

# THE DISTRIBUTION AND IDENTIFICATION OF MIXED-LAYER CLAYS IN SEDIMENTARY ROCKS<sup>1</sup>

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## EXTENDED ABSTRACT

X-ray examination of more than 6,000 sedimentary rock samples has shown that mixed-layer clays are abundant, being present in approximately 70 percent of the rocks. Randomly interstratified clays composed of illite-montmorillonite (examples are shown in which the layer ratio ranges from 9:1 to 1:9) and illite-chlorite-montmorillonite are most abundant. Mixed-layer chlorite-montmorillonite and chlorite-vermiculite are common but relatively less abundant. Three different occurrences of regularly interstratified chlorite-vermiculite have been found.

Combined heat and glycolation treatment of the mixed-layer clays is usually necessary in order to estimate the ratio of the two or more types of layers. Figure 1 contains a curve showing the migration of the 001/001 and 002/003 peaks of

<sup>1</sup> Full paper published in *Amer. Min.*, v. 41, p. 202-221, 1956.

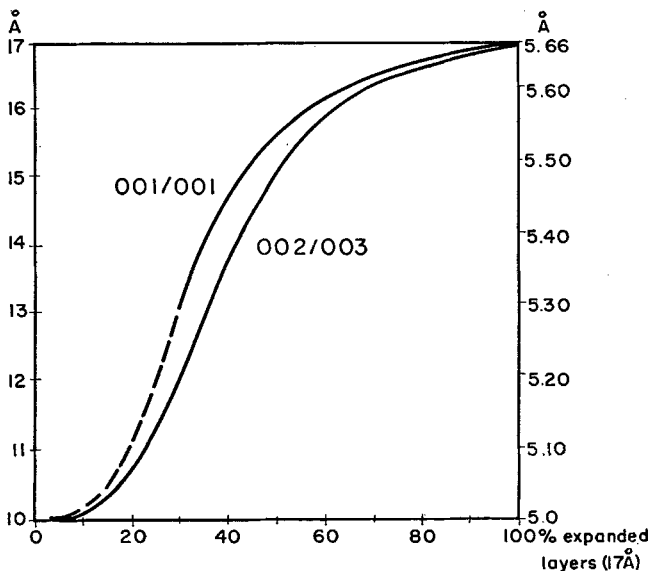


FIGURE 1. — Migration of the 001/001 and 002/003 peaks of randomly interstratified 10 Å and 17 Å layers.

randomly interstratified 10 Å and 17 Å layers. The 001/001 peaks are most useful when illite is present as a discrete phase and the 002/003 peak when montmorillonite is present.

In intergrowths of illite-chlorite-montmorillonite the relative proportion of three types of layers can be estimated by placing  $Mg^{2+}$  in the interlayer montmorillonite positions and forming a two-phase 10 Å and 14 Å system and by heating the clay to 400° C and collapsing the montmorillonite to 10 Å, thus forming a different two-phase system. These two 10 Å to 14 Å ratios can be used to estimate the amount of the three types of layers.

Random mixed-layers of chlorite and vermiculite afford a relatively strong 001 peak and a relatively weak 002 peak. When the clay is heated to 500° C both the 001 and 002 peaks migrate toward the 10 Å spacing. The amount of migration is proportional to the amount of vermiculite layers.

In sediments mixed-layer illite-montmorillonite seems most commonly to have a ratio near 7:3 and 3:7. The 7:3 material is usually associated with illite and the 3:7 material with montmorillonite. This may be an effect of size sorting with the relatively coarse-grained mixed-layer 7:3 clay being concentrated with the illite and the finer grained 3:7 clay associated with fine-grained montmorillonite.

The presence of such a wide variety of mixed-layer clays occurring in a range of ratios vastly increases the prospects of being able to use the clay minerals as an aid to geologic interpretation.