Solid State NMR Characterization of the Thermal Transformation of an Illite-Rich Clay

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Abstract: Lode, a dioctahedral illite-rich clay from Latvia belonging to the mica group of clay minerals, undergoes thermal transformation via a series of structurally disordered intermediate phases. Despite containing high levels of paramagnetic Fe substituted into the octahedral sites, ^{29}Si and ^{27}Al magic angle spinning nuclear magnetic resonance (MAS NMR) spectra of sufficient quality are obtained to resolve different structural units, showing clearly defined structural changes which occur in the sample during calcination to 1200 ° C. However, Fe plays a significant role in broadening the Al signal, with integrated peak intensities decreasing as temperature increases. Significant differences are revealed in the thermal decomposition process by NMR spectra between pyrophyllite, Ca-montmorillonite and illite clays, possibly due to the different cations present in the interlayer. It has also been shown for illite that no structural differences at the atomic level occur when the dwell time at a particular temperature is varied and no difference is observed between samples that have different thermal histories; however, a minor effect of particle size and surface area is visible in the NMR data.

Key Words: Illite • Iron • Paramagnetic Center • Solid-State NMR • Thermal Transformation

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