

**NOTE**

**Analytical Studies of Vanadiferrous and Titaniferrous Magnetites of Dublabera Area of Singhbhum**

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In the present work the analytical studies of vanadiferrous and titaniferrous magnetities are performed.

Vanadium is a rare metal and its utility is increasing day by day in the field of defence material. It has replaced nickel in the manufacture of alloys. Vanadium metal is silvery white in appearance. The pentoxide of vanadium is of great industrial utility. It is used for the manufacture of strong alloy steel and ferrovanadium alloy which is a source of making heavy machines and tools. The world's most important vanadium supply comes from the deposits of patronite in Peru and the other secondary source of vanadium is the carnotite deposits of Colorado, Rhodesia and Southwest Africa. Vanadium also occurs in India in Travancore, in the ash of lignite, but the quantity of vanadium does not warrant commercial operation. Another important source of vanadium is titaniferrous-vanadiferrous magnetite found around the villages of Dublabera, Lango and Sindurpur in Singhbhum district of Bihar. In Dublabera area vanadium and titanium form an association. The area has got a good deposit of vanadium metal. Nearly 25,00,000 tonnes of ores reserve is estimated which is carrying 1.6-2.5% of vanadium peroxide. This mineral is heavy and is a peculiar association of titanium and magnetite minerals. The ore minerals are intimate and intrinsically associated with one another<sup>1</sup>.

The area of Dublabera is situated in Singhbhum district of Bihar near Kotbar Pathar (22°31'30" N. Lat., 86°19' E. Long.) In this area the Precambrian iron ore combination also falls. It is generally a basic and low silica shale, basically in gabbro, dolerite, perodolite and pyroxinite. The atomic number of vanadium is 23, titanium 22 and of iron 26. They are all 'd' block elements. The atomic weight

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and atomic volume are almost same. Hence their physical properties reveal their occurrence in association.

The present study has been undertaken to ascertain their chemical composition and the amount of various constituents present, to ascertain their metallurgical importance and also their possibility of utilization in other industries.

Samples were collected from Dublabera area and Berdiha area by us. A number of drill samples were also sent by Geologist, Singhbhum (Jamshedpur) Circle, Deptt. of Mines and Geology, Govt. of Bihar. Analytical studies were carried out by standard method using conventional and instrumental colorimetric methods. The magnetic contents were determined by magnetic separation using a strong hard magnet. 1 g of the sample was taken in a 250 cc measuring flask; then it was digested at temperature 120°C. Then the mass was mixed with distilled water and cooled. The solution was filtered and the filtrate was collected in a 250 cc measuring flask. The residue was again taken in a platinum crucible and digested with HF + H<sub>2</sub>SO<sub>4</sub> mixture. After digestion this solution was dissolved in water and mixed in the main filtrate. The stock solution was made up to 250 cc. Then 50 cc of the stock solution was treated with N/10 KMnO<sub>4</sub> solution dropwise through a burette till the pink colour persisted for a few seconds. The vanadium turned into vanadyl condition; then the resulting solution was mixed with 10 cc of N/10 ferrous ammonium sulphate solution and 8 cc ammonium persulphate solution (15%). Then this solution was stirred and cooled with iccold water to maintain temperature up to 15°C. The whole solution was titrated against N/20 KMnO<sub>4</sub> solution. The end point was a permanent pink colour. The amount of V<sub>2</sub>O<sub>5</sub> was calculated (1 mL N/10 KMnO<sub>4</sub> solution = 0.00050 g V). From this titre value the amounts of V and V<sub>2</sub>O<sub>5</sub> were also calculated.<sup>2-6</sup> The analytical data are shown in Tables-1 and 2.

TABLE-1

Sample No.	% Magnetic contents	% V <sub>2</sub> O <sub>5</sub>	% T/Fe	% TiO <sub>2</sub>
1.	65	2.5	45.5	6.5
2.	72	2.1	50.0	6.6
3.	80	3.2	60.0	5.5
4.	75	3.0	52.0	5.5
5.	55	2.0	40.0	4.0
6.	85	2.8	62.0	7.0
7.	78	2.5	55.0	5.6
8.	60	1.8	45.0	4.5
9.	70	2.5	50.0	8.5
10.	73	2.6	55.0	7.5

TABLE-2  
ANALYTICAL RESULTS OF SAMPLES SENT BY GEOLOGIST OF DEPT. OF MINES  
AND GEOLOGY, GOVT. OF BIHAR (JAMSHEDPUR CIRCLE)

S. No.	Sample No.	% Magnetic content	% V metal	% T/Fe	% TiO <sub>2</sub>
1.	RMBH/3/60	85.0	1.8	62.0	4.5
	RMBH/3/10	73.0	2.0	52.0	5.0
2.	RMPH/CH-15	58.0	1.8	45.0	4.5
	RMPH/CH-4	45.0	1.6	32.0	4.0
3.	Mag/KP/89-90/TR-4/23	59.0	0.8	45.5	5.5
4.	Mag/KP/89-90/P-2/5	72.0	1.2	50.0	4.5
5.	Mag/KP/89-90/TR-4/14	74.0	0.6	53.0	6.5
6.	Mag/KP/89-90/TR-4/16	51.0	0.7	38.0	4.0
7.	RMBH-3/55	65.0	1.3	50.0	4.5
8.	RMBH-3/70	72.0	2.0	52.0	5.0
9.	RMBHBG-21	85.0	1.8	—	3.5

### Petrological report

Petrological studies of country rock sample of Dublabera area (sent by Geologist, Directorate of Geology, Govt. of Bihar to State Geological Lab., Hazaribagh) were carried out.

Serial No. 1:	Field No.	Pet. No.
	Dub 490	1865
	496	1870
	497	1871

(03 samples of tremolite and actinolite-schists).

*Megascopic study:* The rock sample is greyish in colour, medium grained, massive in nature, heavy, hard and compact. The mafic minerals are greyish in colour. These are pyroxene with other vitreous quartz.

*Microscopic study:* The rock shows tremolite and actinolite minerals as prismatic crystal which are an altered product of pyroxene; the alteration is seen along the parallel alignment.

The other minerals recognised are anhedral quartz and plagioclased feldspar (albite) showing polysynthetic twinning.

Serial No. 2:	Field No.	Pet. No.
	Dub 267	1883
	269	1884
	270	1885 (core sample)
	271	1886 (core sample)
	273	1872
	498	—

(06 samples of meta-gabbro).

*Megascopic study:* The rock is greyish in colour, medium to coarse grained,

heavy, hard and compact. The minerals recognised are glassy quartz with grey colour, ferromagnesium minerals, e.g., mica.

*Microscopic study:* The rock shows granulitic exture. The porphyric grains of quartz with twinned plagioclased feldspar are conspicuous. The other constituents of the rock are orhopyroxene and linopyroxene (augite), brown biotite with very few grains of green hornblende; a few crystals of sphene and leached iron are also seen. Alteration in plagioclased feldspar (sericitization) has also occurred.

Serial No. 3:	Field No.	Pet. No.
	Dub 485	1861
	487	1862
	491	1866
	499	1893

(4 samples of granite-gneiss).

*Megasopic study:* The rock sample is buff in colour, medium to fine grained, massive in nature, heavy, hard and compact. The gneissic structure is conspicuous. The minerals recognised are vitreous glassy quartz, white feldspar, black mica (biotite), muscovite.

*Microscopic study:* The thin section of rock shows gneissic texture. It contains vermicular quartz, micro perthite, plagioclased feldspar (albite). A few magnetite grains are also seen (brown biotite). Alteration of plagioclased feldspar produces muscovite and sericite.

The samples were found to be magnetite, haematite, ilmenite and vanadium mineral intimately mixed with each other. The colour was brown, black and pink respectively. The specific gravity was found to be 3 to 4.5, The section shows  $\text{Fe}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{FeTiO}_3$  intricately mixed with each other. A detailed study was also carried out to ascertain vanadium's quantity in the magnetic part and the non-magnetic part.

S. No.	Sample No.	% Magnetic content	% V in magnetic part	% V in non-magnetic part
1.	RM/BH/3/60	85.0	1.2	0.6
2.	RM/BH/3/30	73.0	1.5	0.5
3.	RM/TH/4/6	76.5	0.5	0.4
4.	RM/TH/4/114	74.0	0.4	0.2

## Uses

Hydro and pyrometallurgical methods may be tried to recover titanium and vanadium mineral. For the manufacture of ferrovanadium alloys, the ores have to be enriched in vanadium to bring 35–46 per cent V in the alloy. Another important use is in the field of catalysis. The catalytic activity has to be studied because finely divided iron and vanadium is used as a catalyst in the industrial production of ammonia and sulphuric acid.

Another important use is in the manufacture of chrome vanadium steel (Cr 1% and V 0.15%). Because this type of steel is tenacious and load bearing, this is used for making axles, springs and cog-wheels. Moreover, it is also asserted that one tonne of steel requires few pounds of  $V_2O_5$  to improve the quality of steel for the manufacture of heavy machines and different tools. After isolation of  $V_2O_5$  from the ores, vanadium pentoxide is also used in industries like insecticide, dyes, inks, photographic materials and paints etc.

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