Evolution of the Tamtsag Basin / NE-Mongolia — part II: structure and hydrocarbon potential *Poster*

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Introduction

The Tamtsag basin in NE Mongolia is part of a widespread basin system which formed during Late Jurassic and Cretaceous times (Graham et al. 2001, Qing-Ren et al. 2003). It is filled with continental sediments and volcanics which can reach up to 4 km in thickness. Rifting and subsequent basin inversion led to a complex basin geometry characterized by several horst and graben structures. The geodynamic causes for regional basin formation are discussed controversially and several hypothesis ranging from orogenic collapse via subduction rollback to collision-induced rifting have been put forward.

Scientific research on the Mesozoic basins in Mongolia has so far concentrated on the East Gobi basin to the southwest (Graham et al. 2001, Prost 2004, Johnson et al. 2004) and some work has also been published on the Hailar Basin (Qing-Ren et al. 2003), the northeastward continuation of the Tamtsag Basin into China. Fundamental data on the fill and tectonics of the Tamtsag Basin in between is still missing. This is partly due to poor exposure as most of the basin fill is covered by Cenozoic sediments and only locally, near the borders faults, rocks are accessible for surface investigations. However, recent discoveries of oil in the Tamtsag and Hailar Basins have resulted in intense exploration activity and a strong interest in the area.

This contribution describes the results of a field campaign in Fall 2005 focusing on the structure and hydrocarbon potential while a companion paper (Geerdts et al. this volume) deals with the fill of the Tamtsag Basin.

Tectonics

The Tamtsag Basin is an approximately 300 km long and 80 km wide ENE-trending fault-controlled structure. The basin architecture is characterized by uplifted fault blocks in the central parts and graben-like structures to the North and South, close to main basin bounding faults. In the nearby East Gobi Basin, Prost (2004) distinguished five structural episodes: (1) pre-Jurassic north-east shortening, (2) Middle Jurassic to Early Cretaceous north-east directed extension, including rifting, (3) late Early Cretaceous north-south shortening, that led to the basin inversion on already existing normal faults, (4) Middle-Cretaceous uplift and erosion, and finally (5) east-west directed shortening and dextral movement on north-east trending faults.

Field work concentrated on the western margin of the basin where sufficient outcrops for structural analysis are available. The large-scale structural elements, i.e. the major faults, follow the regional ENE trend. Of particular interest are ridges composed of Mesozoic magmatic rocks which are uplifted relative to the surrounding Cretaceous sedimentary basin fill and strongly resemble positive flower structures. For example, one of the ridges is crosscut by several faults striking 20°, thus forming an angle

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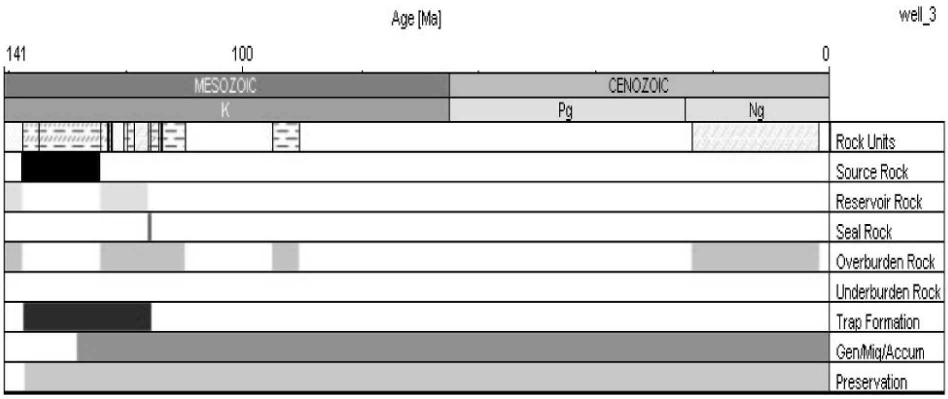

Figure 1: Schematic petroleum system chart of the Tamtsag Basin

of 40° to the principle basin axis. Most are normal or reverse faults with an additional strike-slip component.

Hydrocarbon potential

Oil has recently been found in block XIX of the Tamtsag Basin. Reservoirs are located in sandstones of the Lower Cretaceous Tsagaantsav and Zuunbayan Formations. Source rocks are situated in the same stratigraphic units and total organic carbon contents in the corresponding shales reach up to 3%. Transpression at the end of the Lower Cretaceous formed structural traps, e.g. titled fault blocks and anticlinal folding, as well as stratigraphic traps beneath the related unconformity.

In order to get a quantitative understanding of petroleum formation in the Tamtsag Basin the subsidence and thermal histories of various wells are modelled. This requires a complete reconstruction of the sedimentation and uplift history, i.e. the thickness and age of the eroded, and hence missing, strata has to be estimated. Using shale compaction data derived from sonic logs and the method of Magara (1976), respectively, it can be found that the rocks of the Tamtsag basin were once buried 350–800 m deeper than today. Comparison with the regional evolution indicates that this maximum burial occurred during late Lower Cretaceous time prior to deposition of Upper Cretaceous Saynshand formation. This burial history forms the basis for maturity modelling using the software Petromod1D of IES, Jülich. The thermal history model is calibrated against observed vitrinite reflectance data. Modelling results show heating of the source rocks, the critical moment, i.e. the onset of oil migration as well as the time of peak oil generation. For example, the oldest source rocks of the Tsagaantsav formation reach maximum temperatures of up to 136°C during the late Lower Cretaceous at about 118 Ma bp. Petroleum systems modelling will be extended to 2D and basin-wide sections to provide quantitative information for future exploration in blocks XX, XXI and XXII.

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