INTRODUCTION

During diagenesis, the amount of illite layers in mixed-layer illite-smectite increases (e.g., Burst 1969; Shutov et al. 1969a, 1969b; Perry and Hower 1970; Weaver and Beck 1971; Hower et al. 1976). This illitization has been modeled as: (a) a solid-state transformation characterized by tetrahedral Al for Si substitution and subsequent dehydration and fixation of interlayer cations in interlayers of smectite or in smectite interlayers of I-S crystallites (Shutov et al. 1969a, 1969b; Pollard 1971; Hower et al. 1976; Drits et al. 1997a); (b) as a solid-state layer-by-layer neoformation in smectite or I-S crystallites (Bell 1986; Bethke and Altaner 1986; Drits et al. 1996); or (c) in sandstones and bentonites, as a smectite dissolution and illite neoformation through precipitation (Nadeau et al. 1985; Nadeau and Bain 1986).

The Al for the illitization process may originate from the breakdown of feldspars, kaolinite, detrital mica, or I-S. The supply of interlayer cations, in diagenesis for a long time assumed to be K, is then the main chemical control on the illitization process (Powers 1959; Long and Neglia 1968; Hower et al. 1976; Šrodon 1979). However, in oil source rocks, NH₃ produced during oil generation may be present in pore waters as NH₄⁺ and be fixed during illitization (Williams et al. 1989, 1992), this fixation being preferential to fixation of K⁺ (Lindgreen 1994).

Previously, we investigated the illitization in a shale of Upper Jurassic age that is the main source rock for oil in the North Sea. The samples represent the temperature interval 30–140 °C (early to middle diagenesis). We found that the illitization in this oil source rock was a single-interlayer, solid-state transformation of smectite interlayers to tobelite interlayers in intact I-S crystallites. This illitization occurred by increasing Al