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ROCK FROM MT. MUGGA QUARRY, A.C.T. - ITS SUITABILITY AS AGGREGATE

by

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Petrologist

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SUMMARY

Granodiorite porphyry from Mt. Mugga Quarry has been examined in both hand specimens and microscope slides with the following results :

1. Although the rock is generally impregnated with haematite (Fe_2O_3), no pyrite was found.

2. The groundmass of the porphyry is sufficiently coarse-grained to make it unlikely that any cryptocrystalline silica has escaped notice. However, a little haematitic chalcedony was found in the floor of the quarry, and so it is possible that some parts of the rock may be impregnated by reactive silica. It is suggested, therefore, that the porphyry be properly sampled and tested for suitability as aggregate.

INTRODUCTION

Late in September last year the writer, accompanied by L.C. Noakes and an officer of the Department of Works and Housing, Mr. F.K. Hosking, spent part of a morning examining the rock in Mt. Mugga quarry.

The object of the examination was to find whether the rock was suitable for aggregate, as the presence of pyrite had been reported some years ago.

A set of representative specimens was collected, and these have been studied microscopically.

DESCRIPTIVE GEOLOGY

All of the rock exposed in the quarry is massive, jointed felspar-quartz porphyry, and there is every reason for assuming that a large volume of generally similar rock will be available.

No pyrite was visible to the unaided eye in any easily accessible part of the quarry, nor was any seen in loose blocks on the floor of the quarry.

Most of the porphyry is stained by haematite in varying degree. Actually only very little virtually unstained material is left, and it is coloured medium buff-grey. However, even this may contain scattered grains of stained quartz.

At least three different degrees of haematitisation may be recognized :-

a. The groundmass of the porphyry is purplish grey.

b. The purplish-grey groundmass is unevenly stained dark greyish red; the quartz phenocrysts are marginally or wholly impregnated by haematite along cracks, but the felspar crystals are only slightly or not at all affected at this stage.

c. The rocks most strongly stained by haematite represent only a very small part of the total bulk. Two types of staining were noted :

1. The farthest limit of staining of type b. above is commonly marked by a zone about ½ of an inch wide in which the groundmass is heavily impregnated by haematite, so that it appears almost uniformly dark red to the naked eye. The quartz and felspar are approximately equally stained, though the staining is not more than four times as heavy as that noted in quartz under b. above.

2. In the neighbourhood of and sub-parallel to major joints there is a type of haematite staining of the same intensity as that described under c.1 above, but it is disposed in such a way as to resemble a ramifying system of veinlets, which range in width from about ⅛ of an inch downwards.

From a study of the whole quarry face it is clear that haematite has been introduced along major joints and has spread out therefrom in an irregular fashion. Irregular masses of sparsely-haematitised or non-haematitised porphyry remain where the iron-bearing fluids have penetrated only slightly or not at all.

A few narrow - ½ inch to ⅛ inch - veinlets of epidote and of an iron-bearing carbonate, which is stained brown on the exposed surface, were noted.

A fragment of a vein composed of quartz and chalcedony stained dark red and red, respectively, was found in the floor of the quarry.

It seems likely that all three of these vein-materials and the haematite in the body of the rock were introduced at a time when the rock had solidified but was still hot; they may be attributable to the transfer of fluids from a more deep-seated part of the same porphyry mass at a late-magmatic stage.

PETROGRAPHIC DESCRIPTION

The variation in the colours of hand specimens with the degree of haematite staining has been described in the previous section.

Most plentiful among the porphyritic crystals is greyish or greenish white plagioclase. Semivitreous to vitreous quartz is little subordinate to the plagioclase in amount, and next is a grey ferromagnesian with the cleavage of amphibole or pyroxene. Scattered phenocrysts of flesh-coloured potash felspar can be easily distinguished, but these make up only about 1 per cent, or less, of the whole rock.

Six representative thin sections of the porphyry have been prepared for microscopic study.

The plagioclase occurs as subhedral to euhedral crystals whose composition varies slightly in different parts of the quarry. In sections showing combined albite and Carlsbad twinning the lower and upper limits of anorthite content are, respectively, 53 per cent. and 56 per cent. Determinations on such sections may generally be taken as being more reliable than any others that may be done without a universal stage, and therefore some doubt may rest in one determination which gave an anorthite content of 63 per cent. from extinction angles in the symmetrical zone. However, it is possible that the lime content of the felspar in this particular case has been increased, and the soda correspondingly reduced, due to the invasion of the rock by lime-bearing solutions whose former presence is attested by a vein of mixed carbonate and by considerable carbonatisation of the felspar and of the groundmass near the vein. In another slide a plagioclase crystal is heavily carbonated where a narrow vein containing quartz, epidote, carbonate and chlorite crosses it. In all, only a few instances of zoning in the plagioclase were noted.

The plagioclase, on the whole, is fairly fresh, but it may contain two or more of the following alteration products - epidote, sericite, chlorite, kaolin and carbonate. It may also contain haematite along cracks and cleavages, but only in those specimens which have been relatively heavily haematitised.

The quartz phenocrysts commonly have irregular outlines and may also be corroded, though numerous subhedral crystals were noted. Inclusions and veinlets of carbonate, chlorite, and haematite may be present.

The porphyritic ferromagnesian was brown hornblende which, at a late stage in the cooling of the porphyry, was largely or, in the case of the smaller crystals, completely altered to black iron ore, chlorite and leucoxene. In some places the alteration has taken a slightly different course. Where carbonate has been introduced the minerals replacing the amphibole are carbonate, black iron ore, leucoxene and haematite; in rocks rich in haematite the leucoxene has been re-converted to black iron ore, presumably ilmenite. Partially altered brown hornblende remains within many of the clots of alteration products; furthermore, the shapes of some of these clots are such that their derivation from euhedral amphibole is beyond doubt.

Only a few crystals of potash-felspar appear in the slides. They are of the perthitic variety and are easily distinguishable from untwinned plagioclase by their being only slightly clouded through incipient alteration to kaolin.

The grainsize of the groundmass is about 0.1 mm., but it may vary considerably from this figure, particularly towards a smaller value. On grainsize it appears that the porphyry is intrusive and not volcanic.

By far the most abundant mineral in the groundmass is plagioclase - it makes up not less than 85 per cent. of the whole. The remaining minerals are quartz, chlorite, carbonate, and epidote.

Very small amounts of zircon and apatite are the only primary accessories.

No pyrite appears in any of the six thin sections available.

Microscopic examination of the veinlets described in the previous section of this report shows that those composed predominantly of epidote contain in addition quartz, chlorite and carbonate, and that chlorite, quartz and haematite appear in those made up largely of carbonate.

The rock as a whole is a granodiorite porphyry or a labradorite-quartz-hornblende porphyry corresponding in composition to a granodiorite.

CONCLUSIONS

The porphyry appears to be completely free from pyrite; if this mineral is present at all, it is likely that it will be found only in relatively small pockets or narrow zones of rock.

No undoubted cryptocrystalline silica was found in the sections or in the quarry face. However, the presence of part of a vein of haematite-stained cryptocrystalline silica and quartz in the floor of the quarry points to the possibility that parts of the groundmass of the porphyry may be impregnated with such material on a fine scale. Thus, although the groundmass, as seen in the six slides, is relatively coarse-grained and is unlikely to contain any material which would react with high-alkali cements, the possibility of reactivity cannot be absolutely precluded. It would be advisable, therefore, to have the porphyry adequately sampled and then tested in the laboratory of the Cement Section of the C.S.I.R.O. at Fishermen's Bend.

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