The study and 3D modelling of the Late Badenian basal clastics in the Lobodice subsurface gas storage area

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The Late Badenian clastics in the area of the Lobodice subsurface gas storage belong to the central part of the Carpathian Foredeep and are connected to the Lobodice structure that is an elevation of the pre-Neogene basement. The basement was subject to the Late Badenian transgression. In the transgression sequence, the Late Badenian clastics are succeeded by the sedimentation of the Badenian calcareous clays, which document the deepening of the depositional environment (Brzobohatý & Cicha 1993, Buday 1959, Onderka 1992, Svatuška *et al*., 1989).

The depositional environment and the provenance of Badenian basal clastics in the area of Lobodice subsurface gas storage was described during the studies of these sediments. The geological model of tectonics and horizons of interest were created as well.

Drill cores of Lobodice wells were described in the total length of 110 m for the purpose of depositional environment description. The textures and structures were described on these cores and on this basis three lithofacies were recognized according to Miall (1996) and Nichols (1999). Well logs were interpreted from sedimentological aspects, 3D seismic measurement was evaluated from aspects of seismic stratigraphy and thus the depositional environment was described. Well log interpretation as well as interpretation of 3D reflexion seismic measurement in total size of 33 km^2 was also done for the purpose of geological modelling. Firstly, the wells and the well tops were converted from depth to time and horizons of interest were recognized. Time conversion was confirmed by synthetic seismograms. The top of Badenian basal clastics and the crystalline basement (the horizons of interest) were picked in the seismic cube as well as fault tectonics. The effect and size of faults were evaluated. The clasts analysis and analysis of the chemistry of garnets and edisonites were done for the purpose of recognition of the provenance of the Badenian basal clastics.

From the results of facies analysis, it was described that lithofacies "A" is a grey, very poorly sorted conglomerate with a matrix supported structure. Results from seismic stratigraphy and well log interpretation show that it is the result of the deposition of a Gilbert-type delta. Reflection terminations on the 3D seismic measurement were described – the upper and lower boundary - and the topsets, clinoforms and bottomsets were recognized on the delta reflections. Lithofacies "B" formed the rippled, fine and medium and very well sorted sandstone, and was interpreted as the result of relatively low energy current probably deposited in marine environment. Lithofacies "C" formed grey, partial lamination, clay siltstone often with bioturbation and was interpreted as the probable result of deposition in the outer part of the shelf influenced by storm activity. From the seismic stratigraphy the coastal onlap was recognized and the transgression interpreted and connected with lithofacies "C".

It is evident from the interpretation of the horizons of interest, among other things, that the central part of the Lobodice structure is formed by the significant elevation and is terminated by the major normal fault in the north. Despite expectations, the top of basement was distinctly ragged. There are a lot of faults that however crosscut the Badenian sediments exceptionally. It applies for both tops of the horizons of interest that the elevation is bordered by significant depressions in the north and south where the thickness of Badenian basal clastics increases. From a tectonic aspect, the basin was in the extension regime that resulted in domino-effect type faults of grabens and horsts. The faults of grabens and horsts are in the W-E direction and almost do not crosscut marine sediments. Younger faults are mostly in the NW-SE and NE-SW directions.

Petrographic analysis shows the studied Late Badenian clastics are polymictic. Clasts of grey limestone are the most common and often are the largest clasts as well. Clasts of white and yellow limestone, shale and graywacke (most likely Culmian), clasts of quartz and dolomite are also common. Clasts of crystalline rocks make up 9% of the total sample. These results indicate the dominant amount of sedimentary rocks in the source area and recycling of the source material. Petrography interpretation results and garnet analysis results show that the source material was Culmian rock of Drahanská vrchovina and Nízký Jeseník, especially Račice member rocks of the Myslejovice Formation, rocks of the Protivanov Formation and rocks of the Horní Benešov Formation. The results are confirmed by edisonite analysis as well.

The results will be then used to understand the geological properties of the subsurface gas storage and as the basis for petrophysical and gas flow modelling. The work was conducted in cooperation with RWE Gas Storage, s.r.o. and the software was provided by Schlumberger company.

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