

Analysis of Manganese Nodules.

By Professor W. Dittmar, F.R.S.

Station 252 ; 2740 fathoms, North Pacific.

These nodules had a brown or brownish black colour, and, in size and shape, were pretty much like potatoes. They were easily broken by the hammer, and then seen to consist of a clay-like nucleus enclosed in concentric layers of dark coloured matter, the degree of blackness increasing with the distance from the centre. In some cases, however, the whole of a section was found to be almost uniformly black. My work was limited to exhaustively determining the elementary composition of the nodules, and to trying to ascertain, as far as possible by chemical methods, the state of combination of the several elements present. In the latter connection I proposed to direct my attention more particularly to the manganese, and to ascertain whether this metal were present altogether as binoxide, or perhaps partly if not wholly in the form of lower oxides.

To obtain a true average sample of the nodules, it would have been necessary to pound up finely and thoroughly mix the entire stock, but I did not consider myself justified in taking this course; I therefore satisfied myself with selecting a few nodules and pounding up these. The powder was well mixed and preserved as "substance to be analysed." A preliminary trial showed that the substance gave up to boiling water nothing but small quantities of chlorides and sulphates¹ (which I thought might safely be put down as sea-water solids), and besides showed that the filtration of the aqueous infusion was a very tedious process. Hence, in proceeding to the actual analysis (which was executed with 100 grms. of substance), the turbid liquid obtained in extracting the small portion of substance soluble in water was simply poured away. The residue was next digested in the cold in acetic acid of 25 per cent. until the carbonates of lime and magnesia and substances of a similar nature could be assumed to be dissolved, and the residue collected on filters and washed with water. This operation was not attended with any visible evolution of gas, which, however, does not prove the absolute absence of carbonates in the substance. The acetic acid extract was evaporated to dryness and the residue (5.23 grms.) analysed. Qualitative tests showed the presence of considerable quantities of lime, magnesia, and soda, of a little alumina, and of traces of iron, copper, and chlorine. There was absolutely no manganese, which proves that the original substance could not have contained any manganous carbonate or hydrate. The principal bases were determined quantitatively with the following results:—

Alumina (Al_2O_3),	.	.	.	0.170	} per 100 parts of original substance.
Lime (CaO),	.	.	.	0.446	
Magnesia (MgO),	.	.	.	0.365	
Soda (Na_2O),*	.	.	.	0.597	

¹ The aqueous extract contained no lime salts, showing the absence of sulphate of lime.

* Including a little potash.