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FORMATION OF SAPONITE FROM KAOLINITE, QUARTZ AND DOLOMITE

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It has been shown by Coombs (1960) and Levinson and Vian (1966) that montmorillonite group minerals can be formed hydrothermally in the laboratory, at temperatures and pressures as low as 175°C and 130 psi, from a suitable mixture of kaolinite, quartz and a carbonate. Much higher rates of reaction are obtained if dolomite is the carbonate. The note describes an occurrence in which this reaction is probably proceeding in nature.

Good quality bentonite has been obtained for some years from claypans scattered over an area near Marchagee in Western Australia. The climate is warm Mediterranean, more than half of the 16-inch annual rainfall occurring in the three winter months. Frosts are rare. There is some surface evidence that montmorillonite is being formed on the site, as fresh montmorillonite can be gathered as a kind of efflorescence after the winter from pans that have previously been scraped bare. The underlying beds are somewhat variable, but in a recent drilling program by British Metal Corporation, the following sequence was observed in one hole. Quartz and dolomite were present at all levels, with the dolomite dominant below 12 feet, but decreasing markedly in the upper 6 to 12 feet and giving place to calcite at the surface; kaolinite and a mixed layer swelling mineral were present from 6 to 36 feet and perhaps lower, increasing from the shallowest level and then decreasing again; and a good quality montmorillonite mineral increases in quantity from 12 feet to the surface, at the expense of the mixed layer and kaolinite.

Except for the mixed layer mineral at depth, and a slight hiatus between the disappearance of the kaolinite and the appearance of the montmorillonite mineral, this is the sequence expected from Levinson and Vian's experiments. The early disappearance of kaolinite could be due to the commencement of the alteration process temporarily producing a disordered structure, or perhaps the kaolinite may be forming the mixed layer mineral as an intermediate stage.

Chemical analyses for Ca^{2+} and Mg^{2+} were carried out on the three upper levels with the results shown in Table 1.

The analysis from the surface fine fraction is consistent with the X-ray diffractometer curve which shows only calcite and a trioctahedral montmorillonite mineral, if the latter is saponite (see also Graham, 1953).

The magnesium is largely in octahedral sites rather than exchange sites as Levinson and Vian supposed. Remembering that the possible degree of substitution for the octahedral Mg^{2+} in saponite is very limited (Brown, 1961), and that the percentage of Mg^{2+} falls markedly with depth down the hole, the most probable situation would appear to be an interleaving of fully substituted and unsubstituted layers to accommodate the changing magnesium content, supporting the view that the mixed layer mineral is an intermediate weathering stage.

The reason for the movement of calcium and magnesium is not clear, but there is no stage when the magnesium content seems sufficient to form a magnesian chlorite (Zen, (1960), White and Muffler (1965)) although the presence of chlorite layers in the mixed layer material has not been excluded.

TABLE 1

	Bulk sample		$<0.5\mu$		
Depth (feet)	CaO%	MgO%	CaO%	MgO%	$\% < 0.5\mu$
0–6	18.3	13.4	6.6	21.6	~50
6–12	18.7	11.6	5.5	10.0	~10
12–18	13.5	9.1	3.3	6.7	~10

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