DEPARTMENT OF MINERAL RESOURCES AND ENERGY

NO. 5572 **22 November 2024**

MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002) ("THE ACT")

INVITATION FOR WRITTEN COMMENTS ON A PROPOSED INVESTIGATION IN TERMS OF SECTION 50 OF THE ACT

I, **SAMSON GWEDE MANTASHE,** Minister of Mineral Resources and Energy, hereby invite written comments on my intention to conduct an investigation to establish the subsurface geology and its structure as it relates to petroleum, on or under land depicted on the plan attached as **Annexure A**, and so, to establish the nature and extent of the subsurface geology and its structure, and assess any potential geological risks. All affected owners, occupiers or persons in control of such land are called upon to furnish their particulars. The investigation in question will be undertaken by;

(i) acquiring and processing new 2D land seismic data over the area or part thereof to obtain modern high-resolution seismic profiles to map and improve understanding of the regional geology of the south-central Karoo Basin; and

(ii) acquiring and processing new airborne magnetic and magneto-telluric over the area or part thereof to support seismic interpretation and to map and improve understanding of the regional geology and structure of the south-central Karoo Basin.

Written comments and particulars of owners, occupiers or persons in control of the land subject to this notice must be submitted to:

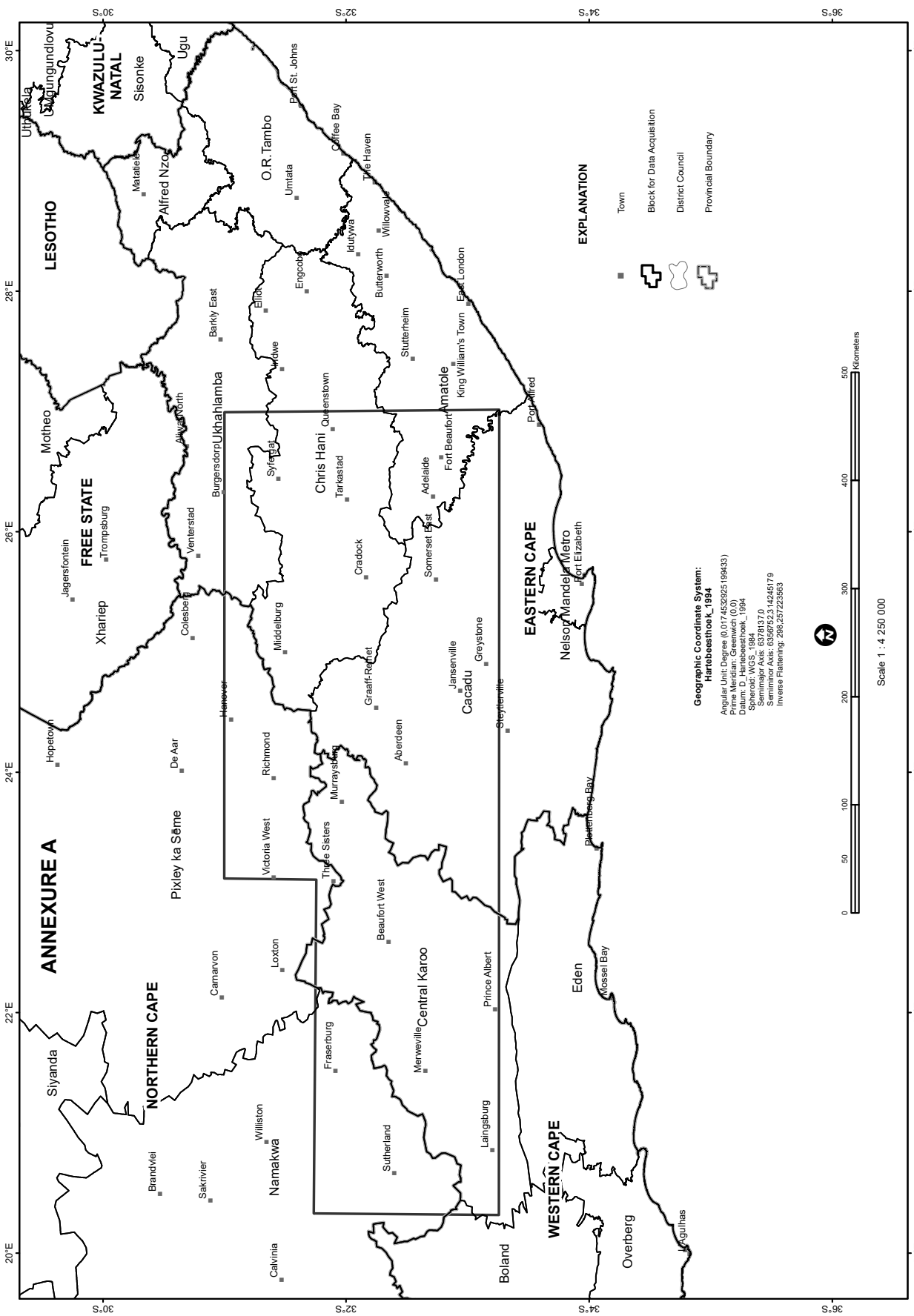
The Chief Executive Officer
Petroleum Agency SA
Heron Place
2nd Floor, Heron Close
CENTURY CITY
7441

Fax: 021 938 3500

Email: section50@petroleumagencysa.com

Written comments must reach the Petroleum Agency SA by no later than 30 days from the date of publication.

HON. SAMSON GWEDE MANTASHE, (MP)
MINISTER OF MINERAL RESOURCES AND ENERGY


ANNEXURE A
EXPLANATION
Town
Block for Data Acquisition
District Council
Provincial Boundary
KWAZULU-NATAL
LESOTHO
FREE STATE
NORTHERN CAPE
EASTERN CAPE
WESTERN CAPE
Ugu
Sisonke
Alfred Nzo
O.R.Tambo
Amatole
Ukhahlamba
Chris Hani
Cacadu
Nelson Mandela Metro
Pixley ka Seme
Namakwa
Siyanda
Central Karoo
Eden
Overberg
Boland
Motheo
Xhariep
Lejweleputswa
Thabo Mofutsanyana
Fezile Dabi
Port St Johns
Coffee Bay
Tyhume Haven
Umtata
Matatiele
Elliot
Barkly East
Engcobo
Idutywa
Willowvale
Butterworth
East London
Stutterheim
King William's Town
Port Alfred
Queenstown
Sterkspruit
Tarkastad
Adelaide
Fort Beaufort
Somerset East
Cradock
Middelburg
Graaff-Reinet
Jansenville
Aberdeen
Steytlerville
Greystone
Port Elizabeth
Uitenhage
Despatch
Humansdorp
Jeffreys Bay
Plettenberg Bay
Mossel Bay
Prince Albert
Laingsburg
Merweville
Beaufort West
Sutherland
Fraserburg
Victoria West
Three Sisters
Murraysburg
Richmond
Hanover
Colesberg
Venterstad
Burgersdorp
Aliwal North
Jagersfontein
Trompsburg
Hopetown
De Aar
Loxton
Carnarvon
Williston
Brandvlei
Sakrivier
Calvinia
Vanrhynsdorp
Lutzville
Vredendal
Clanwilliam
Citrusdal
Piketberg
Malmesbury
Moorreesburg
Caledon
Bredasdorp
Swellendam
Riversdale
Albertinia
Heidelberg
Stilbaai
Mossel Bay
George
Knysna
Plettenberg Bay
Humansdorp
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Fraserburg
Merweville
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Sakrivier
Calvinia
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Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0,0)
Datum: D_Hartebeesthoek_1994
Spheroid: WGS_1984
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.3.14245179
Inverse Flattening: 298.2572235635
Scale 1 : 4 250 000
0
50
100
200
300
400
500
Kilometers
20°E
22°E
24°E
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28°E
30°E
30°S
32°S
34°S
36°S

SUPPLEMENTARY INFORMATION

TO INVESTIGATE THE OCCURRENCE, NATURE AND EXTENT OF PETROLEUM RESOURCES IN TERMS OF SECTION 50 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002)

1. AIM

To investigate the occurrence, nature and the extent of mineral resources in terms of section 50(1) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) ("the Act") in the southern part of the Karoo Basin depicted in the plan/map marked Annexure A (Government Notice).

2. INTRODUCTION

2.1 As required by the MPRDA, a Section 50 notice was approved by the Minister and subsequently published in the Government Gazette Vol. 710 No. 51138 on 30 August 2024, announcing the intention of the Minister to acquire new geophysical data in the Karoo.

2.2 The proposed investigation aims to acquire new geophysical data in the southern Karoo Basin to establish the subsurface geology and its structure as it relates to the occurrence of petroleum and assess any potential geological risks related to the exploration for and the production of petroleum.

2.3 Historically, reflection seismic data was acquired across the southern part of the Karoo by the former South African national oil company SOEKOR from 1966 to 1971. The data were acquired using the technology available at the time. However, the quality of the data is poor and therefore, detailed high-resolution interpretation of the data is not practical. It is therefore necessary to acquire new data using modern technology to generate improved and higher quality images of the subsurface for geological interpretation.

2.4 Airborne magnetic and radiometric data were collected over the area by various surveys flown for the South Africa Geological Survey and its successor, the Council for Geoscience, between the years 1958 and 1997. The area of interest was covered in two primary sections – the Karoo survey, done between 1976 and 1982 and covering almost half of the country;

and the rest, which was surveyed by various companies over a period of more than 30 years, starting in 1958 and ending in 1997.

2.5 Between 1965 and 2022 18 exploration boreholes were drilled in the area of interest in the southern Karoo Basin, several exceeding depths of 3000 m. All boreholes intersected the organic-rich shale (likely source rocks) of the Permian Ecca Group.

2.6 Production tests and water analyses from some of the exploration wells drilled in the Karoo indicated a presence of light hydrocarbons. In particular, methane gas was encountered in the well CR 1/68 drilled on the farm Cranemere near Pearston in 1968. Gas flowed from the Upper Ecca Group of rocks at rates of 1.83 million standard cubic feet of gas per day (MMscf/d) for a period of 24 hours. This discovery demonstrates the presence of gas accumulations in this region of the Karoo Basin.

2.7 Historical data and information, internal archives, and public data confirm that the area has both oil and gas shows at the surface. Gas occurrences in association with dolerite sills have been observed in the Beaufort Group and in the Ecca Group of rocks, in water wells and deep exploration wells without the presence of dolerite sills.

2.8 Geochemical results obtained from recent soil gas baseline surveys undertaken in the Karoo Basin confirms the presence of methane gas in close proximity to some of the historical exploration wells and borehole locations. The microseepage of oil in the basin is a new finding.

3. BACKGROUND INFORMATION ABOUT GEOPHYSICAL SURVEYS

3.1 **What are geophysical surveys in general?**

Geophysical surveys are conducted to infer the structure and properties of the Earth's interior. Typically, measurements are made of variations in the Earth's gravitational and magnetic fields, natural radioactivity, the flow of electrical currents and the transmission and reflection of seismic waves. Geophysical surveys are routinely conducted to search for groundwater, minerals, petroleum and renewable energy sources. The surveys are also used for geotechnical and engineering applications, such as the assessment of the foundations of dams, the identification of pollution plumes, and the mitigation of geohazards. Geophysical surveys can be conducted on the Earth's surfaces, in boreholes, in the air using aircraft, or at sea using ships.

3.2 **Ground vs airborne surveys**

Airborne surveys are generally quick and easier to conduct than ground surveys and are used for reconnaissance. However, some techniques (such as seismic, electrical resistivity and magnetotelluric) cannot be acquired in the air as the energy sources and detectors must be in direct contact with the ground or water. Ground surveys are usually conducted to focus on areas of interest selected from the study of airborne gravity, magnetic, radiometric and electromagnetic data. Ground surveys can be slow, costly and may demand extensive manpower during field work. However, they provide better quality data because the instruments are closer to the targeted geology. There are cases when ground surveys are deemed not to be feasible. For example, waterbodies or harsh topographical variations present as obstacles. Airborne surveys, on the other hand, are cost-effective if the areas covered are large enough so that the cost per data point is effectively reduced. Moreover, in many applications airborne data may lack spatial resolution and more detailed surveys will be required.

3.3 **Active vs passive geophysical methods**

Geophysical methods can either be active (i.e., use controlled man-made energy sources), or passive (i.e., use natural sources such as vibrations produced by ocean waves breaking against the shore, or uncontrolled man-made sources such as traffic noise). The man-made or natural source-generated signals (i.e., data acquisition) are measured in the field by the specialized sensitive detectors, processed in the field/office (i.e., to remove 'unwanted information' or 'noise'). The output is displayed and interpreted geologically (i.e., determining the depth, size, and properties of the targets) using advanced computer techniques for further analysis and evaluation. Examples of passive methods are seismic ambient noise tomography, magnetotelluric, gravity, and magnetic methods, while examples of active methods include seismic reflection, EM, and electrical resistivity.

3.4 **General geophysical exploration workflow**

The typical geophysical exploration workflow starts with the site visit, physical property measurements, survey planning and design (often done in the office), site visits again for field trials, data acquisition (in the field), data processing (in the field and office), data interpretation and geological modelling (in the office).

4. PROPOSED GEOPHYSICAL SURVEYS IN THE KAROO BASIN

4.1. The work will utilize three geophysical surveys: **land reflection seismic method (active and passive)**, **magnetotelluric (MT)**, and **airborne magnetic and radiometric survey**. These techniques were chosen to meet the objectives of the survey, and also because they are cost-effective, novel and environmentally friendly.

(a) Land active and passive reflection seismic survey

The survey will use cost-effective, novel and environmentally friendly seismic instruments to investigate the subsurface geology of the Karoo Basin.

History of seismic surveys in South Africa

The main goal of seismic exploration is to collect information about the composition and structure of the subsurface. Reflection seismology was first used to explore for oil and gas in sedimentary rocks in the USA in the 1930s. In South Africa, it has been used since 1960s to search for oil and gas, mineral deposits, for deep mining planning and developments, and to investigate the deep crustal structure of the Earth for research and academic purposes. So, these will not be the first 2D seismic surveys in the Karoo or in South Africa. In fact, mining industry in South Africa uses the technique to mitigate mining related risks and improve ore resource evaluation.

- **How does the reflection seismic method work?** A survey involves the recording of the vibrations and waves in the Earth's crust. Seismic surveys can be either active or passive. For example, in an active seismic survey, man-made controlled sources include dynamite or mechanical vibrators, while a passive seismic survey utilizes the energy coming from natural sources such as earthquakes, road traffic noise, industry and human activity, wind and ocean waves. The generated waves travel through the Earth and are refracted and reflected at boundaries between rocks that have different physical properties. As these waves return to the surface, the ground motion is recorded by specialized sensors (known as geophones). The information is analyzed (processed) and the output is interpreted to allow us to create a detailed picture of the structure and composition of the subsurface.

- **Where would the data be acquired?** The data will be acquired along the public roads.

- **What method will be utilized?** The method will utilize both passive and active seismic methods.

- **What instrument will be used as an active energy source?** A vibroseis truck will be used to generate energy at 20 m interval offroad along roadside. The vibroseis truck was chosen because it provides better depth of penetration and quality data, but also has lower environmental impact compared to impulsive sources (drop hammer, accelerated weight drop) and explosives (shots).

- **What is a Vibroseis truck?** It is a vehicle that is used to generate seismic signals. In contrast to older technologies that used explosives (shots), the vibroseis vehicle generates artificial seismic waves through mechanical vibration. The vehicle is equipped with a vibrator (vibroseis source) that is in contact with the ground surface. The vibrator generates controlled vibrations with different frequencies and amplitudes. These vibrations propagate underground as seismic waves and reflect to the surface where the energy intensity of the reflected waves is recorded on surface geophones (sensors). With the vibroseis truck, the operator has control over the seismic energy and frequencies being emitted into the ground.

- **What are the technical parameters of the vibroseis truck proposed for Karoo:** P-wave vibrator, frequency range: 10-150 Hz, Peak Force: 278 kN / 62,400 lbf, hold down weight: 28,294 kg / 63,610 lb, length: 10.64 m, width: 3.42 m; height: 3.22 m.

- **What are the impacts and risks associated with the seismic survey?** The surveys have been designed along the public roads to reduce the environmental footprints from the vibrating seismic truck. Prior to seismic surveys, site visits will be conducted as part of the environmental impact assessment and stakeholder engagement processes to identify any potential risk to infrastructure and the environment that may be caused by the vibrating truck. If a potential risk is identified, the vibration point (VP) will be moved to a more suitable position, or only passive seismic data will be collected in those areas, which doesn't require the use of the vibroseis truck.

- **What recording system will be used?** The survey will utilize the latest wireless (cable-free) nodal technology. This technology was chosen to reduce and risk and minimize any environmental impact that could result from deploying cables across the roads and carrying/transporting a large volume of cables in difficult ground terrain. The survey will also utilize the seismic land streamer. The land streamer is an array of geophones attached on the

belt that can be towed in behind the vibrating truck without the need to install geophones on the ground, therefore reducing any envisaged environmental footprint.

- **How is the seismic survey designed:** Sensors (10 Hz geophones) will be placed at 20 m intervals offroad and the truck will generate energy offroad along roadsides to avoid blocking the road. The landstreamer will be pulled behind the truck.

(b) Airborne magnetic and radiometric surveys

- **How does an airborne magnetic/radiometric survey work?** An aeromagnetic/radiometric survey is conducted using an aircraft with an attached magnetometer and installed spectrometer. As the aircraft flies, the magnetometer measures and records the total intensity of the magnetic field at the sensor. This measurement includes the desired magnetic field generated in the Earth as well as tiny variations due to the constantly varying solar wind and the magnetic field of the survey aircraft. Different rock types and soils have varying content of magnetic and radioactive minerals, so the data allow visualization of the geological structure of the upper crust, especially where bedrock is obscured by surface sediments, soil, or water.

- **How will the survey be conducted in the Karoo?** Aeromagnetic/radiometric surveys will be flown on a grid basis along survey lines with further perpendicular (tie) lines. Data will be acquired at 1 km line spacing, and the flight height will be 50 m Mean Terrain Clearance above ground level. Data will be collected with the aircraft in the field, processed (removing unwanted information) and interpreted in the office using advanced computer systems.

- **Any risks and environmental impact associated with this survey?** The survey will be performed by a highly experienced contractor. The key risks associated with the survey include radar contact loss with the aircraft, collision with topography or infrastructure, and sudden changing weather conditions. A full project risk assessment for the survey block to be flown will be provided, this will be updated after a reconnaissance flight of the survey area in order to identify additional/unidentified risks or issues such as rural development, terrain, power lines and communication antennae. Due consideration will be given to dangerous obstacles such as power lines, communication antennae, trees, mine headgear, buildings etc. Safety systems (including radar/laser antennae, loading pre-existing infrastructure, etc) are in place that ensures that the contract specified minimum terrain clearance is not breached during the survey. The aircraft is equipped with advanced weather warning systems, 24/7 live tracking via radar and communication radios not only with the air-traffic control but with operational centres on the ground.

(c) Magnetotelluric (MT) surveys

- **About the method:** MT is a passive geophysical method that uses natural electromagnetic fields to investigate the electrical conductivity structure of the earth from 100's of metres to 100's of km depth below ground surface. The non-destructive nature of the MT, in addition to good resolution it provides, was the main reason behind its choice for the Karoo survey.

- **What type of data will be recorded?** Audio Magnetotelluric (AMT) and Broadband Magnetotelluric (BBMT). The difference between the two recording is the type of magnetometer used and the amount of recording time.

- **Where will the data be collected?** The data will be collected along the seismic profiles (on the verge adjacent to the road) for several days using specialised MT instruments (e.g., electrodes and magnetic sensors that will be installed/buried for continuous data recording of the data). The instruments will be installed (buried 30 cm deep) at 1-2 km away from each other along the seismic profiles. The data will be processed (removing noise) and interpreted (inversion) using software packages to produce final 3D Earth's subsurface models.

- **Any environmental impact associated with MT survey?** No environmental impact or infrastructure damage is expected.

4.2. During the seismic survey, vibrator trucks will be used as an energy source Wireless receivers will be installed at the ground surface, offroad along roadsides, for receiving and recording the data. No disturbances to land and infrastructure are expected and any impact on people during operations is expected to be minimal to nil. An environmental impact assessment for the areas of survey operation will be conducted as part of the project.

4.3. The expected value to be derived from the survey investigation includes:

- Delivery of a new suite of high-resolution reflection seismic data and imagery of the subsurface for the purposes of geological interpretation.

- Delivery of a new suite of high-resolution airborne magnetic, radiometric and ground magnetotelluric data over the area of investigation to support the seismic interpretation.

Magnetic data will image magnetite-bearing sills and dykes; magnetotelluric data will image electrically conductive geological formations, faults and dykes.

4.4. The data and information delivered will be integrated to provide a detailed interpretation of subsurface structure, thickness and intrusion density, not possible with existing legacy onshore seismic data.

4.5. This will allow for a reduction in uncertainty of the geological risk parameters, regional target identification and hydrocarbon preservation from igneous intrusions. It is therefore envisaged that the new data contribute to incentivising new petroleum exploration activity and accelerates the development of South Africa's onshore petroleum resources.

4.6. Survey results will also inform the geo-environmental baseline research initiatives underway, such as implementation of a groundwater monitoring network, well risk integrity assessments and seismicity monitoring network.

4.7. The study will assist with the identification and delineation of areas that may be too risky from an environmental point of view and therefore should be excluded from shale gas development.

4.8. In terms of infrastructure, the proposed survey area is serviced by a road network consisting of both highways and main roads that are owned and maintained by the South African National Roads Agency. Furthermore, the area is within 100-400 km of air and seaports of Cape Town, George (airport), Mossel Bay (seaport), East London (air and seaports), Ngqura (seaport), Port Elizabeth (air and seaports) and Durban (air and seaports). The Ngqura (Coega) Industrial Development Zone (IDZ) is one of the selected sites for the development of a 1000MW Gas to Power Station. The land within the defined area consists of State-owned land, privately owned farmlands, commonage land, and communal land managed by tribal authorities. The identified sensitive areas such as National and Provincial parks, and wetlands are excluded in the investigation.

4.9. The total amount of data acquisition, processing, and interpretation is of approximately 2 246-line km of 2D reflection seismic surveys, 21 253-line km of airborne magnetic and radiometric surveys, and approximately 2 318 magnetotelluric stations will be deployed along the seismic profiles. The data obtained by this investigation will enable the Department to make informed decisions regarding the issuing of exploration rights in the area. Of importance, an

environmental impact assessment and public consultation will be undertaken prior to data acquisition operations.

DEPARTEMENT VAN MINERAALBRONNE EN ENERGIE

NO. 5572 **22 November 2024**

WET OP DIE ONTWIKKELING VAN MINERALE EN PETROLEUMBRONNE (28/2002) ("Die WET NO. 28 VAN 2002) ("DIE WET")

UITNODIGING VIR SKRIFTELIKE KOMMENTAAR OOR 'N VOORGESTELDE ONDERSOEK IN TERME VAN ARTIKEL 50 VAN DIE WET

Ek, **SAMSON GWEDE MANTASHE**, Minister van Minerale en Petroleumbronne, nooi hiermee vir skriftelike kommentaar oor my voorneme om ondersoek te doen op die ondergrondse geologie en die struktuur daarvan soos dit met petroleum verband hou en vas te stel, op of onder grond uitgebeeld op die plan aangeheg as **Bylae A**, en so, om die aard en omvang van die ondergrondse geologie en sy struktuur vas te stel, en om potensiële geologiese risiko's te evalueer. Alle geaffekteerde eienaars, okkupeerders of persone in beheer van sodanige grond word versoek om hul besonderhede te verstrek sodat hulle gekontak kan word vir die doel van konsultasie.

Die betrokke ondersoek sal onderneem word deur;

(i) Die verkryging en verwerking van nuwe 2D-land seismiese data oor die area of deel daarvan om moderne hoë-resolusie seismiese profiele te verkry om die streekgeologie van die suid-sentrale Karookom te karteer en beter te verstaan; en

(ii) Verkryging en verwerking van nuwe magnetiese en magneto-telluriese in die lug oor die gebied of 'n deel daarvan om seismiese interpretasie te ondersteun en om begrip van die streeksgeologie en struktuur van die suid-sentrale Karookom te karteer en beter te verstaan.

Skriftelike kommentaar en besonderhede van eienaars, okkupeerders of persone in beheer van die grond onderworpe aan hierdie kennisgewing moet ingedien word by:

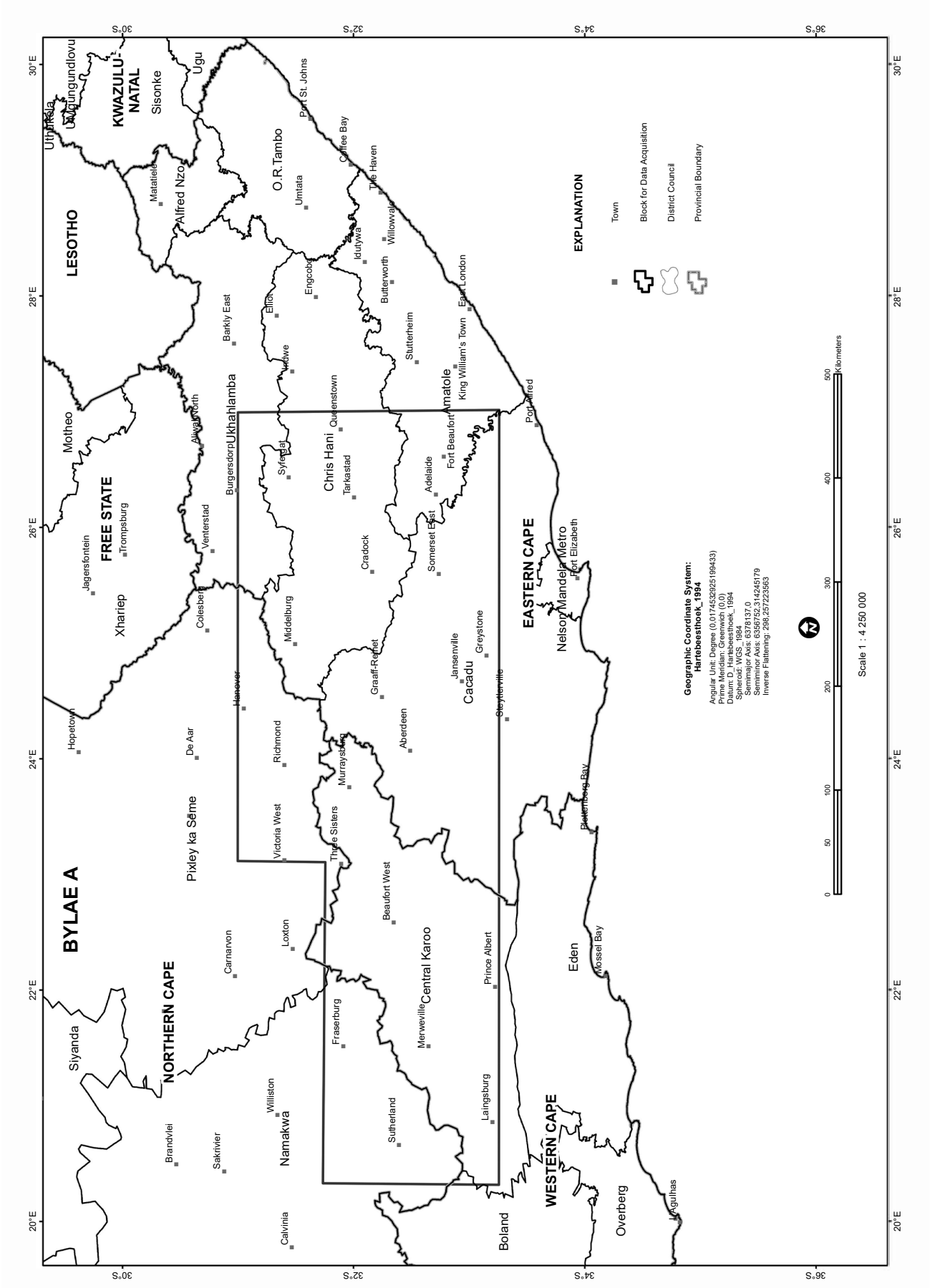
Die Hoof Uitvoerende Beampte
Petroleum Agency SA
Heron Place
2de Vloer, Heron Close
CENTURY CITY
7441

Faks: 021 938 3500

E-pos: section50@petroleumagencysa.com

Geskrewe kommentaar moet die Petroleum Agency SA bereik teen nie later nie as 30 dae vanaf die datum van publikasie.

HON. SAMSON GWEDE MANTASHE, (MP)
MINISTER VAN MINERAAL EN PETROLEUMBRONNE


BYLAE A
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Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314245179
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Scale 1 : 4 250 000
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KWAZULU-NATAL
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Central Karoo
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Nelson Mandela Metro
Eden
Overberg
Boland
Siyanda
Port St. Johns
Coffee Bay
Umtata
Matatiele
Elliot
Barkly East
Engcobo
Idutywa
Butterworth
The Haven
Willowvale
East London
Stutterheim
King William's Town
Port Alfred
Queenstown
Adelaide
Fort Beaufort
Alwal North
Burgersdorp
Sylvania
Tarkastad
Somerset East
Cradock
Jagersfontein
Trompsburg
Venterstad
Colesberg
Middelburg
Graaff-Reinet
Jansenville
Greytown
Aberdeen
Murraysburg
Richmond
De Aar
Hopetown
Hanover
Victoria West
Three Sisters
Beaufort West
Loxton
Carnarvon
Fraserburg
Merweville
Prince Albert
Laingsburg
Sutherland
Williston
Brandvlei
Sakrivier
Calvinia
Port Elizabeth
Plettenberg Bay
Mossel Bay
Agulhas
20°E
22°E
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30°E
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36°S

AANVULLENDE INLIGTING

OM DIE VOORKOMS, AARD EN OMVANG VAN PETROLEUMBRONNE TE ONDERSOEK INGEVOLGE ARTIKEL 50 VAN DIE WET OP MINERAAL- EN PETROLEUMBRONNE ONTWIKKELING, 2002 (WET NR. 28 VAN 2002)

1. DOEL

Om die voorkoms, aard en omvang van minerale bronne te ondersoek ingevolge artikel 50(1) van die Wet op die Ontwikkeling van Minerale en Petroleumbronne, 2002 (Wet No. 28 van 2002) ("die Wet") in die suidelike deel van die Karookom uitgebeeld in die plan/kaart gemerk Bylaag A (Regeringskennisgewing).

2. INLEIDING

2.1 Soos deur die MPRDA vereis, is 'n Artikel 50-kennisgewing deur die Minister goedgekeur en daarna in die Staatskoerant Vol. 710 No. 51138 van 30 Augustus 2024 gepubliseer, wat die voorneme van die Minister aankondig om nuwe geofisiese data in die Karoo te bekom.

2.2 Die voorgestelde ondersoek het ten doel om nuwe geofisiese data in die suidelike Karookom te bekom om die ondergrondse geologie en sy struktuur vas te stel soos dit verband hou met die voorkoms van petroleum en om enige potensiële geologiese risiko's wat verband hou met die eksplorasie na en die produksie van petroleum te evalueer.

2.3 Histories is refleksie seismiese data oor die suidelike deel van die Karoo verkry deur die voormalige Suid-Afrikaanse nasionale oliemaatskappy SOEKOR tussen 1966 en 1971. Die data is verkry deur gebruik te maak van destydse tegnologie wat beskikbaar was. Die kwaliteit van die data is egter swak en daarom is gedetailleerde hoë-resolusie-interpretasie van die data nie prakties nie. Dit is dus nodig om nuwe data te bekom deur moderne tegnologie te gebruik om verbeterde en hoër kwaliteit beelde van die ondergrond te genereer vir geologiese interpretasie.

2.4 Magnetiese en radiometriese data is oor die gebied ingesamel deur verskeie lugopnames wat vir die Suid-Afrika Geologiese Opname en sy opvolger, die Raad vir Geowetenskap, tussen die jare 1958 en 1997 uitgevoer is. Die area van belangstelling is in twee primêre afdelings gedek – die Karoo opname, gedoen tussen 1976 en 1982,wat byna die helfte van

die land dek; en die res, wat oor 'n tydperk van meer as 30 jaar deur verskeie maatskappye ondersoek is, wat in 1958 begin en in 1997 geindig het.

2.5 Tussen 1965 en 2022 is 18 eksplorasieboorgate in die gebied van belang in die suidelike Karookom geboor, verskeie waarvan dieptes van 3000 m oorskry het. Alle boorgate het die organies-ryke skalie (waarskynlik brongesteentes) van die Permiese Ecca-groep gekruis.

2.6 Produksietoetse en waterontledings van sommige van die eksplorasieboorgate wat in die Karoo geboor is, het 'n teenwoordigheid van ligte koolwaterstowwe aangedui. In die besonder, is metaangas teëgekom in boorgat CR 1/68 wat in 1968 op die plaas Cranemere naby Pearston geboor is. Gas het uit die Bo-Ecca-groep gesteentes gevloei teen koerse van 1,83 miljoen standaard kubieke voet gas per dag (MMskf/d) vir 'n tydperk van 24 uur. Hierdie ontdekking demonstreer die teenwoordigheid van gasafsettingss in hierdie streek van die Karookom.

2.7 Historiese data en inligting, interne argiewe en openbare data bevestig dat die gebied beide olie- en gasvertonings op die oppervlak het. Gasvoorvalle in assosiasie met dolerietplate is waargeneem in die Beaufort-groep en in die Ecca-groep gesteentes, in waterboorgate en diep eksplorasieboorgate sonder die teenwoordigheid van dolerietplate.

2.8 Geochemiese resultate verkry uit onlangse grondgas-basislynopnames wat in die Karookom onderneem is, bevestig die teenwoordigheid van metaangas in die nabyheid van sommige van die historiese eksplorasieboorgate en boorgatliggings. Die mikrosypeling van olie in die Karookom is 'n nuwe bevinding.

3. AGTERGRONDINLIGTING OOR GEOFISIESE OPNAMES

3.1 **Wat is geofisiese opnames in die algemeen?**

Geofisiese opnames word uitgevoer om die struktuur en eienskappe van die aarde af te lei. Tipies word metings gemaak van variasies in die aarde se gravitasie- en magnetiese velde, natuurlike radioaktiwiteit, die vloei van elektriese strome en die oordrag en weerkaatsing van seismiese golwe. Geofisiese opnames word gereeld uitgevoer om na grondwater, minerale, petroleum en hernubare energiebronne te soek. Die opnames word ook gebruik vir geotegniese en ingenieurstoepassings, soos die assessering van die fondamente van damme, die identifisering van besoedelingspluime en die versagting van geogevare. Geofisiese opnames kan op die aarde se oppervlak, in boorgate, in die lug met vliegtuie, of op see met skepe uitgevoer word.

3.2 **Grond- en lugopnames**

Lugopnames is oor die algemeen vinnig en makliker om uit te voer as grondopnames en word vir verkenning gebruik. Sommige tegnieke (soos seismies, elektriese weerstand en magnetotelluriese) kan egter nie deur n lugopname verkry word nie, aangesien die energiebronne en detektors in direkte kontak met die grond of water moet wees. Grondopnames word gewoonlik gedoen om te fokus op areas van belang wat gekies word uit die studie van swaartekrag in die lug, magnetiese, radiometriese en elektromagnetiese data. Grondopnames kan stadig en duur wees en kan uitgebreide mannekrag vereis tydens veldwerk. Hulle verskaf egter data van beter gehalte omdat die instrumente nader aan die geteikende geologie is. Daar is gevalle waar grondopnames as nie haalbaar geag word nie. Byvoorbeeld, waterliggame of harde topografiese variasies verskyn as struikelblokke. Lugopnames, daarteenoor, is koste-effektief as die gebiede wat gedek word groot genoeg is sodat die koste per datapunt effektief verminder word. Boonop kan in baie toepassings lugopname data nie ruimtelike resolusie hê nie en sal meer gedetailleerde opnames vereis word.

3.3 **Aktiewe vs passiewe geofisiese metodes**

Geofisiese metodes kan óf aktief wees (d.w.s. gebruik beheerde mensgemaakte energiebronne), óf passief (d.w.s. gebruik natuurlike bronne soos vibrasies wat geproduseer word deur seegolwe wat teen die kus breek, of onbeheerde mensgemaakte bronne soos verkeersgeraas). Die mensgemaakte of natuurlike bron-gegenereerde seine (d.w.s. data-verkryging) word in die veld gemeet deur gespesialiseerde sensitiewe detektors, en verwerk in die veld/kantoor (d.w.s. om 'ongewenste inligting' of 'geraas' te verwyder). Die uitset word geologies vertoon en geïnterpreteer (d.i. die diepte, grootte en eienskappe van die teikens bepaal) deur gebruik te maak van gevorderde rekenaartegnieke vir verdere analise en evaluering. Voorbeelde van passiewe metodes is seismiese omgewingsgeraastomografie, magnetotelluriese, swaartekrag- en magnetiese metodes, terwyl voorbeelde van aktiewe metodes seismiese refleksie, EM en elektriese weerstand insluit.

3.4 **Algemene geofisiese verkenningswerkvloei**

Die tipiese geofisiese verkenningswerkvloei begin met die terreinbesoek, fisiese eiendommetings, opnamebeplanning en -ontwerp (dikwels in die kantoor gedoen), terreinbesoeke weer vir veldproewe, data-verkryging (in die veld), dataverwerking (in die veld en kantoor)), data-interpretasie en geologiese modellering (in die kantoor).

4. VOORGESTELDE GEOFISIESE OPNAMES IN DIE KAROOKOM

4.1. Die werk sal drie geofisiese opnames gebruik: **landrefleksie seismiese metode (aktief en passief), magnetotelluriese (MT),** en **luggedraagde magnetiese en radiometriese opname**. Hierdie tegnieke is gekies om aan die doelwitte van die opname te voldoen, en ook omdat dit koste-effektief, nuut en omgewingsvriendelik is.

(a) Land aktiewe en passiewe refleksie seismiese opname

Die opname sal koste-effektiewe, nuwe en omgewingsvriendelike seismiese instrumente gebruik om die ondergrondse geologie van die Karookom te ondersoek.

Geskiedenis van seismiese opnames in Suid-Afrika

Die hoofdoel van seismiese eksplorasie is om inligting oor die samestelling en struktuur van die ondergrond in te samel. Refleksie-seismologie is die eerste keer in die 1930's in die VSA gebruik om olie en gas in sedimentêre gesteentes te ondersoek. In Suid-Afrika word dit sedert 1960's gebruik om te soek na olie en gas, mineraalafsettings, vir diep mynboubeplanning en -ontwikkelings, en om die diep korsstruktuur van die aarde vir navorsing en akademiese doeleindes te ondersoek. Dit sal dus nie die eerste 2D seismiese opnames in die Karoo of in Suid-Afrika wees nie. Trouens, die mynbedryf in Suid-Afrika gebruik die tegniek om mynbouverwante risiko's te versag en ertshulpbron-evaluering te verbeter.

- **Hoe werk die refleksie seismiese metode?** ’n Opname behels die opname van die vibrasies en golwe in die aardkors. Seismiese opnames kan óf aktief óf passief wees. Byvoorbeeld, in 'n aktiewe seismiese opname sluit mensgemaakte beheerde bronne soos dinamiet of meganiese vibrators in, terwyl 'n passiewe seismiese opname die energie gebruik wat afkomstig is van natuurlike bronne soos aardbewings, padverkeer geraas, nywerheid en menslike aktiwiteit, wind en seegolwe. Die gegenereerde golwe beweeg deur die aarde en word gebreek en weerkaats by grense tussen gesteentes wat verskillende fisiese eienskappe het. Soos hierdie golwe na die oppervlak terugkeer, word die grondbeweging deur gespesialiseerde sensors (bekend as geofone) aangeteken. Die inligting word ontleed (verwerk) en die uitset word geïnterpreteer sodat 'n gedetailleerde prentjie van die struktuur en samestelling van die ondergrond kan skep kan word.

- **Waar sal die data verkry word?** Die data sal langs die openbare paaie verkry word.

- **Watter metode sal gebruik word?** Die metode sal beide passiewe en aktiewe seismiese metodes gebruik.

- **Watter instrument sal as 'n aktiewe energiebron gebruik word?** 'n Vibroseis-vragmotor sal gebruik word om energie met 'n interval van 20 m aan die rand van die pad langs op te wek. Die vibroseis-vragmotor is verkies omdat dit beter diepte van penetrasie en kwaliteit data verskaf, maar ook 'n laer omgewingsimpak het in vergelyking met impulsiewe bronne (valhamer, versnelde gewigsval) en plofstof (skote).

- **Wat is 'n vibroseis-vragmotor?** Dit is 'n voertuig wat gebruik word om seismiese seine te genereer. In teenstelling met ouer tegnologieë wat plofstof (skote) gebruik, genereer die vibroseis-voertuig kunsmatige seismiese golwe deur meganiese vibrasie. Die voertuig is toegerus met 'n vibrator (vibroseis-bron) wat in kontak is met die grondoppervlak. Die vibrator genereer beheerde vibrasies met verskillende frekwensies en amplitudes. Hierdie vibrasies versprei ondergronds as seismiese golwe en reflekteer na die oppervlak waar die energie-intensiteit van die gereflekteerde golwe op oppervlakgeofone (sensors) aangeteken word. Met die vibroseis-vragmotor het die operateur beheer oor die seismiese energie en frekwensies wat in die grond uitgestraal word.

- **Wat is die tegniese parameters van die vibroseis-vragmotor wat vir Karoo voorgestel word**: P-golfvibrator, frekwensiebereik: 10-150 Hz, Piekkrag: 278 kN / 62 400 lbf, hou gewig: 28 294 kg / 63 610 lb, lengte: 10,64 m; breedte: 3,42 m; hoogte: 3,22 m.

- **Wat is die impak en risiko's verbonde aan die seismiese opname?** Die opnames is langs die openbare paaie ontwerp om die omgewingsvoetspore van die vibrerende seismiese vragmotor te verminder. Voor seismiese opnames sal terreinbesoeke uitgevoer word as deel van die omgewingsimpakbepaling en prosesse vir betrokkenheid van belanghebbendes om enige potensiële risiko vir infrastruktuur en die omgewing wat deur die vibrerende vragmotor veroorsaak kan word, te identifiseer. As 'n potensiële risiko geïdentifiseer word, sal die vibrasiepunt (VP) na 'n meer geskikte posisie geskuif word, of slegs passiewe seismiese data sal in daardie gebiede ingesamel word, wat nie die gebruik van die vibroseis-vragmotor vereis nie.

- **Watter opnamestelsel sal gebruik word?** Die opname sal die nuutste draadlose (kabelvrye) nodale tegnologie gebruik. Hierdie tegnologie is gekies om enige omgewingsimpak wat kan voortspruit uit die ontplooiing van kabels oor die paaie en die dra/vervoer van 'n groot volume

kabels in moeilike grondterrein te verminder en te risiko en te minimaliseer. Die opname sal ook die seismiese landstroomer gebruik. Die ‘landstreamer’ is 'n reeks geofone wat op die gordel geheg is wat agter die vibrerende vragmotor ingesleep kan word sonder dat dit nodig is om geofone op die grond te installeer, wat dus enige beoogde omgewingsvoetspoor verminder.

- **Hoe is die seismiese opname ontwerp**: Sensors (10 Hz geofone) sal met 20 m intervalle in die veld geplaas word en die vragmotor sal energie in die veld opwek langs paaie om te verhoed dat die pad versper word. Die landstreamer sal agter die vragmotor getrek word.

(b) Magnetiese en radiometriese lugopnames

- **Hoe werk 'n magnetiese/radiometriese lugopnames?**'n Lugmagnetiese/radiometriese opname word uitgevoer met behulp van 'n vliegtuig met 'n aangehegte magnetometer en geïnstalleerde spektrometer. Terwyl die vliegtuig vlieg, meet en teken die magnetometer die totale intensiteit van die magnetiese veld by die sensor aan. Hierdie meting sluit die verlangde magnetiese veld in wat deur die aarde gegenereer word, asook klein variasies as gevolg van die voortdurend wisselende sonwind en die magnetiese veld van die opnamevliegtuig. Verskillende rotstipes en grondsoorte het verskillende inhoud van magnetiese en radioaktiewe minerale, so die data laat visualisering van die geologiese struktuur van die boonste kors toe, veral waar grondgesteente deur oppervlaksedimente, grond of water verduister word.

- **Hoe gaan die opname in die Karoo uitgevoer word?** Aeromagnetiese/radiometriese opnames sal op 'n ko-ordinaatnetbasis langs opnamelyne met verdere loodregte (bind)lyne gevlieg word. Data sal verkry word teen 1 km lynspasiëring, en die vlughoogte sal 50 m gemiddelde terreinvryhoogte bo grondvlak wees. Data sal met die vliegtuig in die veld ingesamel word, verwerk (verwydering van ongewenste inligting) en in die kantoor geïnterpreteer word met behulp van gevorderde rekenaarstelsels.

- **Enige risiko's en omgewingsimpak verbonde aan hierdie opname?** Die opname sal deur 'n hoogs ervare kontrakteur uitgevoer word. Die belangrikste risiko's verbonde aan die opname sluit in verlies van radarkontak met die vliegtuig, botsing met topografie of infrastruktuur, en skielike veranderende weerstoestande. 'n Volledige projekrisiko-evaluering vir die opnameblok wat gevlieg moet word, sal verskaf word, dit sal bygewerk word na 'n verkenningsvlug van die opnamegebied ten einde bykomende/ongeïdentifiseerde risiko's of kwessies soos landelike ontwikkeling, terrein, kraglyne en kommunikasie-antennas te identifiseer. Behoorlike oorweging sal gegee word aan gevaarlike struikelblokke soos kraglyne, kommunikasie-

antennas, bome, mynhoofdeksels, geboue, ens. Veiligheidstelsels (insluitend radar-/laserantennas, laai van bestaande infrastruktuur, ens.) is in plek wat verseker dat die kontrak gespesifiseer word minimum terreinvryhoogte word nie tydens die opname oortree nie. Die vliegtuig is toegerus met gevorderde weerwaarskuwingstelsels, 24/7 regstreekse opsporing via radar en kommunikasieradio's, in kontak nie net met lugverkeerbeheer nie, maar met operasionele sentrums op die grond.

(c) Magnetotelluriese (MT) opnames

- **Oor die metode**: MT is 'n passiewe geofisiese metode wat natuurlike elektromagnetiese velde gebruik om die elektriese geleidingstruktuur van die aarde van honderde meter tot honderde km diepte onder die grondoppervlak te ondersoek. Die nie-vernietigende aard van die MT, benewens goeie resolusie wat dit verskaf, was die hoofrede agter sy keuse vir die Karoo-opname.

- **Watter tipe data sal aangeteken word?** Audio Magnetotelluric (AMT) en Breëband Magnetotelluric (BBMT). Die verskil tussen die twee opnames is die tipe magnetometer wat gebruik word en die hoeveelheid opname tyd.

- **Waar sal die data ingesamel word?** Die data sal vir etlike dae langs die seismiese profiele (op die rand langs die pad) ingesamel word met behulp van gespesialiseerde MT-instrumente (bv. elektrodes en magnetiese sensors wat geïnstalleer/begrawe sal word vir deurlopende data-opname van die data). Die instrumente sal geïnstalleer word (30 cm diep begrawe) op 1-2 km uit mekaar uit langs die seismiese profiele. Die data sal verwerk word (verwydering van geraas) en geïnterpreteer (inversie) met behulp van sagtewarepakkette om finale 3D aarde ondergrondse modelle te produseer.

- **Enige omgewingsimpak wat verband hou met MT-opname?** Geen omgewingsimpak of infrastruktuurskade word verwag nie.

4.2. Tydens die seismiese opname sal vibratorvragmotors as 'n energiebron gebruik word. Draadlose ontvangers sal op die grondoppervlak, aan die rand van paaie, geïnstalleer word om die data te ontvang en op te teken. Geen steurings aan grond en infrastruktuur word verwag nie en enige impak op mense tydens bedrywighede sal na verwagting minimaal tot nul wees. 'n Omgewingsimpakbepaling vir die gebiede van opname sal as deel van die projek uitgevoer word.

4.3. Die verwagte waarde wat uit die opname-ondersoek verkry moet word, sluit in:

- Lewering van 'n nuwe reeks hoë-resolusie refleksie seismiese data en beelde van die ondergrond vir die doeleindes van geologiese interpretasie.
- Lewering van 'n nuwe reeks hoë-resolusie magnetiese, radiometriese en grond magnetotelluriese data oor die gebied van ondersoek om die seismiese interpretasie te ondersteun. Magnetiese data sal magnetiet-draende plate en dyke beeld; magnetotelluriese data sal elektries geleidende geologiese formasies, verskuiwings en dyke afbeeld.

4.4. Die data en inligting wat gelewer word, sal geïntegreer word om 'n gedetailleerde interpretasie van ondergrondse struktuur, dikte en indringingsdigtheid te verskaf, wat nie moontlik is met bestaande verouderde seismiese data aan land nie.

4.5. Dit sal 'n vermindering van onsekerheid van die geologiese risikoparameters, streeksteikenidentifikasie en koolwaterstofbewaring van stollingsindringing moontlik maak. Daar word dus in die vooruitsig gestel dat die nuwe data bydra tot die aansporing van nuwe petroleumeksplorasieaktiwiteit en die ontwikkeling van Suid-Afrika se aanlandige petroleumhulpbronne versnel.

4.6. Opnameresultate sal ook die geo-omgewingsbasislyn navorsings inisiatiewe wat tans uitgevoer word, inlig, soos implementering van 'n grondwatermoniteringsnetwerk, boorgatrisiko-integriteitbeoordelings en seismisiteitmoniteringsnetwerk.

4.7. Die studie sal help met die identifisering en afbakening van gebiede wat uit 'n omgewingsoogpunt te riskant kan wees en dus uitgesluit moet word van skaliegasontwikkeling.

4.8. Wat infrastruktuur betref, word die voorgestelde opnamegebied bedien deur 'n padnetwerk wat bestaan uit beide hoofweë en hoofpaaie wat deur die Suid-Afrikaanse Nasionale Padagentskap besit en onderhou word. Verder is die gebied binne 100-400 km van lug- en seehawens van Kaapstad, George (lughawe), Mosselbaai (seehawe), Oos-Londen (lug- en seehawens), Ngqura (seehawe), Port Elizabeth (lug- en seehawens) en Durban (lug- en seehawens). Die Ngqura (Coega) Nywerheidsontwikkelingsone (IDZ) is een van die geselekteerde terreine vir die ontwikkeling van 'n 1000MW Gas-tot Kragstasie. Die grond binne die omskrewe gebied bestaan uit grond in staatsbesit, plaasgrond in private besit, meentgrond en gemeenskaplike grond wat deur stamowerhede bestuur word. Die

geïdentifiseerde sensitiewe gebiede soos Nasionale en Provinsiale parke en vleilande word by die ondersoek uitgesluit.

4.9. Die totale hoeveelheid data-verkryging, verwerking en interpretasie behels ongeveer 2 246-lyn km 2D-refleksie seismiese opnames en 21 253-lyn km magnetiese en radiometriese lugopnames, en ongeveer 2 318 magnetotelluriese stasies sal langs die seismiese profiele ontplooi word . Die data wat deur hierdie ondersoek verkry word, sal die Departement in staat stel om ingeligte besluite te neem rakende die uitreiking van eksplorasieregte in die gebied. Van belang is dat 'n omgewingsimpakbeoordeling en openbare konsultasie onderneem sal word voordat data-verkrygingsbedrywighede begin.

ISAZISO SIKARHULUMENTE

NO. ____ **UMHLA: _____**

UMTHETHO WOKUPHUHLISWA KWEZIMBIWA NEPETROLI, 2002 (UMTHETHO NOMBOLO 28 KA-2002) ("UMTHETHO")

ISIMEMO SEZIMVO EZIBHALIWEYO NGOPHANDO OLUCETYWAYO NGOKWECANDELO 50 LOMTHETHO

Mna, **SAMSON GWEDE MANTASHE**, uMphathiswa weziMbiwa nePetroli, ndimema izimvo zenu malunga nenjongo yam yokwenza uphando lokuseka ijoloji yangaphantsi komhlaba kunye nolwakhiwo lwayo ngokunxulumene nepetroli, emhlabeni okanye ngaphantsi komhlaba oboniswe **kwisiHlomelo A**, kwaye ke, ukuseka ubume kunye nobungakanani bejoloji engaphantsi komhlaba kunye nokwakheka kwayo, kunye nokuvavanya nayiphi na imingcipheko yokwakheka komhlaba. Bonke abanini abachaphazelekayo, abahlali okanye abantu abalawulayo kulo mhlaba bayacelwa ukuba banike iinkcukacha zabo ukuze kuqhagamshelwane nabo ngeenjongo zokubonisana. Uphando ekuthethwa ngalo luya kwenziwa:

(i) ekufumaneni nasekuphuculeni ulwazi olutsha lwe-2D yenyikima kummandla okanye inxalenye yawo ukuze kufunyanwe iiprofayili zala maxesha ezinezisombululo eziphakamileyo zenyikima ukuze kuphuhliswe ulwazi lwejoloji yommandla woMzantsi-mbindi weKaroo Basin; kwaye

(ii) ukufumana kunye nokwenza umngcelele omtsha wemagnethi yomoya kunye nemagneto-telluric phezu kommandla okanye inxalenye yawo ukuxhasa utoliko lwenyikima nokubeka imephu nokuphucula ukuqondwa kobume belizwe nolwakhiwo loMzantsi-mbindi weKaroo Basin.

Izimvo ezibhaliweyo kunye neenkcukacha zabanini, abahlali okanye abantu abalawula umhlaba ngokuphantsi kwesi saziso kufuneka zingeniswe ku:

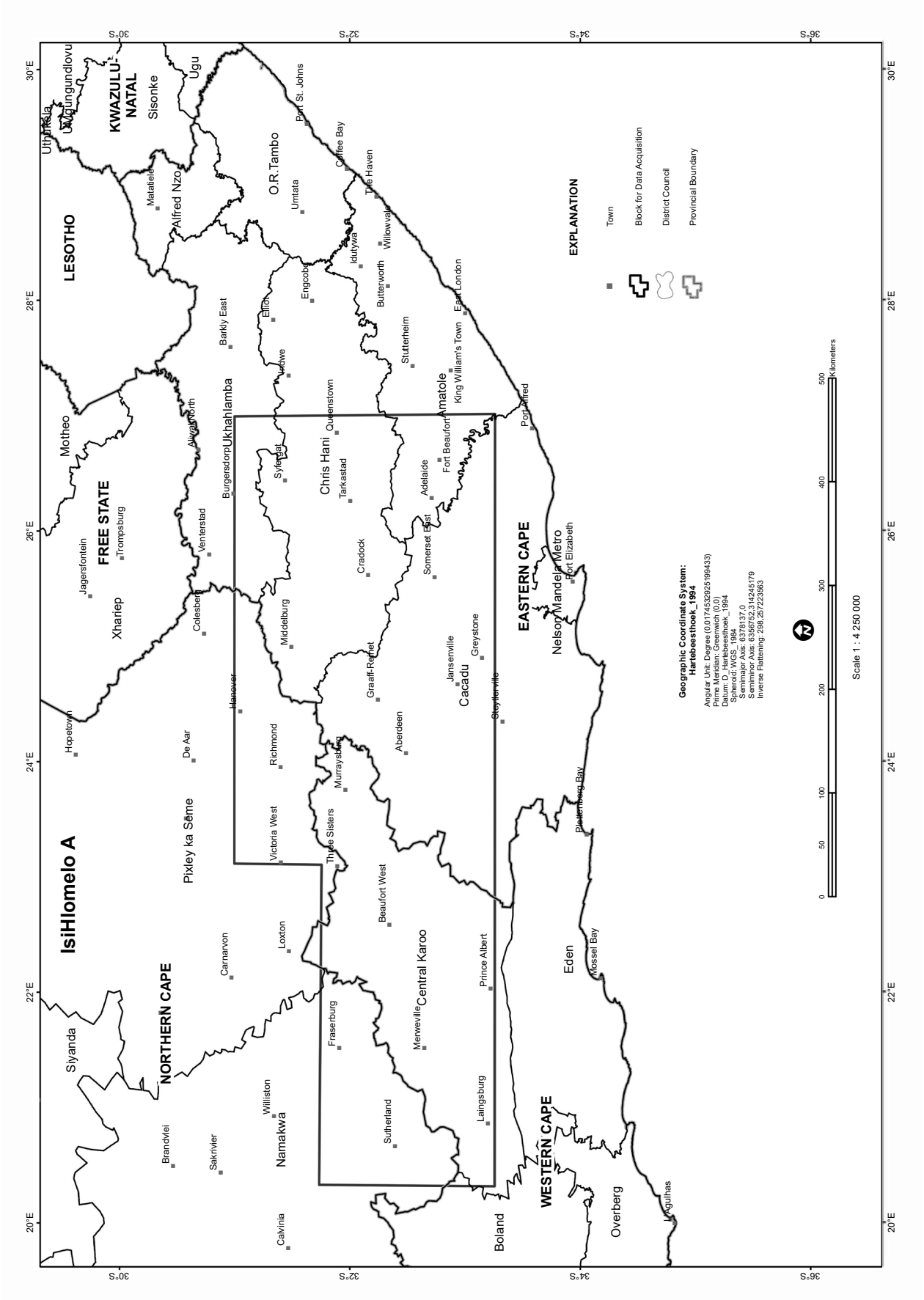
IGosa eliyiNtloko lesiGqeba
Petroleum Agency SA
Heron Place
2nd Floor, Heron Close
CENTURY CITY
7441

Ifeksi: 021 938 3500

I-imeyile: section50@petroleumagencysa.com

Izimvo ezibhaliweyo mazifike kwiPetroleum Agency SA zingadlulanga iintsuku ezingamashumi amathathu (30) ukususela kumhla wopapasho.

HON. SAMSON GWEDE MANTASHE, (MP)
UMPHATHISWA WEZIMBIWA NEPETROLI


EXPLANATION
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Block for Data Acquisition
District Council
Provincial Boundary
Geographic Coordinate System:
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Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_Hartebeesthoek_1994
Spheroid: WGS 84
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314245179
Inverse Flattening: 298.257223563
Scale 1 : 4 250 000
Kilometers
LESOTHO
KWAZULU-NATAL
FREE STATE
EASTERN CAPE
NORTHERN CAPE
WESTERN CAPE
IsiHlomelo A
Pixley ka Seme
Xhariep
Ukhahlamba
Chris Hani
Amatole
O.R.Tambo
Alfred Nzo
Sisonke
Ugu
Umzinyathi
Uthukela
Nelson Mandela Metro
Cacadu
Central Karoo
Namakwa
Siyanda
Eden
Overberg
Boland
Motheo
Port St. Johns
Coffee Bay
Umtata
Matatiele
Barkly East
Elliot
Engcobo
Idutywa
Butterworth
Willowvale
East London
Stutterheim
King William's Town
Port Alfred
Queenstown
Tarkastad
Adelaide
Fort Beaufort
Alwal North
Burgersdorp
Sydenham
Cradock
Somerset East
Jagersfontein
Trompsburg
Venterstad
Colesberg
Middelburg
Graaff-Reinet
Jansenville
Greystone
Steytlerville
Port Elizabeth
Hopetown
De Aar
Hanover
Richmond
Murraysburg
Aberdeen
Victoria West
Three Sisters
Beaufort West
Prince Albert
Loxton
Carnarvon
Fraserburg
Merweville
Sutherland
Laingsburg
Williston
Brandvlei
Sakrivier
Calvinia
Plettenberg Bay
Mossel Bay
Uitenhage
Langulhas

ULWAZI OLONGEZELELWEYO

UKUPHANDA UKWENZEKA, UHLOBO NOBUBANZI BEMITHOMBO YEPETROLI NGOKWEMIMISELO YECANDELO 50 LOMTHETHO WOPHUHLISO LWEMITHOMBO YEZIMBIWA NEPETROLI, WONYAKA WAMA-2002 (UMTHETHO ONGUNOMBOLO 28 WONYAKA WAMA-2002)

1. INJONGO

Kukuphanda ukwenzeka, uhlobo nobubanzi bemithombo yezimbiwa ngokwemimiselo yecandelo 50(1) loMthetho woPhuhliso lweMithombo yeziMbiwa nePetroli, wonyaka wama-2002 (uMthetho onguNombolo 28 wonyaka wama-2002) ("uMthetho") kummandla osemazantsi we-*Karoo Basin* njengoko kubonakalisiwe kwimephu ephawulwe njengesiHlonyelwa A (Isaziso sikaRhulumente).

2. INTSHAYELELO

2.1 Njengoko kufanelekile ngokomthetho i-MPRDA, isaziso seCandelo 50 siphunyeziwe nguMphathiswa saze sapapashwa kwiPhephandaba loMbuso (i-*Government Gazette Vol 710 No. 51138*) ngomhla wama-30 kweyeThupha ngonyakawama-2024, sivakalisa ngenjongo yoMphathiswa yokufumana uvimba weenkcukacha ezintsha malunga nobume bangaphantsi komhlaba (i-geophysical data) e-*Karoo.*

2.2 Injongo yophando olucetywayo kukufumana iinkcukacha ezintsha malunga bobume bangaphantsi komhlaba ukuze kwaziwe ubume bomhlaba namatye abonakalise ukwenzeka nobukho bamafutha (petroleum). Ukuvavanya ubungozi obunokuvela xa kuphandwa okanye kuveliswa amafutha (petroleum) yenye yenjongo zoluphando.

2.3 Ngokwembali, iinkcukacha zokubonakalisa ukunyikima komhlaba kuwo wonke ummamdla osemazantsi we-*Karoo* zafumanyaniswa yinkampani eyayisakuba yinkampani ye-oli yaseMzantsi Afrika i-SOEKOR ukususela ngonyaka we-1966 ukuya kowe-1971. Ezi nkcukacha zafumaneka ngokusebenzisa ubuchwepheshe obabukhona ngelo xesha. Umgangatho wezo nkcukacha uphantsi kangangokuba uthintela ukuvavaywa nokuphononongwa kwezi nkcukacha ngobuxhakakaxa bangoku. Kuyimfuneko ke ukuba kufunyanwe iinkcukhacha ezintsha ngokusebenzisa ubuchwepheshe nobuxhakaxhaka balimaxesha ukuvelisa imifanekiso ekumgangatho ophezulu ebonisa isimo somhlaba namatye.

2.4 Iinkcukacha ezimalunga nobume bomhlaba namatye ukusukela ngaphezukomhlaba uyokutsho emathunjini omhlaba zafumaneka ngobuxhakaxhaka obusebenzisa uphephela omncinci (i-airborne magnetic and radiometric data) yi-South African Geological Survey kunye nomlandeli wayo, neBhunga leNzululwazi ngoMlaba (i-Council for Geoscience, phakathi kweminyaka yowe-1958 nowe-1997 kuwo wonke ummandla osezantsi kwe-Karoo. Ummandla onika umdla uqukwe kumacandelo amabini wokuqala – uphando lwaseKaroo, lwenziwa phakathi konyaka we-1976 nowe-1982 kwaye luquka phantse isiqingatha sonke seli lizwe, nenxalenye, eyayiphandwe zinkampani ezahlukeneyo kwixesha elingaphezulu kweminyaka engama-30, ukuqala ngonyaka we-1958 uyokuphela kowe-1997.

2.5 Phakathi konyaka we-1965 nowe-2022 abe li-18 amaqula okuhlola agrunjiweyo kulo mmandla usezantsi kwi-*Karoo Basin*, amaninzi kuwo ubunzulu bawo bungaphezulu kwama-3000 weemitha. Onke lamaqula anqumla kumatye ane-shale eninzi arhaneleka ukuba angumthombo wamafutha nerhasi ephandwayo aziwa ngokufumaneka kwi-Permian Ecca Group.

2.6 Uvavanyo lwemveliso kunye nokuphononongwa kwamanzi kwamanye amaqula wokuhlola agrunjwe e-*Karoo* lubonisa ukubakho kohlobo lwezimbiwa ezibizwa ihaydrojin nekhabhoni. Ezi zimbiwa ziquka igesi ye-*methane* eyafunyanwa kwiqula u-CR1/68 eligrunjwe kwifama i-*Cranemere* kufutshane nedolophu i-*Pearston* ngonyaka we-1968. Igesi ihambe ukusuka kumatye akwi-*Upper Ecca Group* ngesantya se-1.83 sezigidi zomgangatho we-*cubic feet* yegesi ngosuku (MMscf/d) kwisithuba seeyure ezingama-24. Oku kubonakalisa ukubakho ukuqokeleleka kwegesi kulo mmandla we-*Karoo Basin*.

2.7 Iinkcukacha eziyimbali kunye nolwazi, oovimba bangaphakathi, kunye neenkcukacha zoluntu zingqina okokuba lo mmandla unaw amafutha nerhasii ngokomfanekiso womhlaba. Ukubakho kwegesi ngokunxulumene namatye avumela ukuhamba nokuhlala kwezinto kuwo (I-dolorite sills) kuye kwaqatshelwa kwiqela le-*Beaufort Group* nakwi-*Ecca Group* yamatye, kumaqula amanzi kunye namaqula anzulu wokuhlola ngaphandle kokubakho kwamatye avumela ukuhamba nokuhlala kwezinto kuwo (i-dolorite sills).

2.8 Iziphumo zokwakheka kwamatye nomhlaba (Geochemical) ezifumaneke kuphando lakutshanje lwegesi esemhlabeni olwenziwe kwi-*Karoo Basin* zingqina ukubakho kwegesi ye-*methane* kufutshane kwindawo apho kukho khona amanye wamaqula okuhlola nemingxuma yawo yokuhlola eyimbali. Ukubakho kwezimbiwa ihydrojini nekhabhoni ngamaqondo aphe emhlabeni ziziphumo ezitsha kwi-Karoo Basin.

3. IMVELAPHI NGOPHANDO OLWENZIWA NGAPHANTSI KOMHLABA

3.1 Yintoni uphando olwenziwa ngaphantsi komhlaba?

Uphando lwangaphantsi komhlaba lokusebenza kwendalo engumhlaba lwenzelwa ukucacisa kukwakheka kunye neempawu zoMhlaba. Ngokwesiqhelo, imilinganiselo yenziwa ngokwahlukana kwamacandelo okutsala kwamandla woMhlaba (gravitational) ngokusebenzisa uhlobo likamazibuthe (magnetic), ukuphuma kwamandla kwizinto ezifumaneka esibhakabhakeni ngokwendalo, ukuhamba kwemisinga yombane kwakunye nokuhambisa nokubonakala nokunyikima komhlaba. Uphando lokusebenza kwendalo engumhlaba lwenziwa ngokuqhelekileyo ukukhangela amanzi angaphantsi komhlaba, izimbiwa, ipetroli nemithombo yamandla ahlaziyiweyo. Olu phando lukwasetyenziselwa indlela yokuhlela nokwakha izakhiwo nobunjineli, ezifana nokuhlolwa kweziseko zamadama, ukubona izinto ezingcolisa, kunye nokuthonyalaliswa kwezinto ezinobungozi emhlabeni (geohazards). Uphando lobume bomhlaba lunokwenziwa ngaphezulu koMhlaba, kumaqula, emoyeni kusetyenziswa iinqwelo-moya, okanye elwandle kusetyenziswa iinqanawa.

3.2 Uphando olwenziwa emhlabeni xa luthelekiswa nolwenziwa emoyeni

Uphando olwenziwa emoyeni luyakhawuleza kwaye lukwalula ukulenza kunophando olwenziwa emhlabeni kwaye lusetyenziselwa uphando olufutshane. Kodwa, obunye ubuchule (obufana nobokujonga ukunyikima komhlaba, ulibaziseko lombane kunye nokusebenzisa uhlobo oluthile lomazibuthe) abukwazi ukusentyenziswa emoyeni ngoba imithombo yezamandla kunye nezixhobo ezisentyenziswayo kufuneka zithi nca emhlabeni okanye emanzini. Uphando olwenziwa emhlabeni ludla ngokwenzelwa ukugxila kummandla okhethwe ngenxa yeziphumo zophando olwenziwe emoyeni, uphando elusebenzisa uhlobo lomazibuthe, lokubala ukusebenza kwamandla ombane, kunye neenkcukhacha zamandla ombane. Uphando olwenzeka emhlabeni lusenokucotha, lubize imali eninzi kwaye lusenokunyanzelisa ukuba kusetyenziswe abantu abaninzi. Kodwa ke, olu phando lukhupha iinkcukacha ezikumgangatho ophezulu kuba izixhobo ezisetyenziswayo zikufutshane nomhlaba namatye uphando olujolise kuwo. Zikhona iimeko apho uphando olwenziwa emhlabeni luthathwe njengolungakwaziyo ukwenzeka lula nangokukhawuleza. Umzekelo, iindawo zamanzi kunye nemifanekiso yomhlaba engacacanga neyahlukeneyo ziye zibonakalise ubunziwa xa kusenziwa olu phando. Uphando olwenziwa emoyeni, kwelinye icala, alubizi mali eninziukuba ummandla lowo ubandakanyekayo mkhulu ngokwaneleyo ukuze ixabiso ngokwenkcukhacha luncitshiswe ngokubonakalayo. Ngaphezu koko, kwimeko

ezininzi iinkcukhacha ezithathwe emoyeni zinokungabonakali emfanekisweni ngesixhobo sokubona kuze kudingeke uphando olunengcaciso eyongezelelekileyo.

3.3 **Indlela yokusebenza komhlaba eyenziwe ngabantu xa ithelekiswa neyokusebenza komhlaba eyenzeka ngokwendalo**

Indlela yokusebenza komhlaba isenokubangelwa ngabantu (utsho ukuthi, isebenzisa imithombo yamandla elawulwa ngabantu), okanye yenzeke ngokwendalo (utsho ukuthi, isebenzisa imithombo yendalo efana nokunyikima okuveliswa ngamaza wolwandle xa edlala elunxwemeni, okanye umthombo ongenziwanga mntu okufana nengxolo yezithuthi). iimpawu zemithombo ezenziweyo nezendalo (utsho ukuthi, ukufumaneka kweenkcukacha) zilinganiswa ngezixhobo ezikhethekileyo ebaleni, zisetyenziswe ebaleni/e-ofisini (utsho ukuthi, ukususa 'ulwazi olungafunekiyo' okanye 'ingxolo'). Isiphumo siboniswa sicaciswe ngokomhlaba (utsho ukuthi, ukumisela ubunzulu, nobubanzi, neempawu zoko kujoliswe kuko) kusetyenziswa ubuchule obuphambili bekhompyutha ukwenza uphononongo olongeziweyo novavanyo. Imizekelo yeendlela zendalo yingxolo yokunyikima umfanekiso wendalo, umtsalane phakathi kwezinto ezimbini, umtsalane womhlaba kunye neendlela yophando esebenzisa uhlobo oluthile lomazibuthe, ngeli xesha imizekelo yendlela eyenziwe ngabantu iquka umboniso wokunyikima, i-EM, nokuxhathisa kombane.

3.4 **Ukuhamba komsebenzi wokuhlola ukusebenza kwendalo jikelele**

Umsebenzi wokuhlola ukusebenza kwendalo ngokwesiqhelo kuqala ngokutyelela isiza, imilinganiselo yobume bomhlaba, ucwangciso noyilo lokuhlola (lwenziwa e-ofisini rhoqo), utyelelo lwesiza kwakhona ukwenzela ulingo ebaleni, ukufumana iinkcukacha (ebaleni), ukusebenzisa iinkcukacha (ebaleni nase-ofisini), ukucaciswa kweenkcukacha kunye nokubukisa ukusebenza kwendalo (e-ofisini)

4. UHLOLO LOBUME BANGAPHANTSI KOMHLABA KWI-KAROO BASIN

4.1. Iindidi ezintathu zokuhlola ubume bangaphantsi komhlaba: Lo msebenzi uza kusebenzisa uhlolo lokusebenza kwendalo olundidi ntathu: indlela yokubonakalisa ukunyikima komhlaba (eyenziwe ngumntu neyenzeke ngokwendalo), ukusebenzisa uhlobo oluthile lomazibuthe (MT), kunye nohlobo olusebenzisa inqwelo moya. Obu buchule bukhethelwe ukufezekisa iinjongo zolu phando kwakunye nokubanendleko ezincinci, nokuba nendlela entsha yokuvelisa iinkcukacha ezidingwa luphando kwaye kuhambelana nokusingqongileyo.

(a) Uphando lwenyikima lelibonakalisa ukusebenza komhlaba ngokwenziwa ngabantu nokwenzeka ngokwendalo

Olu phando luza kusebenzisa izixhobo ezinendleko ezincinci, ezivelise inkcukacha ezintsha kwaye zihambelena nokusingqongileyo okuphanda ubume bangaphantsi komhlaba base-Karoo Basin.

Imbali yophando lokunyikima eMzantsi Afrika

Ezona njongo ziphambili nezingundoqo zophando lokunyikima kukuqokelela ulwazi malunga nobume kwanenkangeleko yangaphantsi komhlaba. Ukubonakalisa unyikimo lwaqala ukusetyenziselwa ukuhlola amafutha kunye nerhasi kuhlobo lwamatye enzeka ngokwalekana kwezinto eziphulayo kwanye nezimbiwa eMelika kwiminyaka yowe-1930. Olu hlobo lophando luqale ukusetyenziswa EMzantsi Afrika kwiminyaka yowe-1960 ukukhangela amafutha nerhasi, izimbiwa, nocwangciso nophuhliso olunzulu lwezimbiwa, kunye nokuphanda ulwakhiwo olunzului loqweqwe loMhlaba wophando-nzulu neenjongo zezemfundo. Ngoko, olu ayizokuba luphando lokuqala lokunyikima lwe-2D e-Karoo okanye eMzantsi Afrika. Phofu, ushishino lwemigodi eMzantsi Afrika lusebenzisa ubuchule ukuthomalalisi imingcipheko enxulumene nezemigodi nokuphucula uvavanyo lwemithombo yentsimbi.

- **Isebenza njani indlela yembonakalo yokunyikima?** Uphando luquka ukucishilelwa kweenkcukacha zokushukuma kuqweqwe loMhlaba. Uphando lokunyikima lusenokuba lolwenziwe ngumntu okanye lolwenzeke ngokwendalo. Umzekelo, kuphando lokunyikima olubangelwe ngumntu imithombo eyenziwe nelawulwa ngumntu iquka ukusetyenziswa kwesiqhushumbisi se-dynamite okanye isixhobo sokushukumisa umhlaba. Uphando lokunyikima olwenzeka ngokwendalo lusebenzisa amandla aphuma kwimithombo yendalo efana neenyikima, ingxolo yezithuthi ezisendleleni, kumisebenzi yemacandelo ezoshishino nabantu, umoya namaza wolwandle. Amaza enziweyo ahamba ngaphantsi emhlabeni kwaye arhoxiswa aze abonakaliswe kwimida phakathi kwamatye aneempawu ezahlukeneyo. Njengokuba la maza ebuyela kumphezulu womhlaba, intshukumo yomhlaba iinkcukacha zawo zicishilelwa zizivavanyi ezikhethekileyo (ezaziwa njenge-*geophones*). Olu lwazi luyahlalutywa (lusetyenzwe) zize iziphumo zicaciswe ukwenzela ukuba senze umfanekiso oneenkcukacha zokumila nokwakheka komphantsi womphezulu womhlaba
- **Zingafumaneka phi ezi nkcukacha?** Ezi nkcukacha zikufunyanwa apha ezindleleni zikawonkewonke.

- **Kuza kusetyenziswa eyiphi inkqubo?** Le nkqubo izakusebenzisa zombini iindlela zokunyikima komhlaba ngokwenziwa yindalo neendlela yokunyikima komhlaba ngokwenziwa ngumntu.

- **Sesiphi isixhobo esizakusetyenziswa njengomthombo wamandla owenziwa ngumntu?** Kuza kusetyenziswa isigadla esinyikimisa umhlaba (esibizwa *vibroseis truck*) ekwakhelwe kuso isixhobo esinyikimisa umhlaba ukuba siphehle amandla isithuba sokunqumama semizuzu engama-20 phakathi kwezihlandlo ecaleni kwendlela . Esi sigadla sikhethwe kuba sinamandla okungena nzulu kwaye sinika iinkcukacha ezingcono, kodwa sikwanempembelelo ephantsi kokusingqongileyo xa usithelekiswa nemithombo ephehla ngokungxama (ukuwisa ihamile, ukwandisa isantya ekuwiseni isixhobo sobunzima) kunye neziqhushumbisi (izithonga).

- **Yintoni isigadla esinyikimisa umhlaba (Vibroseis)?** Sisithuthi esisetyenziselwa ukuphehla iimpawu zokunyikima. Ngokuchasene nobuchule bakudala obusebenzisa iziqhushumbisi (izithonga), isithuthi sokunyikimisa (vibroseis) siphehla amaza wokunyikima okwenziweyo ngokunyikima okwenziwa ngomatshini. Esi sithuthi sixhotyiswe ngesixhobo sokunyikimisa (umthombo wokunyikimisa) esithe nca kumphezulu womhlaba. Isinyikimisi siphehla ukunyikima okulawulwayo ngamaza womoya awohlukahlukeneyo nobukhulu obukwanjalo. Oku kunyikima kwandisa amaza afana nawokunyikima angaphantsi komhlaba kwaye kubonakalisa kumphezulu womhlaba ukuba kuphi apho amandla wamaza abonakaliswa abhalwe khona ngezivavanyi ezibizwa *geophone* (izivavanyi) ngaphezulu komhlaba aqinise khona. Ngesigadla sokunyikimisa (vibroseis), umqhubi unolawulo lwamandla wokunyikima kunye namaza womoya akhutshelwa ngaphakathi emhlabeni.

- **Yeyiphi imida yobugcisa yesigadla sokunyikimisa (vibroseis) enokusetyenziswa e-Karoo:** P-Amaza onyikimo, uluhlu lwamaza omoya: 10-150 Hz, Amandla weNcopho: 278 kN / 62,400 lbf, bambela ubunzima ezantsi: 28,294 kg / 63,610 lb, ubude: 10.64 m, ububanzi: 3.42 m; ukuphakama: 3.22 m.

- **Yintoni impembelelo nemingcipheko enxulumene nophando lokunyikima?** Lonke uphando luyilwe malunga neendlela zikawonkewonke ukunciphisa impembelelo kokusingqongileyo okuvela kwisigadla sokunyikimisa. Phambi kophando lokunyikima, kuza kutyelelwa iindawo ezichaphazelekayo njengenxalenye yovavanyo lwempembelelo kwindalo esingqongileyo nenkqubo yokuthethana nabadlali-ndima ababalulekileyo ukuchonga nayiphi na imingcipheko enokubakhona kwiziseko ezingundoqo nokusingqongileyo enokubangelwa

sisigadla sokunyikimisa. Ukuba kukho umngcipheko ongakhona oye wavezwa, indawo apho ukunyikima kukhoyo(VP) iza kususwa isiwe kwindawo ifanelekileyo, okanye zinkcukacha zokunyikima komhlaba ezenzeka ngokwendalo kuphela ezinokuqokelelwa kulo mimandla, into ke leyo engazokudinga ukusetyenziswa kwesigadla sokunyikimisa (vibroseis truck).

- **Kuzakusetyenziswa eyiphi inkqubo yokushicilela iinkcukacha ezizakusetyenziswa?** Olu phando luza kusebenzisa ubuchwepheshe bale mihla obungasebenzisi zingcingo (obungadingi ntambo zambane). Obu buchwepheshe bukhethelwe ukunciphisa umngcipheko nokwehlisa izinga layo nayiphi na impembelelo kokusingqongileyo obunokukhokelela ekusetyenzisweni kweentambo zombane kwimimandla yomhlaba enobunzima. Uphando luza kusebenzisa umsinga womhlaba wokunyikima. Umsinga womhlaba luluhlu lwezivavanyi ezibizwa i-*geophones* ezihlonyelwe kwibhanti enokurhuqwa ngasemva kwesigadla esisinyikimisi ngaphandle kwesidingo sokufaka izivavanyi ze-*geophones* emhlabeni, ngalo ndlela kunciphe nakuphi na ukuphazamiseka kokusingqongileyo okulindelekileyo.

- **Uphando lokunyikima luyilwe njani:** Izivavanyi (10 Hz i-*geophones*) zizakubekwa kumakhefu wemizuzu engama-20 ngaphandle endleleni kwaye isigadla sizakuphehla amandla ngaphandle kwendlela ecaleni kwayo ukuphepha ukuba ngumqobo endleleni. Umsinga womhlaba uza kutsalwa ngasemva kwesigadla.

(b) Uphando lwempembelelo yokutsalana (magnetic) nolokubala amandla ombane olwenzeka emoyeni (radiometric)

- **Lusebenza njani uphando lwempembelelo yokutsalana nolokubala amandla ombane olwenzeka emoyeni?** Uphando lwempembelelo yokutsalana/yokubala amandla ombane lwenziwa ngokusebenzisa inqwelo-moya ehlonyelwe isixhobo sokuvavanya ukutsalana phakathi kwezinto ezimbini i-*magnetometer* yaze yafakelwa isixhobo sokuvavanya ukusebenza kwamandla ombane i-*spectrometer*. Njengokuba inqwelo-moya ibhabha, i-*magnetometer* ilinganisa ize ibhale iinkcukhacha zobunzulu obupheleleyo bommandla wokutsalana kwisivavanyi. Lo mlinganiselo uquka ummandla onqwenelekayo wokutsalana ophehlwe eMhlabeni kwakunye nokwahlukana okuncincin ngenxa yomoya welanga owahlukeneyo warhoqo kunye nommandla womtsalane wenqwelo-moya yophando. Iindidi zamatye awohlukeneyo kunye nomhlaba zinomxholo owohlukeneyo wezimbiwa zomtsalane nokubala amandla ombane, ngoko iinkcukacha zivumela imiboniso zokwakheka komhlaba woqweqwe oluphezulu, ingakumbi kwimeko apho umaleko wamatye usithiweyo khona yintlenga yomphezulu womhlaba, ngumhlaba, okanye ngamanzi.

- **Luya kwenziwa njani uphando e-Karoo?** Uphando lwempembelelo yokutsalana/yokubala amandla ombane luya kubhabha kwigridi malunga nemigca yophando ukongeza apho neminye imigca enqumleze embindini (iqhina). Iinkcukacha ziya kufumaneka kumgama ongange-1 km yomgca, ize ukuphakama kwenqwelo-moya kube ngama-50 eemitha umgama phakathi kwenqwelo-moya nomhlaba i-Mean Terrain Clearance ngaphezulu kwinqanaba lomhlaba. Iinkcukacha ziza kuqokelelwa ngenqwelo-moya ekummandla lowo, ukuqhubeka (ukususa ulwazi olungafunekiyo) ize icaciswe e-ofisini ngokusebenzisa iinkqubo zekhompyutha ezikudidi oluphambili.

- **Ingaba ikhona imingcipheko nokuphazamiseka kokusingqongileyo ehambelana nolu phando?** Olu phando luza kwenziwa yikontraka ephume izandla ngamava enawo. Owona mngcipheko ungundoqo ohambelana nolu phando uquka ukulahleka konxulumelwano phakathi kwerada nenqwelo-moya, ungquzulwano nomphezulu womhlaba okanye iziseko ezingundoqo, kunye nokutshintsha ngesiquphe kweemeko zesimo sezulu. Uvavanyo olupheleleyo lomngcipheko weprojekthi malunga nommandla ozakuvavaywa luza kubonelelwa, oku kuza kuhlaziywa emva kokubhabha kusenziwa uphengululo lommandla wophando khona ukuze kuchongwe imingcipheko eyongezelelweyo/engabonwanga okanye imiba efana nokuphuhliswa kwamaphandle, umhlaba, iingcingo zombane kunye neempondo zonxibelelwano. Iziphazamiso ezinobungozi ezifana nengcingo zombane, iimpondo zomnxibelelwano, imithi, izinxibo zasentloko zasemigodini, izakhiwo njalo-njalo, ziza kuyinikwa ingqwalasela ebalulekileyo nefanelekileyo. Iinkqubo zokhuseleko (eziquka irada/i-eriyeli ye-*laser*, ukukhwelisa iziseko ezingundoqo ebezikhona kwangaphambili, njalo-njalo) zikwindawo eqinisekisa ukuba isivumelwano siyayicacisa eyona mvume incinci kumhlaba ayophulwa ngeli xesha lophando. Inqwelo-moya ixhotyiswe ngeyona nkqubo yezilumkiso zemoyezulu ikumgangatho ophambili, ilandelelwa ngalo lonke ixesha ngokusebezisa irada kunye nonomathotholo bonxibelelwano hayi nje ngesilawuli sezithuthi zasemoyeni kuphela kodwa zibe namaziko okusebenza emhlabeni.

(c) Uphando olusebenzisa uhlobo lomazibuthe (MT)

- **Malunga nendlela:** I-MT yindlela yokusebenza ngokwendalo esebenzisa ummandla womazibuthe abathile ngokulawulwa yindalo ukuphanda ukwakheka kokuziphatha kombane womhlaba ukususela kuma-100 emitha ukuya kuma-100 eekilomitha ubunzulu ngaphantsi komhlaba. Ubume bokungonakalisi be-MTnokongeza kwisisombululo esilungileyo esinika sona, yaba zezoona zizathu zingundoqo ekukhethweni kwale ndlela kuphando lwe-Karoo.

- **Kuya kushicilelwa oluphi uhlobo lwenkcukacha?** Isandi sohlobo lomazibuthe (AMT) kunye namaza othungelwano lwe-intanethi ohlobo lomazibuthe (BBMT). Umahluko phakathi kwezi ntlobo zimbini zokucishilela luhlobo lwesixhobo i-*magnetometer* esisetyenziswayo kunye nomthamo wexesha lokucishilela.

- **Ezi nkcukacha ziya kuqokelelwa phi?** Ezi nkcukacha ziya kuqokelelwa kunye neeprofayli zokunyikima komhlaba (encamini esecaleni kwendlela) isithuba seentsuku eziliqela kusetyenziswa izixhobo ezikhethekileyo ze-MT (umzekelo, izivavanyi ze-*electrodes* kunye nezohlobo oluthile lomazibuthe i-*magnetic* eziza kufakwa/zingcwatywe ukwenzela ukucishilelwa kweenkcukacha okuqhubekayo). Izixhobo ziya kufakwa (zingcwatywe kangangama-30 cm ubunzulu) zize zohlulwe ngomgama oyi-1-2 km phakathi kwazo ecaleni kweeprofayili zenyikima. Iinkcukacha ziya kulungiswa (kususwe ingxolo) kunye nengcaciso eguquliweyo (inguqulelo) kusetyenziswa iipakethe ze-*software* ukuvelisa iintlobo zokugqibela ze-3D zomphantsi womhlaba.

- **Ingaba ikhona na impembelelo kokusingqongileyo enxulumene nophando lwe-MT?** Akukho mpembelelo ikhoyo kokusingqongileyo okanye monakalo ulindelekileyo kwiziseko ezingundoqo.

4.2. Ngexesha lophando lwenyikima, izigadla zokunyikimisa ziya kusetyenziswa njengomthombo wamandla izamkeli ezingenazingcingo ziya kufakelwa kumphezulu womhlaba, ecaleni kwendlela, ukwenzela ukufumana nokushicilela iinkcukacha. Akulindelekanga ziphazamiso kumhlaba nakwiziseko ezingundoqo kwaye impembelelo ebantwini ngexesha lokusebenza kulindeleke ukuba ibencinci okanye ingabikho. Uvavanyo lwempembelelo kokusingqongileyo kwimimandla ekwenziwa kuyo uphando luya kwenziwa njengenxalenye yeprojekthi.

4.3. Inzuzo elilindeleke njengesiphumo soluphando iquka:

- Ukuhanjiswa koluhlu olutsha lweenkcukacha ngembonakalo ekudidi oluphezulu lokunyikima nomfanekiso womphantsi womhlaba ukwenzela injongo yokucacisa ngomhlaba.

- Ukuhanjiswa koluhlu olutsha lokusebenza olukudidi oluphezulu lomtsalane phakathi kwezinto ezimbini (magnetic) okwenzeka emoyeni, ukubala amandla ombane kunye neenkcukacha ngokutsalana phakathi kwezinto ezimbini kummandla wophando ukuxhasa ukucaciswa kokunyikima. Iinkcukacha zomtsalane phakathi kwezinto ezimbini ziza kufanekisa amatye

avumela ukuhlala nokuhamba kwezinto kuwo neqweqwe lelitye elinezinto ezinomtsalane kuwo; iinkcukacha zomtsalane phakathi kwezinto ezimbini ezakufanekisa ukwakheka kophando ngomhlaba olunezinto ezinothungelwano lombane, ukuqhekeka neqweqwe lelitye phantsi komhlaba.

4.4. Iinkcukacha nolwazi olunikezelweyo luza kudityaniswa ukuze lunikezele ngengcaciso eneenkcukacha zokwakheka komphantsi womhlaba, ubukhulu, ukuxinana kokungena, akunokwenzeka ngenkcukacha ezindala ezikhoyo zokunyikima elunxwemeni.

4.5. Olu phando luyakubangela ukuncipha kokungaqiniseki komngcipheko omalunga nophando ngomhlaba, ukuchongwa kwenjongo ephambili yommandla nokulondolozwa kwezimbiwa ezigcineke kumathanda ohlobo lelitye elithile. Ngoko ke kucingelwa ukuba iinkcukacha ezintsha zinegalelo ekukhuthazeni imisebenzi emitsha yokuhlolwa kwezimbiwa zamafutha nerhasi kwaye ikhawulezisa uphuhliso lwemithombo yamafuthai elunxwemeni lwaseMzantsi Afrika.

4.6. Iziphumo zophando zizakwazisa iphulo lophando-nzulu isiseko sokusingqongileyo kuphando ngomhlaba oluqhubekayo, olufana nokuphunyezwa kothungelwano lokubeka esweni amanzi aphantsi komhlaba, uvavanyo olugqibeleleyo lomngcipheko kunye nothungelwano lokubeka esweni inyikima.

4.7. Uphando luya kuncedisa ukuchongwa nokuchaza imimandla enokuba semngciphekweni omkhulu ngokombono wezokusingqongileyo ize ngoko ke kufanele ingaqukwa kuphuhliso lwerhasi ephuma ekuqhushumbeni kwamatye.

4.8. Ngokumalunga neziseko ezingundoqo, ummandla wophando olucetywayo uphantsi kwenkonzo yothungelwano lwendlela olwenziwa ngoohola bendlela neendlela ezinkulu ezimnikazi wazo nomgcini wazo iyi-Arhente yeeNdlela zeSizwe yaseMzantsi Afrika (SANRAL). Ukongeza apho, lo mmandla uphakathi kwe-100 – 400 km lesikhululo senqwelo-moya nezibuko laseKapa, eGeorge (isikhululo senqwelo-moya), eMosselbay (izibuko), eMonti (isikhululo senqwelo-moya nezibuko), eNgqura (izibuko), eGqeberha (isikhululo seenqwelo-moya nezibuko) naseThekwini (isikhululo seenqwelo-moya nezibuko). INgqura (Coega) uMmandla woPhuhliso wezoShishino (IDZ) sesinye seziza ezikhethiweyo zophuhliso lweSikhululo seRhasi uya kuMbane (Gas to Power Station) esi-1000MW. Umhlaba ophakathi kulo mmandla uchaziweyo uquka umhlaba kaRhulumente, umhlaba onomnikazi wabucala umhlaba wasefama, umhlaba wesisa, nomhlaba woluntu ophantsi

kolawulo lamagunya ezizwe. Imimandla ichongiweyo inobuzaza efana neepaka zeSizwe nezamaPhondo, kunye nemihlaba emanzi ayiqukwanga kolu phando

4.9. Umthamo opheleleyo wokufunyanwa kweenkcukacha, ukulungiswa, kunye nokucaciswa kumalunga nama-2 246 umgca we-km we-2D nokubonakalisa uphando lokunyikima, ama-21 253 umgca we-km wophando olwenzeka emoyeni lokutsalana kwezinto ezimbini nokubala amandla ombane, namalunga nezitishi zokuphanda ngempembelelo yokutsalana ezingama-2 318 ezizakumiselwa malunga neprofayli yokunyikima. Iinkcukacha ezifunyenweyo lolu phando zizakuvumela ukuba iSebe lithathe izigqibo ezizizo malunga nokukhutshwa kwamalungelo okuphanda kulo mmandla. Okona kubalulekileyo, luvavanyo lwempembelelo kwindalo esingqongileyo kwaye ukuthethana noluntu kuyakwenziwa phambi komsebenzi wokufumaneka kweenkcukacha.