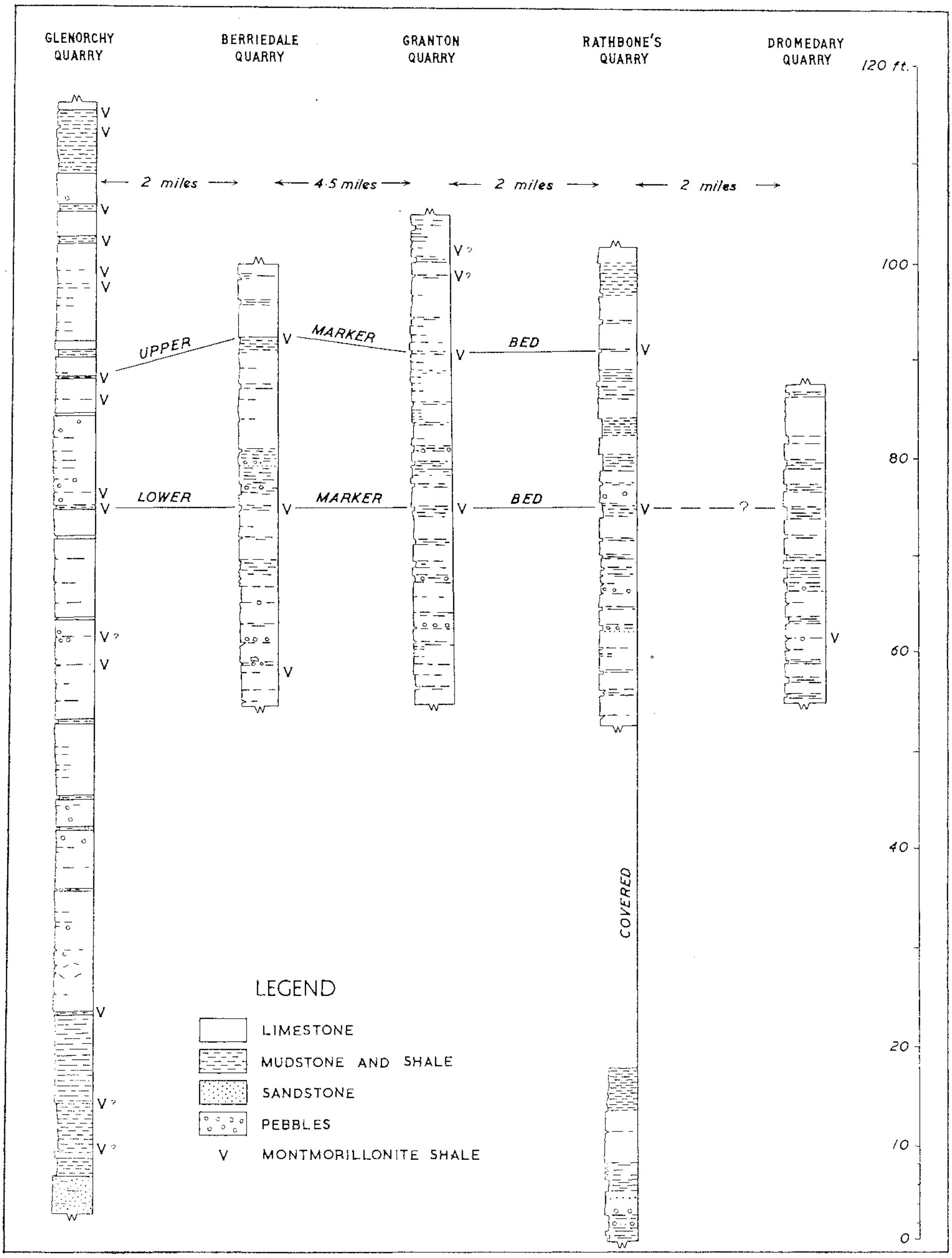
LOCALITY INDEX

	Internat. Grid. Reference K/55 Quadrangle	S.Lat.	E.Long.
Dromedary	Brighton 75	42° 44′	147° 10′
Elephant Pass	St. Marys 49	41° 39′	148° 15′
Friendly Beaches	Swansea 63	42° 3′	148° 17′
Glenorchy Quarry	Hobart 82	42° 51′	147° 15′
Grange Quarry	Hobart 82	42° 56′	147° 20′
Granton	Hobart 82	42° 45′	147° 14′
Judbury	Styx 81	43° 00′	146° 56′
Little Denison River	Styx 81	43° 00′	146° 18′
Maria Island	Maria 77	42° 37′	148° 6′
Mt. Paul	Swansea 63	42° 3′	148° 15′
Mt. Peter	Swansea 63	42° 2′	148° 15′
Ray's Hill	St. Marys 49	41° 32′	148° 12′
Russell River	Styx 81	42° 59′	146° 19′
St. Marys	St. Marys 49	41° 35′	148° 12′



CORRELATION OF MONTMORILLONITE SHALE BEDS IN BERRIEDALE LIMESTONE, DERWENT VALLEY