Sir John Murray & Johan Hjort, The Depths of the Ocean: Scientific Researches of the Norwegian Steamer Michael Sars (1912)

This enrichment in magnesium is a familiar phenomenon at shallow depths, notably in and about coral reefs. It has also been shown on the basis of the "Challenger" analyses that bottom-deposits contain more $MgCO_3$ in proportion to $CaCO_3$ the less calcareous they are. Granted that accumulation of magnesium does take place, there are two explanations which have been offered, viz. (1) that deposited lime is dissolved away in preference to magnesia, and (2) that a kind of pseudomorphosis by the interaction of calcium carbonate and dissolved magnesium salts sets in. Both assume $MgCO_3$ to be less soluble than $CaCO_3$, and both may well hold good. Even if $MgCO_3$ were precipitated as trihydrate, it would sooner or later change into the anhydrous form, or rather into dolomite, that being the most stable and final form. Perhaps this transformation has already been effected in the shell. But dolomite is well known to be less soluble in carbonated water than calcite. As regards enrichment by accession of magnesia, this could only take place if sea-water were nearly saturated for $MgCO_3$, a matter which has not hitherto been put to the test; sea-water is certainly not saturated for the trihydrate, but it is conceivable that anhydrous calcium carbonate would determine the deposition of magnesium carbonate in the anhydrous form, which is relatively very insoluble. Now when calcium carbonate goes into solution, the concentration of CO_3'' ions in its neighbourhood is increased, whereby the solubility of any other carbonate is lowered; thus a precipitation of $MgCO_3$ might ensue. However, if this action were capable of taking place generally, we should expect a far larger percentage of magnesia in the purer calcareous oozes. On the whole, therefore, the enrichment in magnesia in deep-sea deposits proper is rather to be sought in preferential dissolution of lime.

The total magnesium carbonate at the bottom of the sea only amounts to a small percentage of the total calcium carbonate. Since the proportion of Mg to Ca, primarily in rocks and secondarily in river-waters, is much larger than this, it is clear that dissolved magnesium is accumulating in the ocean.

Sulphur.

Another of the more important constituents of sea-water, sulphur, suffers transference, on a modest scale, from the sea to the bottom. Nowhere in the deposits of the open ocean has sulphur been found to occur as sulphate, but in those very extensive landward areas where Blue muds form the deposit there is always a small percentage of ferrous sulphide and of free sulphur, which are directly or indirectly derived from

http://19thcenturyscience.org/HMSC/HMSC-Reports/1912-Murray/README.htm