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# Celadonite and its Transformation to Smectite in an Entisol at Red Rock Canyon, Kern County, California

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**Abstract:** A green, Lithic Torriorthent soil derived from a celadonite-rich, hydrothermally altered basalt immediately north of the Mojave Desert region in southern California was studied to investigate the fate of the celadonite in a pedogenic weathering environment. Celadonite was found to be disseminated in the highly altered rock matrix with cristobalite, chalcedony, and stilbite. X-ray powder diffraction (XRD) showed the soil material to contain celadonite having a  $d(060)$  value of  $1.510 \text{ \AA}$ , indicative of its dioctahedral nature. Very little smectite was detected in the parent material, whereas Fe-rich smectite was found to be abundant in the soil. The Fe-smectite and celadonite were identified as the sole components of the green-colored clay fraction ( $<2 \mu\text{m}$ ) of all soil horizons. The soil clay showed a single  $d(060)$  value of  $1.507 \text{ \AA}$ , indicating that the smectite was also dioctahedral and that its  $b$ -dimension was the same as that of the celadonite. Mössbauer spectroscopy showed that the chemical environments of Fe in the rock-matrix celadonite and in the smectite-rich soil clay were also nearly identical. These data strongly suggest a simple transformation of the celadonite to an Fe-rich smectite during soil formation.

Supporting evidence for this transformation was obtained by artificial weathering of celadonite, using sodium tetraphenyl boron to extract interlayer K. The intensity of the 001 XRD peak (at  $10.1 \text{ \AA}$ ) of celadonite was greatly reduced after the treatment and a peak at  $14.4 \text{ \AA}$ , absent in the pattern of the untreated material, appeared. On glycolation of the sample, this peak expanded to  $17.4 \text{ \AA}$ , similar to the behavior of the soil smectite. The alteration of celadonite to smectite is a simple transformation requiring only the loss of interlayer K. The transformation is apparently possible under present-day conditions, inasmuch as the erosional landscape position, shallow depth, and lack of significant horizonation indicate that the soil is very young.

**Key Words:** Celadonite • Entisol • Mica • Mössbauer spectroscopy • Smectite • Soil • Weathering • X-ray powder diffraction

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