Summary
High resolution aerogravity and aeromagnetic data were acquired in 2006 over a licence area in NE Libya. These data are compared with ground gravity and vintage magnetic data acquired in the 1960s and 1970s. The improvement with respect to the resolution of the tectonic features is discussed. The new data provided an excellent background for seismic survey planning. An area of about 30 x 80 km was covered with denser infill aerogravity lines (500 m line spacing). These data are investigated in order to test the improvement in resolution due to tighter line spacing as claimed by Sander et al., 2003.

Introduction
The obligatory 5 year limitation of exploration programmes before relinquishing ground within an exploration licence demands a fast track exploration effort. The licence Area 94 (Figure 1) had been covered during the 1960s and 1970s by an aeromagnetic survey, sparse ground gravity surveys, and some seismic data of limited quality. In order to optimally design a suitable seismic acquisition programme a better geological understanding of the area was needed. High resolution aerogravity and aeromagnetic data (see Figure 2) were acquired in order to provide the necessary input. This presentation shows the improvements in resolution for the aerogravity for the infill area (Figure 2 blue box) in accordance with the claims of Sander et al. (2003).
Aeromagnetic Data
The vintage aeromagnetic data comprises of a data grid composite of the 1969 CGG survey, with 4 km line spacing in N-S direction, for the northern part and the 1960 Hunting survey, with 5 km line spacing in N-S direction, over the central and southern part. In 2006 SGL acquired a high resolution survey with 500 m line spacing (Figure 4) in N-S direction (see Figure 2). Due to the fact that it was not permitted to fly over the Libyan-Egyptian border, a 1.5 to 6 km wide strip along this border could not be surveyed.
Figure 4.

The ground gravity data was acquired prior to 1980, while the aerogravity data was acquired in 2006 by SGL (see Figure 3). A 30 km wide strip (in N-S direction) was covered by denser aerogravity infill, as Statoil wished both to test the claimed improvement of resolution, and to cover the particular area that might not be covered by seismic survey lines (due to land mines, lakes, and rough topography) with the best possible aerogravity data.

Comparison of Data Sets
The comparison of newly acquired and vintage data shows a good agreement between the gravity data sets (Figure 3). The aerogravity data provided much more details and confirmed the presence of anomalies that – in some cases – could have been one point ground gravity anomalies. The station spacing of the ground gravity data can be up to 10 km wide which severely limits the spatial resolution of the data.

However, a major discrepancy occurs when comparing the vintage (Figure 4) and recent aeromagnetic data (Total Magnetic Intensity = TMI – see Figure 4). Whilst there is a good correlation for the northern part, the central and southern parts show extreme differences. The area of discrepancy had been covered in 1960 by Hunting whilst the northern part had been covered in 1969 by CGG. The following explanation for the discrepancy seems to be likely: a) acquisition and positioning problems of the 1960 survey and, b) that some other product than the TMI had been digitized and integrated into the vintage regional data set.

Resolution Test
Aerogravity with a line spacing of 2 km, 1 km, and 0.5 km has been acquired in order to test the improvement in resolution. The bandwidth of wavelength of the anomalies will be shown by spectral analysis and by extraction of profiles across selected anomalies.

As this filtering is carried out by the contractor, as is any prior data processing, it is proprietary and not known to us. The major element in improving of resolution by the virtue of a denser line spacing is thought to be a line to line correlation algorithm that discriminates between signal and noise by virtue of correlation/non-correlation respectively (compare with Sander et al., 2003).
Figure 5 shows the differences in aerogravity resolution as a function of the line spacing dependent processing. The closer line spacing indeed shows a better resolution. In order to better quantify the improvement in resolution a profile was extracted that covered the western low, the southern central high and the eastern high. The results are shown in Figure 6. The dominant improvement in wave length and amplitude occurs between the 1000 and 2000 m grid processed data sets. However, the 500 m grid processing allowed a better resolution of some anomalies at the edge of the data set.

Figure 6.

Trend Interpretation
The 1\textsuperscript{st} vertical gradients of the Bouguer and TMI (Figure 7) data show a good correlation of trends in the southern and SE part of the licence area. These anomalies can be explained by major basement faults. The Bouguer gravity (Figure 4) indicates a deeper basin within the southern half of the licence area, whilst the vertical gradients of the Bouguer gravity and TMI highlight areas with possibly suitable structuration within this southern half. Different magnetic anomaly patterns indicate the presence of two basement terrains. The reduction to pole (RTP) of the TMI (Figure 7) indicates some distortion of the anomalies with respect to the TMI, which points to remanent magnetization in the northern- and southernmost parts (large negative anomalies). The gravity gradient high in the SE correlates well with a medium amplitude RTP high.
Conclusions
Recently acquired high resolution aerogravity and aeromagnetic data have dramatically improved the resolution when compared to ground gravity and vintage magnetic data that were acquired during the 1960s and 1970s. Image processing of the high resolution gravity and magnetic data has shown to appreciably improve the structural knowledge of the area. This has been of great value for focusing the regional seismic exploration programme. Areas of particular interest have been highlighted and will be covered by a denser seismic line grid. The acquisition of infill gravity data has given a reasonable improvement of the spatial resolution, but also indicated a natural limit for this type of data.

References