Effect of Adsorbed Iron on Thermoluminescence and Electron Spin Resonance Spectra of Ca-Fe-Exchanged Montmorillonite

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Abstract: The electron spin resonance (ESR) spectra and the natural and gamma-induced thermoluminescence (TL) glow curves of a series of variably cation-exchanged Fe-Ca-clays prepared from SWy-1 montmorillonite were examined. The ESR signal (g = 2) intensity associated with the surface Fe was found to increase linearly with surface Fe content up to a nominal concentration of 50% exchangeable Fe. At > 50% exchangeable Fe, no appreciable increase in the signal was noted. The TL intensity decreased linearly with increasing surface Fe up to 50% nominal exchangeable Fe. At > 50%, the signal was not appreciably further diminished. The natural TL showed only a high-temperature peak, but irradiation produced an additional low-temperature peak. One month after gamma-irradiation, the integrated TL signal was still 10 – 100 times higher than that from the non-irradiated material. Thus, (1) surface iron clusters may form above a certain critical Fe concentration; (2) the Fe clusters are probably less effective in quenching TL than are single Fe atoms, implying interaction between surface Fe and the stored energy content of the material; and (3) the electronic energy stored in the material as the result of gamma-irradiation is only slowly dissipated.

Key Words: Electron spin resonance • Iron • Montmorillonite • Surface adsorption • Thermoluminescence

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