erably. Similar crystals observed on other Las Chispas specimens had fewer forms. In every case, however, at least {100}, {110}, {113}, and {012} are present. Despite this variation the great majority of these transparent crystals show all of the holohedral isometric forms.

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AN INTERLAYER MIXTURE OF THREE CLAY MINERAL TYPES FROM HECTOR, CALIFORNIA

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The occurrence of mixed-layer clays in relatively pure clay deposits has been reported by various authors. Randomly interstratified mixed-layer silicates are found commonly as intermediate stages in the alteration of micas and other silicates to clay minerals. Random mixed-layer clays are minerals in which the layers occur in random intergrowth. A sample of clay from Hector, California, exhibits peculiarities inconsistent with existing data for the clay mineral hectorite. The clay is trioctahedral with an expanding lattice and has a pH of 9.8. In addition, the sample contains a small amount of calcite.

Because the description of the occurrence of such a material might cast some light on the genesis of the Hector deposits, and because of the possibility that the peculiarities attributed to hectorite might be the consequence of a polymineralic character in certain instances, the author believes the data presented herein are significant.

X-RAY ANALYSIS

X-ray diffraction curves of the basal 00*l* reflections are incompatible with a normal hectorite structure. By use of Ni-filtered Cu-radiation

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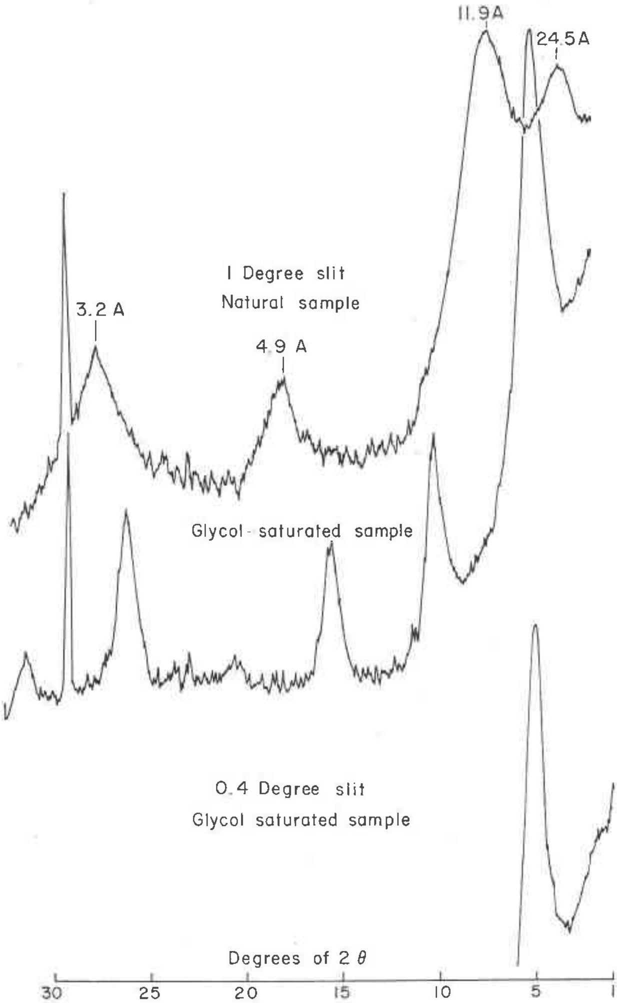

FIG. 1. *X*-ray diffraction curves of natural sample before and after glycol saturation using 1.0 and 0.4 degree slits with Ni-filtered Cu-radiation.

and a 1 degree slit, the *x*-ray diffraction curve for the natural material shows prominent reflections at 24.5 Å, 11.9 Å, 4.9 Å, and 3.2 Å (Fig. 1). Because the 00*l* series is not an integral sequence it is suggested that this clay is polymineralic and that it is composed of several different types of layers that form a random mixed-layer clay.

The identity of the various components was determined by the method described by Weaver (1956). It is assumed that the separate reflections represent average values resulting from simultaneous scattering from the different types of layers.

Evidence for the presence of expansible montmorillonite-like layers was obtained by saturating the clay with ethylene glycol. A prominent nearly integral submultiple sequence of reflections appeared at 17.3 Å, 8.7 Å, 5.7 Å, 4.3 Å and 3.4 Å, confirming the abundant presence of montmorillonite in this mixed system. A less intense period of about 55 Å was detected by using a 0.4 degree slit.

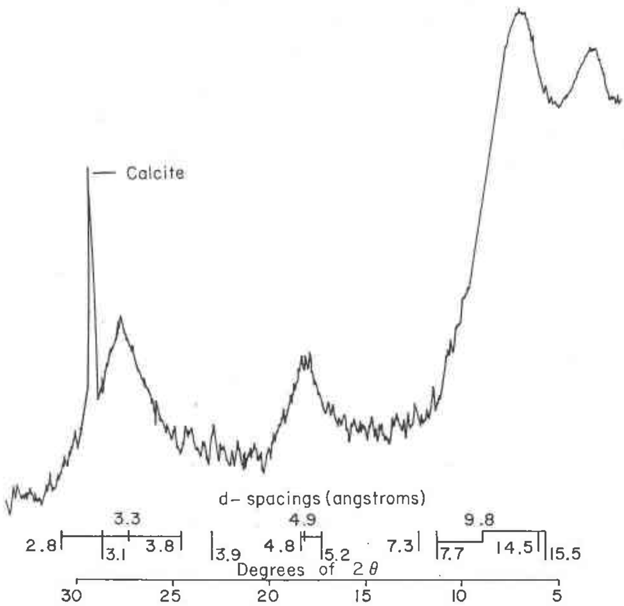

FIG. 2. Relation between observed reflections (X-ray diffraction curve), and positions of reflections of the three proposed randomly interstratified clay mineral types (vertical lines).

The vertical lines below the x-ray diffraction curve illustrated in Fig. 2 indicate the position of the $00l$ reflections for the three types of layers. The short lines show the position of the 9.8 Å $00l$ series (9.8, 4.9, 3.3), the medium lines the $00l$ reflections of the 14.5 Å layers (14.5, 7.3, 4.8, 3.8, 2.8), and the long lines the $00l$ reflections of the 15.5 Å layers (15.5, 7.7, 5.2, 3.9, 3.1). Horizontal lines connecting adjacent vertical lines show which reflections contribute to the observed reflections.

The close agreement between the positions of the observed reflections and those of the proposed mixed-layer components (Fig. 2) is undeniable. The broad reflection at about 3.3 Å is the sum of contributions from each component spread over a broad range. That at about 5.0 Å is sharper and is the result of close grouping. A weak but distinct reflection occurs at about 8.5 Å, the sum of contributions from the 9.8 Å and 7.7 Å components, and a very prominent reflection occurs at about 12 Å which is the average of the first order reflections of all three components. The shapes and positions of the maxima suggest that all three types of layers are moderately abundant.

After glycolation the swollen layers strongly predominate indicating that at least two of the three components are expansible. The long period suggests that one species, with an abundance near one-third, differs somewhat from the other two.

Significance

It is suggested that the sample of clay represents an intermediate stage between phlogopite and hectorite. The fact that the 9.8 Å $00l$ series approaches those of the micas permits a certain amount of speculation regarding the material found at Hector. It is suggested that the expansible clay mineral hectorite is the product of the action of hot springs on a nonexpanding trioctahedral magnesium silicate mineral such as phlogopite, with loss of interlayer potassium and an apparent gain of some sodium.

Ames *et al.* (1958) consider hectorite to be the result of the alteration of dacitic tuff through an intermediate zeolite (clinoptilolite) by acid solutions during hot spring activity in a restricted lake environment. Randomly interstratified mixed-layer clays, similar to that described in this paper, are commonly considered to be intermediate stages in the alteration of micas and other silicates to clay minerals, yet such a material has not previously been described from the Hector deposits. It is suggested here that hectorite is derived from the alteration of phlogopite, and that the random mixed-layer material described herein is an intermediate stage between phlogopite and hectorite.

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