Geophysical Research Abstracts, Vol. 7, 03586, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03586

Diagenetic reorientation of phyllosilicate minerals in the Palaeogene Flysch of the Podhale Basin, Poland

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Mineral assemblages and petrophysical properties of mudstones change during burial and as diagenetic process occur. Phyllosilicate minerals gain greatest mechanical stability on sedimentation by orienting themselves parallel to bedding; this is due to their lath-shaped habit. However, quartz, feldspar and other detrital minerals with more equidimentional characteristics will break up this natural fabric development. The dominance of the vertical component of stress deceases with burial and there are greater frictional restraints on the mechanical rotation of platy phyllosilicates as burial continues. Rigid rotation is restricted as porosity decreases, with continuing reorientation of phyllosilicates driven by recrystallisation. Although chemical changes begin immediately after deposition, their importance increases with increasing temperature, with attendant changes in sediment fabric. Recently, the quantification of fabric orientation associated with diagenetic recrystallisation has been described from a variety of geological settings from early sedimentation to the early stages of metamorphism.

In this study, the preferred orientation of phyllosilicates in a homogeneous, well characterised suite of Palaeogene mudstones from the Podhale Basin in southern Poland has been quantified using High Resolution X-ray Texture Goniometry (HRXTG). Maximum burial temperatures of the samples range from 60 to 160˚C. Quantitative XRD reveals that the sample set straddles the smectite to illite transition zone and that illitization terminates at ∼80% illite layers. An increase in chlorite and a decrease in both kaolinite and K-feldspar occur at the same depth/temperature interval. Quartz contents increase with increasing temperature. HRXTG shows that the align-

ment of both illite-smectite and chlorite/kaolinite increases strongly and consistently with depth, both within and beyond the S to I transition. These samples thus document a strong relationship between millimetre-scale fabric and clay mineral transformations, not only as a result of illitization but also, we speculate, as a result of continuing recrystallisation of "illite" at temperatures above $\sim$140˚C. Consistent changes in both porosity and the pore size distributions of the samples further suggest that recrystallisation and related changes in fabric also result in a degree of chemical compaction, as observed frequently in both sandstones and limestones.