Multi-Client Seismic in Frontier Areas.

Kjell Trommestad, VP & General Director Europe and Erling Frantzen, Sales Manager, TGS

Dalmorneftegeophizica (DMNG), a Russian seismic company based in Yuzhno-Sakhalinsk, and TGS-NOPEC Geophysical Company (TGS), a Norwegian/American company specialising in multi-client seismic have jointly carried out a number of multi-client seismic projects throughout the world for more than 10 years. During the last 6-7 years, the multi-client concept has also been very successfully implemented in the Sea of Okhotsk in the Far East Russia (Figure 1). This activity has played a significant role in the exploration for oil and gas in this region.

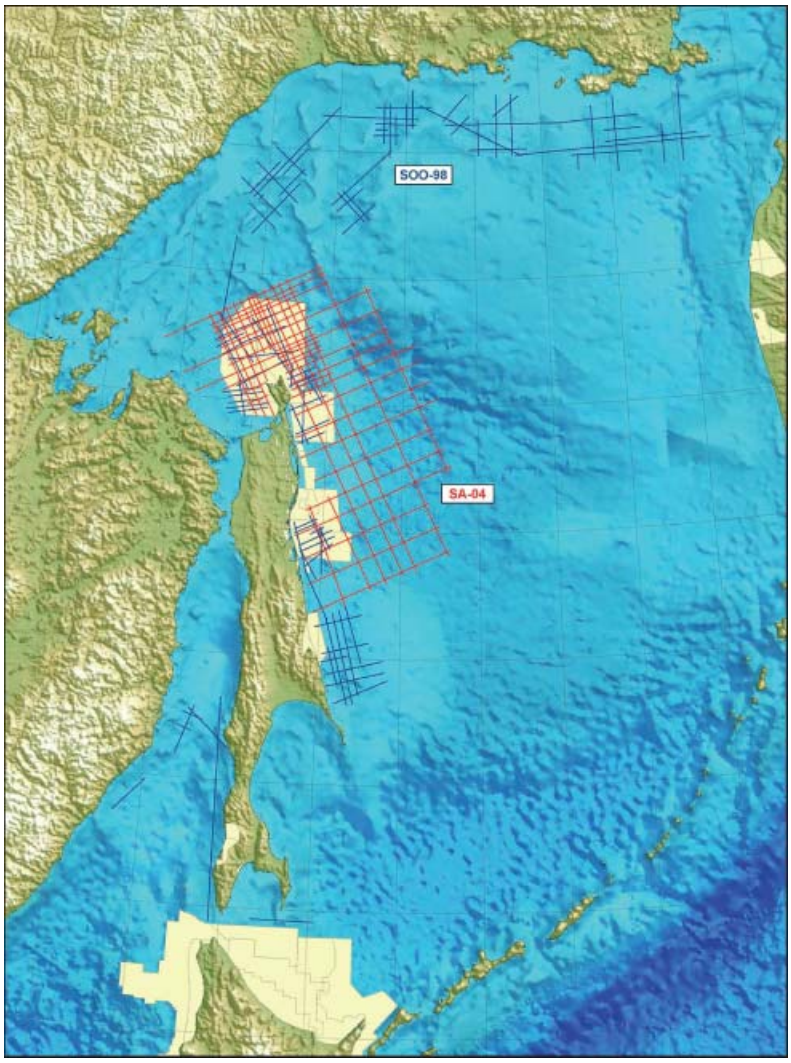

Figure 1: Map of Sea of Okhotsk

Exploration in the Sea of Okhotsk has to date been more or less limited to the areas offshore Sakhalin. This activity was initiated during the first half of the 1970s, first through a co-operation between Soviet Union and Japanese companies, followed by a phase of activity by Russian companies alone, and eventually the entrance of international exploration companies came in the late 1980s, early 1990s. Current investors in this area include major oil companies like BP, ChevronTexaco, ExxonMobil, Rosneft, Shell, TNK-BP and others.

During the period from 1977 to 1989 a number of significant oil and gas discoveries were made offshore Sakhalin, including Odoptu (1977), Chaivo (1979), Lunskoye (1984) (Figure 2), Piltun-Astokhskoye (1986) and Arkutun-Dagi (1989). This has established offshore Sakhalin as a world-class hydrocarbon province. Accumulated reserves discovered to date are in excess of 5.5 billion barrels of oil and 35 trillion cu.feet of gas. Total reserves (in place) in the area is estimated to be in excess of 90 billion barrels of oil equivalents. In comparison total accumulated production on the UK continental shelf to date is in the order of 30 billion barrels of oil equivalents.

Figure 2: Seismic example from Lunskoye gas field offshore Sakhalin.

Despite the established prospectivity of the region, offshore exploration activity has to date been very much restricted to a narrow corridor east of the Sakhalin Island, where all of the above mentioned discoveries are located. The Pela-Lache well drilled by Rosneft/BP in the Astrakhanovsky block (Sakhalin V) in 2004 represents the first step of exploration outside the established “fairway”. In October 2004 Rosneft/BP announced that the well had encountered significant volumes of oil and gas in a number of high quality sandstone reservoirs. This is a first confirmation of a prolific trend extending to the east and could lead to opening of new areas for exploration and subsequent development offshore northern Sakhalin.

Most of the current understanding of the regional geological setting in Sea of Okhotsk is based on evaluations and interpretation of old seismic data with clear limitations with respect to resolution and sequence definitions. With the use of modern, high-quality seismic a new and better understanding of the area could be obtained, and thereby lead to more successful exploration.

Hence TGS in 1998 entered into a 5-years renewable seismic agreement with DMNG. The purpose with the agreement was to make plans, acquire, process and market new non-exclusive seismic 2D-surveys in Eastern Russia, limited in the extreme north-east by the Bering Straight and by Japanese Sea in the extreme south-west.
Seismic 2D programmes had been acquired for many years prior to the agreement between the two parties. However, in order to attract the international oil companies and to limit geological risk, first of all in the Sea of Okhotsk, it was decided that the first programme in 1998 under joint TGS/DMNG operation, should include surveys confirming some of the major undrilled structural trends DMNG had mapped around Sakhalin Island and on the Khabarovsk and Magadan shelves (Figure 1). From now on new modern seismic data would be available to the industry.

This first 9700 km programme showed that the Magadan shelf contains huge basement related tilted fault-blocks, horsts, anticline structures and pinch out leads of world-class sizes. The presence of these elements combined with the fact that a large number of DHIs were encountered, give the best possible ground for future petroleum exploration in parts of Magadan offshore areas. The target reservoir sequences are believed to be of Paleogene to Neogene age, with hydrocarbons sourced from Paleogene. However, more detailed mapping and further seismic acquisition is needed, in order to establish better control on the reservoir distribution offshore Magadan. Not less important for the international petroleum-community is the need to see a firm tender-plan presented by the local authorities in order to be in a position to allocate funds for further investigation on this particular high potential shelf.

On the Khabarovsk shelf the new 1998 survey confirmed a heavily faulted NE/SW striking structural trend where post Cretaceous deep grabens are supposed to contain mature source rocks. More extensive acquisition is needed in this area in order to establish confidence in leads and prospects.

Around Sakhalin Island the new 1998 data represented a solid improvement in resolution and definition of sequences and structural trends in many of the already established petroleum provinces. Pre-Tertiary sequences, specifically in Sakhalin 4 and 5 areas could now be defined and un-drilled inversion structures in Sakhalin 1, 2 and 3 stood out.

Interpretation and investigations has taken place in both TGS and DMNG after completion of the 1998 programme. The Agreement has been extended with another five years. During 2003 the planning of the second non-exclusive survey started, and during summer of 2004 the SA04 survey was acquired (9,650 km). The purpose of this survey was with base in the 1998 survey, to dense up the grid in some regions (Sakhalin 4 and 5), but also to test the idea of Tertiary fan deposition into an area east of the Sakhalin License-areas not covered by seismic before. A confirmation of fan systems further to the east would also actualize the need for establishing the Deriugin Basin as an active and mature source kitchen area, hence the programme coverage as seen on Figure 1.

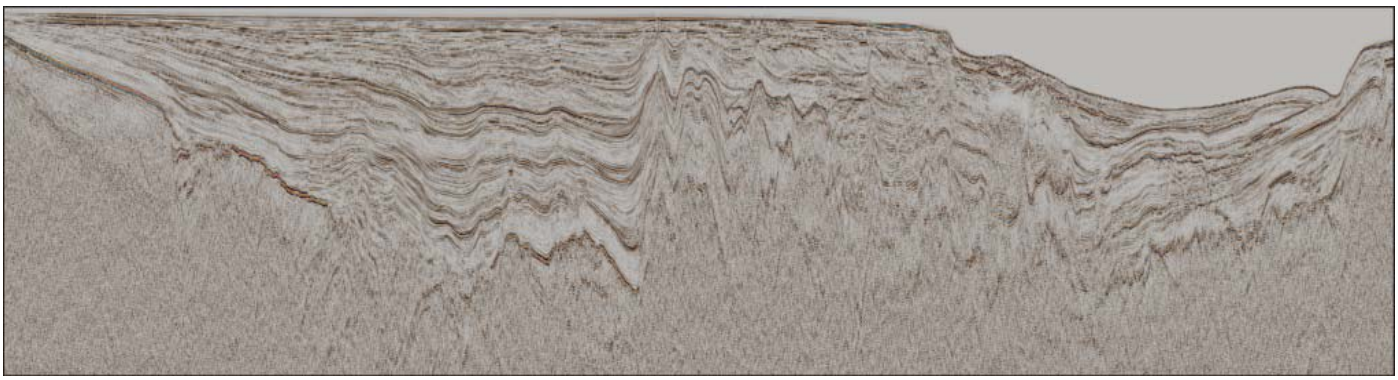

Figure 3: Seismic example from SA04 survey, north of Sakhalin Island (preliminary version)

Based on review of preliminary data (Figure 3) from the SA04 survey, it is clear that the objectives of the survey have been met. Another significant step forward has been made with regards to data quality, and in combination with the extended coverage towards the deep-water areas of Sea of Okhotsk, the new survey will most likely image new structural elements and exploration models to be considered in the future exploration programmes. Based on these very promising initial results, tentative plans have already been established for further acquisition in 2005. It is expected that acquisition will continue in the following years, and that more data will be acquired in the Khabarovsk, Magadan and West-Kamchatka areas.

There is an increasing interest for Sea of Okhotsk among the international exploration companies. Several new players are working with the multi-client data as a part of their initial evaluations, with the aim to establish themselves as active investors and partners in the region. However, key factors will be the availability of exploration licenses/acreage, and that the processes and terms related to this are predictable.

Sea of Okhotsk represents only one example of an area where non-exclusive seismic data have been, and will be, a key tool for exploration in a frontier area. A number of other areas offshore Russia will be equally suitable for this type of activity. Remoteness and harsh environmental conditions mean that general exploration investment level will be high compared to many other areas.

Through multi-client projects the cost and risk is spread among a number of companies, and thereby mitigated. The challenge lies with central and local Russian authorities. It is important that terms allow and stimulate to non-exclusive data acquisition in all areas offshore Russia. All parties will benefit from it. Russian seismic contractors will play an important role and Russian authorities will experience an increased interest and competition for exploration acreage.