INFLUENCE OF SALT–BEARING ENVIRONMENT TO ILLITIZATION

P. UHLÍK[1], M. HONTY[1], V. ŠUCHA[1], J. FRANCŮ[2], A. BIROŇ[3], N. CLAUER[4], Z. HANZELYOVÁ[1] and J. MAJZLAN[5]

[1] *Department of Geology of Mineral Deposits, Comenius University, Mlynská Dolina G, 842 15 Bratislava, Slovakia*

[2] *Czech Geological Survey, Leitnerova 22, 65869 Brno, Czech Republic*

[3] *Geological Institute, Slovak Academy of Sciences, Severná 5, 974 01 Banská Bystrica, Slovakia*

[4] *Centre de Géochimie de la Surface, Strasbourg, France*

[5] *Department of Geology, University of California at Davis, Davis, CA 95616, USA*

Abstract: The paper deals with smectite to illite transformation in the different boreholes of the East Slovak Basin with accent on the study of the salt-bearing bentonites and claystones. Illitization is different in salt-bearing rocks in the comparison with common bentonites and claystones in the area. A process of illitization is studied by wetting and drying and hydrothermal synthesis experiments in salty environment.

Key words: illite-smectite, salty environment, the East Slovak Basin, K-Ar dating, wetting and drying

INTRODUCTION

Transformation of smectite to illite through mixed-layer illite-smectite (illitization of smectite) is the most frequent and useful reaction, taking place in the shallow parts of earth crust. The process, characterised by decreasing expandability of illite-smectite (percentage of smectite layers) has been intensively studied in shales and claystones, but also in sandstones and buried bentonites (volcanoclastic material, mainly altered tuff). Transformation of smectite to illite is accelerated by increasing temperature and is frequently used as an independent geothermometer that is in good correlation with maturity of organic matter (see review in Pollastro, 1993; Środoń, 1995).

The purpose of the work is to present state of the art of illitization process in salt-bearing rocks in the comparison with salt-free bentonites and claystones in the East Slovak Basin.

RESULTS AND DISCUSSION

Illitization in salt-bearing bentonites

The illitization is discontinuous in salt-bearing bentonites as in the case of common bentonites of studied area. From the depth of 1800 m (above 100°C) systematically lower values of expandabilities were observed for salt-bearing bentonites when compared with normal bentonites for the same burial temperature (Fig.1).

The expandability values in salty bentonites vary in the range of 5-35 % except two samples from shallow depths. XRD data rendered R1 to R3 ordering in salt-bearing bentonites while R0 ordering in salt unaffected bentonites in the same depth. Illite-smectite and grade of organic matter transformation of claystones and shales cored in the near vicinity of salt-bearing bentonites expelled non-diagenetic short-termed increase of temperature (e.g. effect of lava flows or magmatic intrusion). Both indicators show trends identical with the general trends of the basin for salt-free claystones and shales (Fig. 1). The next arguments against the additional heat source are K-Ar ages of the finest fractions of the salty bentonites. The ages of different fractions are not the same as they should be after the illitization connected with short duration of thermal activity (hydrothermal fluids, volcanism).

Intense illitization in the salt bearing tuffs could not take place exclusively under the control of the salty environment immediately after deposition in a way that was observed before in the salt, alkaline lakes (Singer and Stoffers, 1980; Turner and Fishman, 1991). It seems that diagenesis also effected illitization at least to certain measure. This fact indicates time-temperature model of burial history combined with K-Ar data. K-Ar ages of the samples Bánovce 13/12 (14.5 -12.5 Ma) and Senné 45 1/5 (9.2 - 7.5 Ma) are lower than stratigraphic age (16-15.5 Ma). Time-temperature model of the progressive burial of the sample Senné 45 1/5 shows, that illitization was temperature-controlled process as well as in the case of I-S from unsalty pyroclastics (Clauer et al., 1997). The existence of two salty tuffs in the shallow depths with usual expandabilities supports the statement, that the effect of salty environment becomes visible after arriving at certain (so far unknown) temperature.

Illitization in salt-bearing shales and experimental conditions

The effect of evaporitic environment also produced differences between common and salt-bearing pelitic siliciclastic sediments (Fig.1). Samples from borehole - Iňačovce 3 were studied. Illitization

degree of these samples is variable in comparison with general trend. Higher, normal and actually lower transformation degrees were observed. We try to resolve the influence of environment with increased salt content to illitization by laboratory experiments at present. The wetting and drying experiments performed at 60°C were used to examine the effect of various concentrations of NaCl solutions on illitization of K-saturated standard smectites. Initial results suggest that increased concentration of NaCl accelerated illitization but too high concentration (5 M NaCl) retarded the process.

Experiment of hydrothermal synthesis in duration 7 and 30 days presents stability of K-saturated smectite in 3 different solutions (distilled water, 1 a 5 M NaCl; a ratio of solution: sample was 5:1) to temperature of 300°C.

CONCLUSION

The understanding of the transformation from smectite to illite in salt-bearing environment is important not only for geological interpretation but also for use of bentonites as a backfills for radioactive waste disposals in salt, alkaline environment.

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Fig. 1. Illitization trend of salt-bearing bentonites and shales in comparison with general trends in the East Slovak Basin (Šucha et al., 1993)