

the same composition whether formed in fresh water or in the sea. Quantitatively, it might be expected to show a difference for terrigenous and pelagic origin respectively, since the mother-rocks are in general not the same. Nevertheless, a remarkably close similarity is revealed by analyses, such as the "Challenger" analyses of Blue muds and Red clays, or still better, of Clarke's ultimate analyses of averaged "Challenger" deposits.¹ One notable point of difference is brought out, viz. the greater manganese-content of pelagic deposits.

The action of unlimited water, oxygen, and carbonic acid on the earth's crust tends to lead to certain definite end-products, the nature of which is dictated by the abundance and the affinities of the elements concerned, and by their habit as regards solubility. All minerals, given time, succumb to these agencies. Reviewing the chief elements, we find the final conditions of stability under subaqueous influences to be as follows. The alkalies, being of a highly soluble tendency, go into solution and accumulate in the hydrosphere. Calcium and magnesium are rendered soluble by the presence of carbonic acid and become sea-water constituents, the former being ultimately redeposited by organic processes. Phosphorus behaves similarly. Ferric iron is very feebly basic, and therefore tends to the condition not of a salt but of a hydrated oxide ($\text{Fe}_2\text{O}_3 \cdot \text{Aq}$) which, being very insoluble, remains in the residuum. Ferrous iron, which is a much stronger base, is leached out by the aid of carbonic acid, but is soon oxidized to ferric iron and rendered insoluble. Much the same holds good of manganese, which exists in minerals almost exclusively in the manganous state: it is dissolved as bicarbonate, undergoes oxidation, and comes to rest as hydrated peroxide ($\text{MnO}_2 \cdot \text{Aq}$). Aluminium forms only one base, which is very weak, but has the property of combining with silica to form a highly insoluble substance, ideal clay ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$), which represents its final stable condition. Silicon exists as a weak acid (SiO_2) of insoluble tendencies, which, after having been brought into solution, partly joins the residuum as clay and is partly redeposited as hydrated silica through organic agency.

The ultimate mineral residuum, then, consists, if we pass over the rarer elements, of aluminous clay, hydrated ferric oxide, and hydrated manganese peroxide. In all probability the two former substances should be considered together and submarine clay regarded as an ill-defined colloidal compound in which

¹ *Proc. Roy. Soc. Edin.*, vol. xxxvii. pp. 167 and 269, 1907.