Project Description

North Flemish Pass

Gravity Gradient Survey

2013 - 2017

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1 INTRODUCTION

ARKeX Ltd. and JEBCO SEISMIC (CANADA) Co. in partnership are proposing to conduct a Non-Exclusive Geophysical program offshore Newfoundland under the jurisdiction of the Canada- Newfoundland and Labrador Offshore Petroleum Board.

JEBCO is an independent international geophysical contractor that supplies first class geophysical products, services and solutions worldwide. JEBCO optimizes data in prospective regions through niche surveys at a low cost, utilizing the best and most appropriate acquisition and processing.

The primary tool used by ARKeX in surveying is the Gravity Gradiometer, which provides the highest possible resolution across the widest bandwidth of any gravity instrumentation. The application of Gravity Gradiometry has been shown to be very complementary to seismic data, especially as a way to quickly fill in information between 2D seismic lines in a very cost effective way. Whichever platform is used to acquire the data (i.e. aircraft or vessel), there are a number of other data sets that can also be acquired at the same time (i.e. magnetic data).

Gravity Gradiometry has been used as an exploration technique since the 1920s in the form of the torsion balance. In 1938, the development of less sensitive but cheaper methods meant the torsion balance was superseded and the industry focused on utilizing ground gravity measurements for exploration at that time. Subsequent developments in dynamic gravity instrumentation focused on these less sensitive measurement techniques, which subsequently led to the development of the L & R type dynamic air/sea meter. Although more recently the development of accelerometer-based systems has taken place (e.g. BGM-3, AirGrav system, and GT-1A), their measurement resolution is fundamentally limited, particularly in high dynamic environments.

In 1973, the US navy developed the first Full Tensor Gradiometer (FTG). The subsequent de-classification of the system and adaptation of the technique for oil, gas, and mineral exploration now means that Gravity Gradiometry is once again a commercially viable technique. With greater resolution and accuracy, Gradiometry now offers the greater geologic resolving power, especially in high dynamic environments (e.g. airborne acquisition).

This document is a Project Description, presented to allow C-NLOPB the opportunity to provide scoping advice to provide C-NLOPB with an Environmental Assessment for the project.

1.1 RELEVENT LEGISLATION & REGULATORY APPROVAL

An authorization to conduct a geophysical program will be required by the C-NLOPB. The C-NLOPB is mandated in this matter by the “Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act” and the “Canada-Newfoundland Atlantic Accord Implementation Act”. Geophysical Surveys are no longer on the schedule of projects under the Canada Environmental Assessment Act 2012.

1.2 THE OPERATOR

The Operator will be ARKeX, a geophysical service company for the oil & gas exploration industry specializing in providing non-seismic solutions. ARKeX helps deliver an upgraded geologic insight to exploration companies seeking a deeper understanding of their geology, but lacking the specialist resources necessary to efficiently leverage all that non-seismic data can offer. ARKeX helps reduce the risk of exploration and increase the likelihood of success. ARKeX is the industry's most experienced and proven non-seismic specialists, the single most concentrated pool of Gravity Gradiometry processing, interpretation, and integration expertise within the oil and gas sector, a unique team armed with unique tools and patented processes.

1.3 CANADA NEWFOUNDLAND & LABRADOR BENEFITS

ARKeX, and its partner JEBCO, are committed to providing maximum benefits associated with East Coast operations to Canadian, and in particular Newfoundland and Labrador residents and companies, where they are commercially acceptable in accordance with "The Operators" operating requirements and fair market value.

The Operator will manage the East Coast operation from Newfoundland & Labrador. The Operator will provide full and fair opportunity to Canadian individuals and organizations, in particular those from Newfoundland and Labrador, to participate in its activities. The Operator will support the principle that first consideration will be given to personnel and support services that can be provided in Newfoundland & Labrador.

Contractors working with ARKeX must apply a high standard of Health, Safety & Environmental competency where such services can be delivered.

1.4 CONTACTS

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2 PROJECT DESCRIPTION

The official name of the proposed project is "**North Flemish Pass Gravity Gradient Survey**". The Operator is proposing to conduct one or more Gravity Gradient surveys from the first of April through the end of October in 2013 through 2017. The survey may start as early as April 1st, 2013, within the proposed Project Area 2013 (Figure 1).

The "Study Area," the area potentially affected by project activities beyond the Project Area 2013-2017, is shown as a green box in Figure 1 (coordinates given in Table 1). The "Project Area" (purple box) represents the area where project activities, including line changes, for the full 2013 to 2017 period will occur (Table 2). The Project Area 2013 (red box), represents the area to be surveyed in 2013 (Table 3).

There are 2 options open to ARKeX to conduct this survey. The survey data will be either acquired from a Fixed Wing Aircraft flown at a constant altitude or sailed with a small dedicated Marine Vessel.

Option 1 – Fixed Wing Aircraft
Option 2 – Small Dedicated Marine Vessel

The Operator would like the flexibility to use either option in a given year (2013-2017). The decision on whether or not any given year will use Option 1 or Option 2 will be based on the availability of the Aircraft, Vessel, and system. The "Geophysical Operations Authorization" (GOA) will be submitted in accordance with which acquisition mode has been determined.

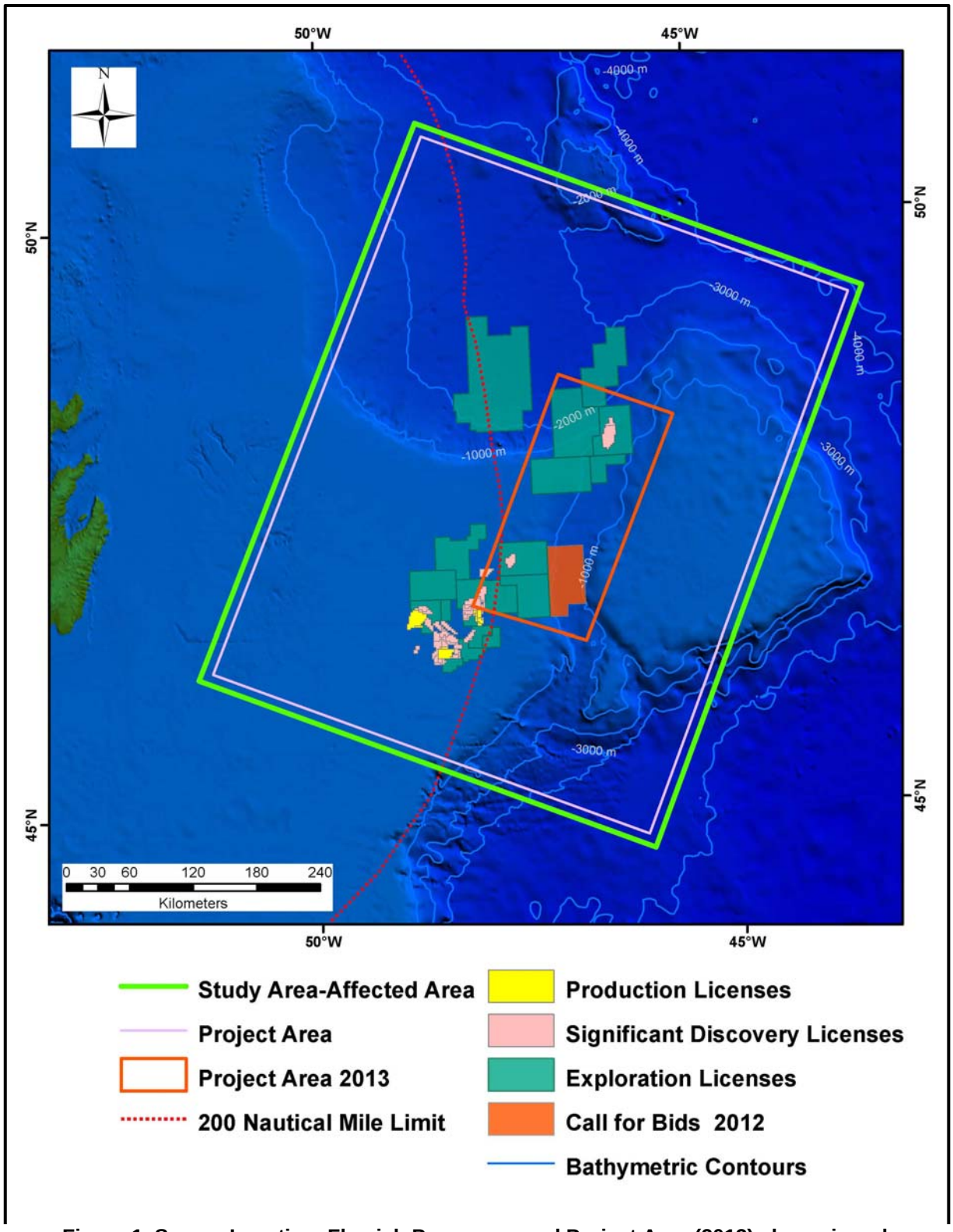

Figure 1. Survey Location, Flemish Pass proposed Project Area (2013) shown in red Outline of current C-NLOPB license blocks also shown

2.1 SPACIAL AND TEMPORAL BOUNDARIES

The Study Area (2013-2017; Table 1) includes the Project Area (2013; Table 3). The project area (Table 2) is well within the study area, as shown (Figure 1). The coordinates and extents of the Study are the following:

Table 1. UTM22_NAD1983 Coordinates for Study-Affected Area (Green Box)

Northwest corner	666108.373	5650468.216
Northeast corner	1088636.755	5497965.162
Southeast corner	894579.168	4964798.43
Southwest corner	462419.661	5122112.045

Table 2. UTM22_NAD1983 Coordinates for Project Area (Purple Box)

Northwest corner	672013.402	5637936.500
Northeast corner	1075858.913	5492137.229
Southeast corner	888688.764	4977830.341
Southwest corner	475505.686	5128216.773

Table 3. UTM22_NAD1983 Coordinates of ARKeX Project Area 2013 (Red Box)

Northwest corner	801874.009	5412351.318
Northeast corner	910293.464	5375502.894
Southeast corner	828801.707	5160789.951
Southwest corner	721168.324	5192578.862

The temporal boundaries of the survey are between April 1st and October 31st from 2013-2017. The duration of the program is estimated at not greater than 120 days in a given year.

2.2 PROJECT OVERVIEW

The proposed project is a Gravity Gradient Survey, consisting of approximately 26,000 km^2 of data collection in 2013-2017. (Survey lines yet to be determined).

The platform requirements for aircraft and marine vessel deployment are discussed below.

Option 1 – Fixed Wing Aircraft

When a new aircraft is used for the first time a number of modifications have to be made to facilitate the survey work. This makes the process of moving the instrumentation to a new aircraft for each job very expensive. It is normal that once an aircraft is set up and configured for gravity gradient survey work it is used for many years. The Gravity Gradiometer is deployed in a Fixed Wing Aircraft and flown in a grid pattern over the area of interest at a low altitude (typically 150-500m). A typical flight plan for a survey such the one being discussed over Flemish Pass would employ a 1,000m or 1,500m flight line spacing with orthogonal tie lines flown at a much wider spacing (5-10 km). The base of operations (typically a regional airport with hanger access) for survey work could be 100s of km from the area to be surveyed. The aircraft makes repeated trips to the project area over a 2-3 month period, gradually building up the grid of measurements. Operations will be limited by weather, as the survey equipment requires less turbulence to record higher quality data. Good visibility is also required for safe operations at low altitude, so operations are also restricted by daylight hours and weather conditions.

Magnetic data will also be acquired from the aircraft in a remote module on the wingtips or nose/tail boom. Magnetic data will be very useful for understanding basement geology or the presence of igneous deposits.

Option 2 – Dedicated Marine Vessel

The choice of marine survey platform is more flexible than an aircraft in terms of system deployment. The Gravity Gradient survey equipment is containerized and can be fitted to the back deck of an appropriately sized vessel. This allows the use of a vessel that is available and best suited to a certain area. A Gravity Meter is also attached to the same platform as the Gravity Gradiometer. While this Gravity Meter generally lacks the resolution of the Gravity Gradiometer, it is able to boost the signal-to-noise ratio of the very long wavelengths. This is only useful on very large surveys, but the proposed Flemish Pass survey would be an example of this. Magnetic Data will also be easily acquired from a marine vessel via a towed sensor. Magnetic data will be very useful for understanding basement geology or the presence of igneous deposits as mentioned above. It is important to note that none of the gravity or gravity gradiometry equipment is even in the water and although the magnetic equipment is towed on a small cable all systems are complete passive. This means that no signal is emitted; they measure naturally occurring properties of the earth. The cable for the magnetometer is typically twice the length of the vessel and towing depths are shallow, typically 10m.

The Gravity Gradiometer system is regarded as the primary data output and will be maintained within specification throughout the survey duration. All other data systems deployed are deemed secondary systems. ARKeX will provide its best efforts to maintain secondary system specifications throughout the survey duration, but in the event of equipment failure, or degradation of system performance, the affected lines will not to re-flown/re-sailed.

2.2.1 Objectives and Rationale

The primary objective of the project is to determine the presence and likely locations of geological structures that might contain hydrocarbon deposits. The application of Gravity Gradiometry has been shown to be very complementary to seismic data, especially as a way to quickly fill in information between 2D seismic lines in a very cost effective way. Existing 2D / 3D data has been found to be insufficient to serve all the needs of energy companies in their exploration, development, and production activities.

The proposed Gradiometry Survey of data collection will be collected to compliment previous 2D data sets previously collected in the region, including those collected by JEBCO (Figure 2).

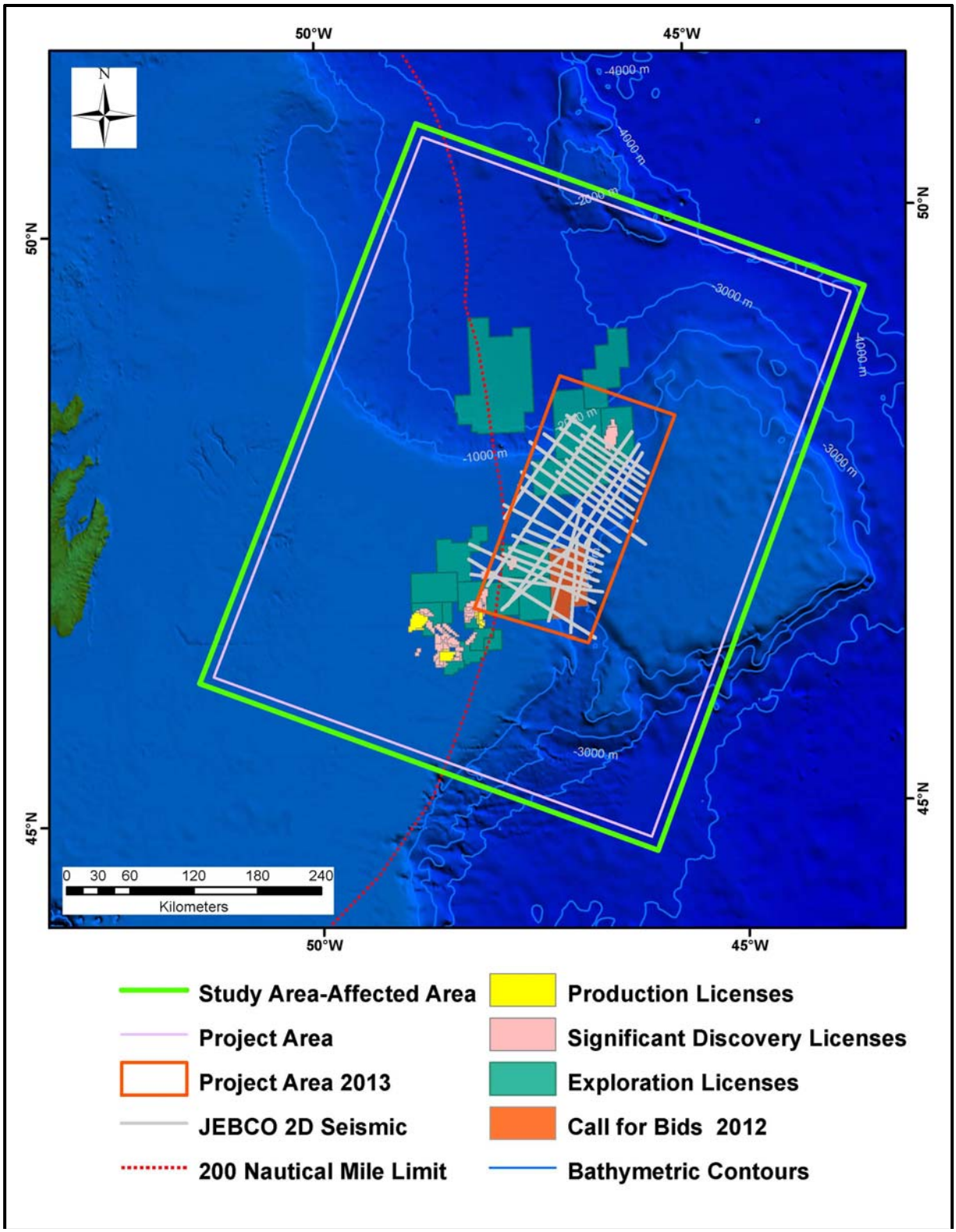

Figure 2. Distribution of JEBCO 2D data and outline of proposed survey with C-NLOPB license blocks

2.2.2 Alternatives to the Project and Within the Project

The alternative to the project would be to forego exploration in Newfoundland and pursue opportunities elsewhere in the world, in order to assist market demand for data.

2.2.3 Phases

The project will be in two phases.

2.2.3.1 Phase 1

This phase will include Gradiometry data collection with auxiliary data, Gravity and Magnetic, in 2013. Final elevation models or ship tracks will be provided upon consideration of flight restrictions, infrastructure, or activity in the area upon filing for the GOA.

2.2.3.2 Phase 2

This phase will include Gravity, Magnetic, and Gradiometry data collected in 2014-2017 in areas within the study area based on the results of the 2013 analysis.

2.2.4 Project Scheduling Phase 1

The survey will not exceed 120 days; however, logistics and weather will play an important role in scheduling, therefore, in order to allow flexibility in timing the proponent is proposing April 1st, 2013 – October 31st, 2013 window for data collection.

2.2.5 Project Scheduling Phase 2

The surveys can occur between April 1st through until October 31st in any given year 2014 - 2017. Estimated duration of the proposed surveys is 120 days per year.

2.2.6 Site Plan

The project area proposed for 2013-2017 is shown in Figure 1. The proposed survey line orientation for Gradiometry data collection in 2013 will be provided upon application for the GOA.

Option 1 – Fixed Wing Aircraft

Altitude	150+ m above sea level
Survey Lines – Direction & Spacing	~010°/190° 1,500m
Tie Lines - Direction & Spacing	~100°/280° - 4,500m

3 EQUIPMENT

3.1 AIRCRAFT

Aircraft:	C-FTGX, Basler BT-67
Operator:	Enterprise Airlines
Endurance:	1860 nm (2140 Miles)
Speed:	205 kts (cruise)
Engines:	2x Pratt & Whitney Canada PT6A 67R Turboprops

3.2 MARINE VESSEL

Example Vessel:	M/V Aquarius
Length:	130ft (40m)
Width:	26ft (8m)
Draft:	11.5 ft (3.5m)
Bunkering:	3 weeks
Speed:	10 knots survey speed

3.3 GRAVITY GRADIOMETRY

Gravity Gradiometer	Full tensor system from Lockheed Martin incorporating latest proprietary technologies
Components:	Independent measurement of 6 components of the gravity gradient tensor
Accuracy:	Typical accuracy of 18 E/rtHz.
Bandwidth:	0.062 Hz (1,000 m)

3.4 GRAVITY GRAVIMETRY

(GMA channel of the FTG SYSTEM)

System:	Lockheed Martin FTG - GMA channel
Static Noise:	0.1 mGal RMS per hour, 0.3 mGal RMS over 30 days

Static Drift: <1 mGal per day

Stability of Drift Rate: above rate stable to <1 mGal/month

3.5 MAGNETIC

Airborne specification:

System: single magnetic sensor mounted in a tail stinger

Sensor type: Geometrics G-822A Cesium Magnetometer

Range: 20,000 – 100,000nT

Sensitivity: <0.0005 nT/sqrtHz rms, typically 0.003nT at sampling rate of 0.1s

Compensation: Aircraft generated fields compensated using digital compensator operating on a measured set of defined maneuvers

Marine specification: Similar level of quality system (or better) to airborne specification

Marine Magnetometer

Example of typical equipment: The Geometrics G-882 cesium-vapor marine magnetometer consists of a small “fish” that is towed from the back deck and a cable that both connect the fish to the vessel and caries the telemetry. The fish unit is fully sealed and no signal or substance is emitted from the fish at any point during operations. The length of the cable is typically twice the length of the boat (to isolate the natural magnetic signal from a steel hull). The depth of the fish is usually shallow (<10m).

Image of G-882 Marine Magnetometer being deployed.

3.6 SELF CONTAINED ARKEX INSTRUMENT CONTAINER

Container Weight:	5 tons
Container Size:	20ft x 8ft 6 x 8ft
Power Requirements:	400v AC 3 phase plus neutral 60 Hz
Positioning:	Back deck close to centre of gravity