Palaeogeography of the main carbonate reservoir, the Late Carboniferous-Early Permian Gipsdalen Group, Norwegian Barents Sea.

Geir Elvebakk*, Juha Ahokas** and Lars Stemmerik***.

Geo-Moski AS, (ex. Det norske oljeselskap ASA), ** Det norske Oljeselskap ASA, * Geologisk Museum, Københavns Universitet.*

Globally carbonates store approximately 50% of the world hydrocarbon resources although these rocks comprise only c. 15% of the world sedimentary rocks. In the Norwegian Barents Sea exploration drillings during the later years have proven recoverable oils in Upper Palaeozoic carbonate reservoirs.

The most promising carbonate reservoirs are present in dolomitized and leached inner and middle ramp carbonates of the Gipsdalen Group. The group was deposited in an arid and warm climate in an ice-house world characterized by high frequency and – amplitude glacio-eustatic sea level changes. The 2D seismic structure mapping of the Gipsdalen Group shows a complex mosaic of basins and highs in the Norwegian Barents Sea. During the latest Serpukovian-Kasimovian trans-arctic rifting led to the development of a complex NE-SW and N-S trending basin and high structures in the Barents Sea. During the earliest and most active rifting stage erosion of the highs supplied siliciclastics into the adjacent basins. The sediments were deposited as reddish-brown coloured coarse-grained alluvial fans along the basin margins and associated floodplain fines in more distal part of the basins. The basins were gradually flooded from the east during the Bashkirian and onwards and led to a complex interfingering of alluvial red beds and shallow marine siliciclastics along basin margins contemporaneous with carbonate ramp development in shallow-marine areas, sulphate evaporites in enclosed middle and outer ramps and halite in the deeper basins. The overall rise in sea level gradually led to flooding of the palaeo-highs and by end Carboniferous only the inner part of the Finnmark Platform were subaerially exposed. Consequently there is a gradual change from siliciclastic to carbonate dominated facies during the deposition of the Gipsdalen Group.

In order to construct the palaeogeographic maps, detailed facies and structural mapping have been performed by using all 2D seismic data from the Barents Sea. The facies interpretation was calibrated to all wells penetrating the Gipsdalen Group. High-amplitude seismic facies calibrate to outer ramp mixed carbonate and sulphate-evaporite deposits and basinal halite deposits in the Nordkapp-, Ottar-, Maud-, Bjørnøya and Tromsø basins. The low-amplitude carbonates comprise mounded, clinoform, parallel and hummocky seismic facies representing various carbonate deposits. Among the carbonates, mounded seismic facies, interpreted as carbonate build-ups, were a key seismic facies. Based on wells and onshore analogues the build-ups represent shallow marine middle and outer ramp carbonates. Clinoform facies probably represent prograding inner ramp grainy lithologies.

Analogue data show that potential reservoir facies are present in inner and middle ramp setting and include palaeoaplysinid-phylloid algal build-ups and higher energy grainy dolomitized facies. Potential source rocks include basinal evaporites, carbonates and siliciclastic mudrocks and sabkha mudrocks/carbonates in inner ramp settings. Prominent top seal are evaporites, tight carbonates and siliciclastic mudrocks.