Geology and Exploration Prospects of Non-Anticlinal Structures of the East Part of the South Border Zone of the Dnieper-Donets Depression

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A broad region of the south border zone of the Dnieper-Donets depression from the Kremenov area on the west to the Orel area on the east has been studied in recent years by seismic surveys on Carboniferous horizons. Computer enhancement of common depth point data has yielded good information on the structure of the lower Visean (VB$_3$) and Tournaisian (VB$_4$) stages.

Seismic refraction surveys have shown that within the study area are the Pereshchepin and Bogatoy basement depressions and adjacent Kremenov and Orel highs. See Fig. 1.

The existence of these highs during time of deposition is indicated by a sharp reduction in thickness of the Devonian and in part the Tournaisian sediments within their limits, as indicated by seismic data.

The upper part of the time sections within the depressions is characterized by well-defined reflections from Carboniferous horizons. Intensive reflections from horizons VB$_3$ and VB$_4$ follow one another with small variation areally. Data from lower horizons are not as good; however, several discordant boundaries are recognized including boundary “R” at the top of the Devonian salt. Other discordances are indicated within the Devonian, between the Devonian and the Tournaisian, and within the Tournaisian.

Variability in lithology and in thickness of individual rock units is indicated also by deep drilling data. For example, the clastic Devonian is at least 1124 m thick in some places and 237 m in others.

In moving northward from the border fault toward the Kremenov and Orel basement highs, the time interval of the Devonian decreases whereas that to VB$_3$ and VB$_4$ increases, indicating a reduction in thickness of the Devonian salt from 3 km near the border fault to 0.5 km on these highs. This reduction in thickness appears to be due to absence of the Devonian salt. The salt was either not deposited or was squeezed out to form salt plugs (Yuzhno-Pereshchepin, Pereshchepin, Lychkov, Bogatoy, Novoselov). The structural plan of the sediments below the salt differs from that higher in the section. Indeed, interpretation of the seismic records for the Devonian is difficult because of the complexity of the geology.

The Carboniferous sediments of the study area dip monoclinally toward the center of the depression. See Fig. 1b. Reflectors VB$_3$ and VB$_4$ are complicated by faults and several structural noses; the latter group themselves into a single zone which coincides in plan with the basement highs and intervening saddle. The structures of this zone were probably closed in pre-Visean time.

Breaks in sediment deposition led to erosion on the highs with development of pinch-outs, which are exploration objectives. Both carbonates and clastics are represented in the pinch-outs. Taking into account that the Tournaisian sediments are regionally oil-gas bearing and are productive in the Bogatoy and Pereshchepin areas, non-anticlinal traps between the structures seem to offer the best prospects.