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NOTES ON OPAL-BEARING SURFACE ROCKS IN THE NORTHERN TERRITORY WITH REFERENCE TO SUPPLIES OF AGGREGATE AND SAND.

by

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In 1946, the writer compiled notes on the general geology of the Darwin Township Area, with special reference to engineering geology. * Supplies of sand for concrete work were mentioned in these notes but the question of rock aggregate was not dealt with.

Geological work in the Territory since 1946 has provided more information on the composition of the so-called "porcellanite" which occupies much of the higher ground in the Peninsula on which the Town of Darwin is built. As pointed out in my earlier notes, this "porcellanite" is actually a fossil soil horizon and represents silicified lower zones of a laterite profile developed on Lower Cretaceous shales during Tertiary time. The degree of silicification, and hence the toughness of the material varies widely and irregularly.

It is certain that at least some of the silica cementing the rock is in opaline form (probably a good deal of it), and, in view of recent work on aggregate containing opal carried out by several workers in United States (Mielenz, Greene and Benton, 1947) and by the C.S.I.R.O. in Australia (Alderman, Gaskin, Jones and Vivian, 1947), it may be as well to point out that the "porcellanites" of the Darwin area should not be used as concrete aggregate for any purpose. Expansive reactions would be expected, even with low-alkali cement.

Since the Cretaceous shales, including the "porcellanite" have been the major rock formation contributing to the building up of beaches in the Darwin Area, it is reasonable to ~~anticipate~~ expect a percentage of opaline material in the beach sand.

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* Bureau of Mineral Resources - File 1?ONT/1 - Geol.& Gephys.

It is understood that beach sand is used in concrete at Darwin and, if the mineralogical composition of the sand has not already been established, it is suggested that an investigation of the opaline silica content of material from present or prospective sand pits would be a worthwhile precaution before using beach sand in important concrete constructions.

It should be noted that the problem of avoiding opaline surface rocks in obtaining supplies of aggregate and sand is not restricted to the Darwin Area, but will be encountered in many parts of the Territory and in adjoining States.

The central and western portions of the Australian continent have been very stable areas geologically and still carry, over large areas, relicts of a land surface which originated in Tertiary time, and which subsequent erosion has only partly removed. This Tertiary land surface was heavily lateritised and much of the laterite is still preserved in mesas, tablelands and in upland areas. In many places, a degree of secondary silicification took place in the lower horizons of the laterite giving rise to hard or tough rock types containing significant amounts of opaline silica.

The two most prominent types in the Territory are the silicified clay-shales (porcellanite) found in the Katherine-Darwin region and to some extent in the Barkly Region, and the "billy" (a silicified sand-rock or quartzite - commonly grey and vitreous) which is found, mainly as boulders, in many places in the central and southern portions of the Territory. Because of their resistance to erosion, boulders and fragments of "billy" remain strewn across plains and ridges or concentrated in creek gravels after other evidence of lateritisation has been removed.

Deposits of sand and river gravels are, therefore, likely to contain some percentage of opaline material (depending mainly on the relationship of the present topography to the Tertiary land surface) and it would be advisable to check for opaline and cryptocrystalline silica before using them as sand or aggregate in concrete. Aggregate which contains small uantities of opaline or cryptocrystalline silica may give rise to delayed action with no recognisable expansion effects for many years.

The potential danger of these materials has been clearly shown in an investigation of a number of Australian aggregates by the Cement Section of the Commonwealth Scientific and Industrial Research Organisation. * From the samples of aggregates tested from South Australia and from the Northern Territory, at least four (from petrological description and from the writer's knowledge of the localities) contained secondary silica of lateritic origin.

Surface gravel from Oodnadatta, S.A., was regarded as "unsatisfactory aggregate" because of reaction due to opal, and opaline quartzite from Coober Pedy was classed as a "dangerous aggregate" for the same reason. There is little doubt that the bulk of these samples consisted of "billy" or material from the silicified zone of a laterite.

As regards the Northern Territory, samples of eight aggregates were tested (see Table). Two of these aggregates almost certainly contained some cryptocrystalline or opaline silica derived from products of lateritisation. Samples of river gravels from Katherine Ø and from Mataranka (No.7 and 8) produced many wet spots in mortar bar tests and the C.S.I.R.O. workers comment that "presence of much cryptocrystalline quartz suggests the possibility of delayed expansion".

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* "Studies in Cement-Aggregate Reaction". Op. Cit.

Ø Some of the cryptocrystalline or chalcedonic quartz in the aggregate from Katherine may have come from chert or flint boulders weathering from Cambrian limestone.

Table 1.

Aggregates from Northern Territory, tested in Mortar Bars. *

No.	Type of Aggregate.	Comment.
NT.1	Sandstone, Newcastle Waters	An occasional damp spot
NT.2	Gravel, Tennant's Creek. (Ferruginous sandstone gravel)	Very few damp spots.
NT.3	Gravel, Tennant's Creek, (Sandstone gravel)	Many wet spots. This rock contains a little cryptocrystalline quartz.
NT.4	Gravel, Barrow Creek(Quartzite, sandstone and trachyte pebbles)	No sign of reaction, although this rock contains some fine-grained siliceous material
NT.5	River Gravel, Alice Springs. (Granite and gneiss gravel)	An occasional damp spot.
N.T.6	Gravel, Alice Springs (Feldspathic quartzite gravel)	A few damp spots. Contains both fine-grained siliceous material and extensively altered feldspar.
NT.7	River gravel, Katherine. (Quartzite chalcedonic rock gravel)	Many wet spots. Presence of much cryptocrystalline quartz suggests the possibility of delayed expansion.
NT.8	River Gravel, Mataranka. (Quartzite and sandstones gravel)	Many wet spots. Presence of much cryptocrystalline quartz suggests the possibility of delayed expansion.

Aggregate and sand from stream 4 miles N.E. of Tennant Creek, on northern side of Honeymoon Range.

No.	Type of Aggregate.	Comment.
NT.9	Sand, bordering stream channel	A few reaction spots. All contain very small amount of opal (up to .05%) but not sufficient to render materials unsuitable for aggregate.
NT.10	Gravel from stream bed	
NT.13	Gravel	
NT.14	Sand from bar in stream bed	

* Taken from a table appearing in "Studies in Cement-Aggregate Reaction". Aggregate No. 9, 10, 13 and 14 were tested by the C.S.I.R.O. in 1948 at the request of Bureau of Mineral Resources.

The other aggregates, with the possible exception of No.3, appear/satisfactory. The petrological description of Sample No.3 refers to "very fine-grained quartzite, some of which is cryptocrystalline", which appears as grains in a hematite-cemented sandstone. The writer suggests that some of this hematite-cemented sandstone is billy or sandstone partly silicified by lateritisation; and the difference in behaviour, under test, between Sample No.3 and the other samples from Tennant Creek is consequent on increase of siliceous lateritic material.

The conclusion is reached, therefore, that individual deposits of sand or gravel in the Northern Territory should be examined geologically, sampled and tested before they are used in any project in which expansive reactions within the concrete would be dangerous or otherwise undesirable.

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