

silica and alumina play the chief part, but ferric hydroxide and even lime, magnesia, and alkalis are also represented. These minor constituents are, at any rate, so combined as to resist leaching out by dilute acids. Vast areas of the lowest depths of the sea are covered by such a clay in a state of considerable mechanical purity, a product of almost exclusively submarine disintegration, known as Red clay.

The chemical action by which pelagic clay is derived from its volcanic mother-rocks must proceed, as compared with subaerial weathering, with the utmost sluggishness. The fundamental question, indeed, whether fresh or salt water exerts the more powerful action upon rocks must be regarded as not yet answered. Great experimental difficulties are encountered, and we find the results of Thoulet, who concluded that fresh water is a better disintegrant than salt, diametrically opposed to those of Joly.¹ But several other considerations must be taken into account, and it cannot be doubted that rock silicates are degraded more slowly in the sea than on land. For instance, the clastic action of frost is never brought into play. There is no comminution of the minerals by moving water. The soluble by-products are removed, and the supply of oxygen and carbonic acid maintained, by diffusion only.

At this stage the state of rest of the deep-sea residuum is not even yet necessarily final, but is capable of being disturbed locally by organic agencies. Aluminous clay, indeed, is permanent once it is at the bottom, but, whilst floating, it is to some extent decomposed, as we have seen, by siliceous algæ for purposes of nutrition. Iron and manganese oxides are susceptible to reduction by purifying sarcodic matter, whence result the ferrous iron of the Blue muds, and also many of the concretionary forms of these oxides.

The Blue mud areas, which are of vast extent, afford a most important example of the reduction of submarine clay after deposition. We may indeed divide the floor of the sea, according to the relative abundance or paucity of dissolved oxygen in the bottom-waters, into oxidizing and reducing areas. Reducing conditions will prevail wherever there is a larger excess of putrefiable organic matter than can be coped with by whatever supply of oxygen (depending on the circulation of the area) may be available. In general, therefore, the coast-lines of continents are girdled by reducing areas, and it is here that

¹ It may be mentioned that the methods of leaching adopted by these experimenters are somewhat different, and that Thoulet measures his effects by loss in weight, whereas Joly determined the amounts taken up in solution.