



## New insights into the basement of the Transylvanian Depression (Romania)

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### ABSTRACT

In the Transylvanian Depression (Romania) a number of deep wells were drilled to investigate and exploit methane gas fields. From these, only a few penetrated the Middle to Upper Jurassic volcanics in the basement. From three boreholes (Deleni, Cenade and Zoreni) rock samples were available for investigations. Deleni and Cenade show calc-alkaline basalts to andesites which are similar to the island arc volcanics of the Southern Apuseni Mountains. Zoreni basalts and basaltic andesites show a boninitic affinity, which was not found up to now in outcrops. The distribution of the volcanics in the basement of the Transylvanian Depression, which correlates with a geomagnetic anomaly, can be explained by the presence of a magnetite-rich ophiolite layer beneath the island arc volcanics. Comparable oceanic crust rocks are found further west, in the Southern Apuseni Mountains. They are considered to be remnants of a marginal or back-arc basin, in which a volcanic arc including boninites developed. Upon the westward-directed subduction of an open ocean, the island arc and part of the back-arc basin were overthrust eastwards onto continental crust during the Late Jurassic or Early Cretaceous. A flip in the subduction direction caused late Early Cretaceous westward thrusting of the back-arc basin and island arc rocks onto the crystalline basement of the Tisia continent.

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### 1. Introduction

The Pannonian Basin including the Vienna Basin, and the Transylvanian Depression (TD) are located in the central and eastern part of Europe, being surrounded by the Eastern Alps, the Carpathian arc and the Dinarides respectively. The easternmost Transylvanian Depression, consisting of several sub-basins, is situated at the inner side of the Eastern and Southern Carpathians (Fig. 1) and is separated from the neighbouring Pannonian Basin by a S–N trending horst-like orogen comprising the Apuseni Mountains and the crystalline islands of Țicău and Preluca. Despite their close vicinity, the Transylvanian Depression is significantly different from the Pannonian Basin as many authors have noticed previously (Huismans et al., 1997; Ciulavu et al., 2002; Sanders et al., 2002 and references therein). The particularities of the Transylvanian Depression vs. Pannonian Basin following Beșuțiu

et al. (2005) can be summarized as follow: (1) an unusual high topography, around 600 m, (2) a very low surface heat flow, about 40 mW/m<sup>2</sup>, which is approximately two times less than in the Pannonian Basin, (3) a very strong, positive, airborne geomagnetic anomaly in the centre of the depression, (4) normal thickness of the crust, (5) large and numerous salt deposits, (6) large and numerous methane gas structures, but no oil deposits and (7) a basaltic layer in the basement, in the very centre of the depression.

For a more detailed description of the regional setting, the internal stratigraphy and the evolution of the TD the reader is referred to e.g. Ciulavu et al. (2002), Huismans and Bertotti (2002), and Krézsek and Bally (2006).

Due to the wealth of methane gas reservoirs and salt deposits, more than 2000 wells were drilled within the TD and a number of seismic profiles were shot through the whole depression. Based on the data of the gas companies and our own tectonic studies a number of papers dealing with the Cenozoic evolution of the Transylvanian Depression were published. Several works briefly discussed the basement (Ciupagea et al., 1970; Rădulescu and Săndulescu, 1973; Rădulescu et al., 1976; Săndulescu and Visarion, 1979; Beșuțiu, 1984; Săndulescu, 1984; Soroiu et al., 1985; Balintoni et al., 1998; Ciulavu et al., 2002; Krézsek and Bally, 2006; Schmid et al., 2008). Most of these authors (Rădulescu and Săndulescu, 1973; Săndulescu and Visarion, 1979; Beșuțiu, 1984; Săndulescu, 1984; Krézsek and Bally,

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