
Observations on the Dark, Opaque
Inclusions in the Nellore Garnets.

THE garnet which encloses the inclusion being almost transparent in thin sections, these inclusions which are black and opaque, are clearly visible in transmitted light. Micro-metric estimates show that they form about two per cent. of the garnet by volume. They have submetallic to adamantine lustre; streak is black; colour iron-black with a slight violet tint. Most of these inclusions are granular but some of them are minute tabular crystals, often in thin plates or laminæ. These inclusions are magnetic and they are magnetically more powerful than almandite (garnet) but slightly less than ilmenite. Under the microscope in transmitted light, these inclusions are opaque except for a few enclosed rutile crystals. In reflected light they exhibit a steel-grey colour tinged with pale violet. While some of them show clear crystal boundaries when examined "*in situ*," many present a streaky and granular appearance.

To separate these inclusions from the garnet the following procedure was adopted: A few crystals of garnet were reduced to a 100 mesh powder which was then treated with an electromagnet when a concentrate of this black mineral was obtained. The impurities and lighter minerals like quartz which accompanied the concentrate were removed by using a heavy liquid (methylene iodide). A pure sample was then obtained by repeatedly treating the concentrates with a horse-shoe magnet to the poles of which two needles were attached to bring about a pointed field. A final picking under a microscope was also resorted to.

When strongly heated, these inclusions change to a brownish black colour and an increase in weight is also noticed. When

fused with Na_2CO_3 the material is only slowly decomposed, but fusion with either potassium bisulphate or sodium bisulphate results in complete decomposition of the material and the fused mass thus obtained dissolves readily and almost completely in hot dilute H_2SO_4 . These inclusions give no tests for either calcium or manganese, but no attempt was made to test for the presence of alkalis. A very pure sample of these inclusions obtained as indicated above was analysed and the results obtained are as follows :

ANALYSIS OF INCLUSIONS.

Oxides.	Per cent.
TiO_2	65.85
FeO (by difference)	18.84
Fe_2O_3	15.31
SiO_2	trace
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Total	100.00

A complete analysis of the entire garnet showed a titanium content of nearly 1.0 per cent. Since careful tests with clear garnet grains as well as with the quartz inclusions found therein, showed complete absence of titanium, it appears certain that all the titanium associated with the garnet is present in these black inclusions.

A microscopic study indicated that crystals of rutile are sometimes present in the inclusions to the extent of 7 to 8 per cent. This small quantity of rutile cannot account for the high percentage of TiO_2 found by chemical analysis. The chemical analysis shows also that the TiO_2 content is far in excess of the ferrous oxide required to form normal ilmenite, and that there is in addition a large proportion of ferric oxide. Further work is in progress with a view to explain the large TiO_2 content of these inclusions.

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