# A REAPPRAISAL OF THE MIXED-LAYER CLAY MINERALS IN THE MARINE CLAYS NEAR ALBERNI, B.C.[1]

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In a paper dealing with dioctahedral chlorite in the AB horizon of the Alberni soil of B.C. (Brydon *et al.*, 1961), reference was made to the nature of the clay in the underlying material. Further analysis of this C horizon material and other samples of marine clays at greater depth has been carried out and the results are reported herein.

Glycerol and ethylene glycol have been used interchangeably for a number of years to distinguish hydrated-layer phylloscilicates. Most vermiculites form a 1-layer complex with either liquid giving a basal spacing of 14 Å, and montmorillonites form a 2-layer complex giving a 17 Å spacing with ethylene glycol and a 17.7 Å spacing with glycerol. It became apparent, however, that a further definition of the specimen and the experimental conditions was required to avoid false identification (Kunze, 1955; Walker, 1958). Walker (1958) concluded that the specimen must be Mg-saturated and solvated with glycerol; certain vermiculites like the montmorillonites expanded beyond 14 Å with ethylene glycol.

Although it was thought originally (Ross & Hendricks, 1945) that montmorillonites had a rather uniform charge of 0.33 equivalents per half cell, later work showed a range of charges within and between the montmorillonite and vermiculite groups. Hofmann (1956) proposed 0.55 equivalents per half cell as an arbitrary boundary. The practical limitations of this criterion were reviewed by Walker (1958) and he stressed the lattice swelling characteristics with glycerol for distinguishing the two groups of minerals. Jonas (1960) has presented evidence that the charge and expansion properties are related to particle size. From this, the criteria of either Walker or Hofmann imply that the coarse fraction of a given sample might be a vermiculite and the fine fraction a montmorillonite. Furthermore, Johns & Tettenhorst (1959) have shown that the ease of expansion of dehydrated montmorillonites followed the order water < glycerol < ethylene glycol. Glycerol was found to show two kinds of layers in one specimen whereas with ethylene glycol all the layers expanded to 17 Å. A somewhat analogous situation was found with the Alberni C horizon clay and other samples of marine clay, all of which were similar.

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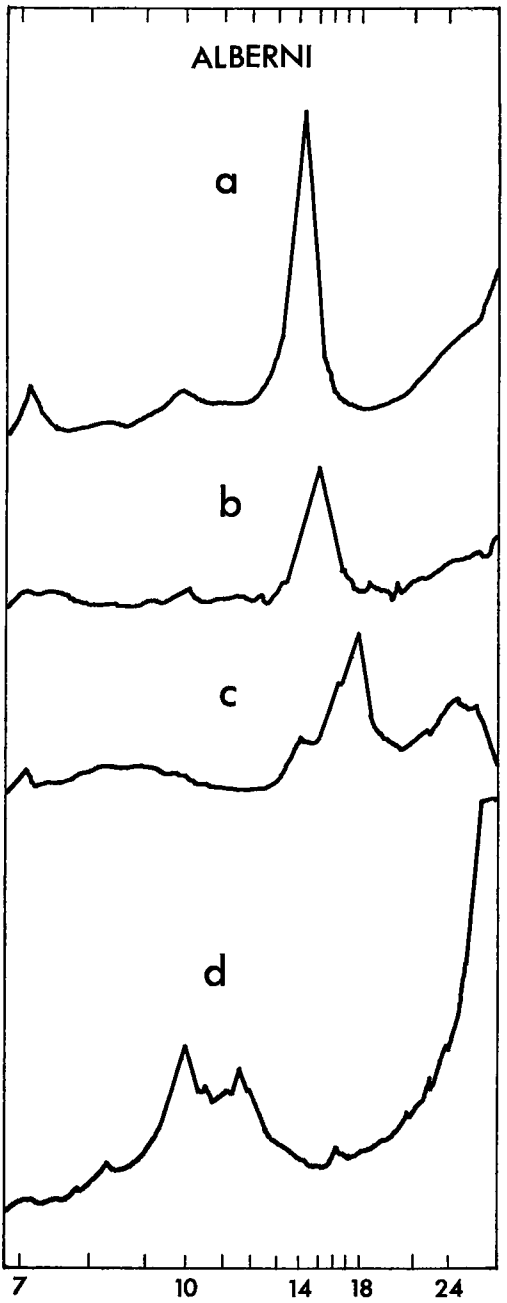


FIG. 1. *X*-ray diffraction patterns (Fe filtered Co radiation) of the 2–0.2 micron clay fraction of the Alberni marine clay at a depth of 30 inches, Mg saturated oriented specimen (a) air-dry; (b) ethylene glycol; (c) glycerol; (d) heated at 500° C. for ½ hr.

The air-dry specimen (Curve a, Figure 1) showed a strong sharp symmetrical peak at 14.6 Å. This peak was shifted to 15.5 Å with ethylene glycol as the solvating agent (Curve b) and, when glycerol was used, it was apparently split into two components giving peaks at 14 and 18 Å (Curve c). Heating resulted in 10 Å and 11.5 Å peaks. On the basis of the expansion to 15.5 Å with ethylene glycol and the contraction to 11.5 Å on heating, it was concluded (Brydon *et al.* 1961) that there was a 40 per cent chlorite—60 per cent montmorillonite random mixed-layer structure. From the glycerol and heating treatments, the material is interpreted as consisting of discrete montmorillonite showing a 17.7 Å peak with glycerol and 10 Å on heating, plus a 40 per cent chlorite—60 per cent vermiculite random mixed-layer structure showing a 14 Å peak with glycerol and an 11.5 Å on heating.

This dual behaviour and interpretation points out the need for clarification of the interrelationships between particle size, layer expansion, layer charge and chemical composition before specific mineral identifications can be made. Possibly, the expanding layers in the Alberni C horizon have properties near the boundary between vermiculite and montmorillonite as defined by Walker (1958) and perhaps also as defined by Hofmann (1956). Until clarification is achieved, Walker's criteria (1958) for distinguishing vermiculites and montmorillonites must be adhered to. Therefore, the preferred interpretation of the Alberni C horizon clay mineralogy is that relating to glycerol solvation; the clay is considered to be a mixture of montmorillonite and a mixed-layer chlorite-vermiculite in addition to the accessory minerals amphibole, feldspar and quartz as reported in Brydon *et al.* (1961).

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