Competent Persons Report

Tai Helium Gas Prospect

Rukwa Basin, Onshore Tanzania

Prepared For:	Helium One Global Ltd
By:	ERC Equipoise Ltd
Date:	May 2023

Independent Energy Experts

Date released to client: 19 May 2023

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19 May 2023

The Directors
Helium One Global Limited
PO Box 957
Offshore Incorporations Centre
Road Town
Tortola
British Virgin Islands

Dear Directors,

Re: Tai Prospective Helium Resources Evaluation

In accordance with your instructions, ERC Equipoise Ltd (ERCE) has evaluated the total gas and helium Prospective Resources, plus Geological Chance of Success, attributable to the Tai prospect within the licence PL 10712/2015 and PL 10713/2015, onshore Tanzania. Helium One Global Ltd (Helium One) has a 100% interest in these exploration licences.

The Effective Date of this report is 1 May 2023. For the preparation of this report ERCE was provided with data and information by Helium One up to 30 April 2023. Helium One has confirmed to ERCE that there have been no material changes with respect to the properties assessed between the effective date and the date of this report.

The June 2018 SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resources Management System (PRMS) and associated guidance notes allow for the application of PRMS principles to the estimation of non-hydrocarbon resources, such as helium. Accordingly, ERCE has applied the principles of the PRMS to the estimation of the helium Prospective Resources disclosed in this report, noting that such application is outside the scope of the PRMS. A summary of the PRMS is found in Appendix 1 of the report. The full text can be downloaded from:-

petroleum-resources-management-system-2018 (spe.org)

Use of the Report

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Disclaimer

ERCE has made every effort to ensure that the interpretations, conclusions and recommendations presented in this report are accurate and reliable in accordance with good industry practice. ERCE does not, however, guarantee the correctness of any such interpretations and shall not be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation or recommendation made by any of its officers, agents or employees.

ERCE has used standard evaluation techniques in the generation of this report. These techniques combine geophysical and geological knowledge with assessments of porosity and permeability distributions, fluid characteristics, production performance and reservoir pressure. There is uncertainty in the measurement and interpretation of basic data. ERCE has estimated the degree of this uncertainty and determined the range of gas initially place and recoverable gas volumes. In applying these procedures and tests, nothing came to the attention of ERCE that would suggest that information provided by Helium One was not complete and accurate unless where stated in this report. ERCE reserves the right to review all calculations referred to or included in this report and to revise the estimates in light of erroneous data supplied or information existing but not made available which becomes known subsequent to the preparation of this report.

The accuracy of any Prospective Resources estimates is a function of the quality and quantity of available data and of engineering interpretation and judgment. While the estimates presented herein are considered reasonable, the estimates should be accepted with the understanding that reservoir performance subsequent to the date of the estimate may justify revision, either upward or downward.

In the case of undiscovered resources (Prospective Resources) presented in this report, there is no certainty that any portion of the resources will be discovered. If discovered, there is no certainty that it will be commercially viable to produce any portion of the resources.

No site visits were undertaken in the preparation of this report.

Professional Qualifications

ERCE is an independent consultancy specialising in geoscience evaluation, engineering and economic assessment. ERCE will receive a fee for the preparation of this report in accordance with normal professional consulting practices. This fee is not dependent on the findings of this report and ERCE will receive no other benefit for the preparation of this report.

Neither ERCE, the persons responsible for authoring the report, nor any Directors of ERCE, have at the date of this letter, any shareholding in Helium One. Consequently, ERCE and the Directors of ERCE consider themselves to be independent of Helium One, its directors and senior management.

ERCE has the relevant and appropriate qualifications, experience and technical knowledge to appraise professionally and independently the assets.

The work has been supervised by Dr Adam Law, Geoscience Director of ERCE, a post-graduate in Geology, a Fellow of the Geological Society and a member of the Society of Petroleum Evaluation Engineers.

Yours faithfully

Dr Adam Law

Director, ERCE

1. Executive Summary

In 2015, Helium One acquired interests in 3,808 km^2 of exploration licences within the Rukwa, Eyasi and Balangida basins, onshore Tanzania, for the purposes of exploration for helium resources. ERCE has assessed a prospective structure identified by Helium One within PL 10712/2015 and PL 10713/2015; the Tai prospect. Helium One wishes to re-drill the Tai prospect in 2023, due to the difficulties encountered with Well Tai-1/1A, which attempted to test the prospect in 2021. A summary of the Helium One's licence interests is given in Table 1.1.

Table 1.1: Summary of Licences

Licence	Main Asset	Organisation / Group	Horizon Interest (%)	Status	Licence expiry date (Second Term)	Licence area (km^2)
PL 10712/2015	Tai Prospect	Helium One Global Ltd	100%	Exploration	17th September 2024	264.25
PL 10713/2015	Tai Prospect	Helium One Global Ltd	100%	Exploration	17th September 2024	297.58

1.1. Data Provided

ERCE has relied upon data made available by Helium One in the preparation of this report. This includes seismic data, well results, petrophysics and geochemistry reports.

ERCE has reviewed data made available to 30 March 2023 and the effective date of this report is 1 May 2023. Helium One has confirmed to ERCE that there have been no material changes with respect to the properties assessed between the effective date and the date of this report.

1.2. Work Completed

ERCE has used standard evaluation techniques in the generation of this report. These techniques combine geophysical and geological knowledge with assessments of porosity and permeability distributions, fluid characteristics, production performance and reservoir pressure. There is uncertainty in the measurement and interpretation of basic data. ERCE has estimated the degree of this uncertainty and determined the range of gas initially place and recoverable gas volumes. In applying these procedures and tests, nothing came to the attention of ERCE that would suggest that information provided by Helium One was not complete and accurate unless where stated in this report. ERCE reserves the right to review all calculations referred to or included in this report and to revise the estimates in light of erroneous data supplied or information existing but not made available which becomes known subsequent to the preparation of this report.

In the case of undiscovered resources (Prospective Resources) presented in this report, there is no certainty that any portion of the resources will be discovered. If discovered, there is no certainty that it will be commercially viable to produce any portion of the resources.

1.3. Summary of Results

ERCE has independently assessed the total gas and helium Prospective Resources, plus Geological Chance of Success (COS), for the Tai prospect. The June 2018 SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resources Management System (PRMS) and associated guidance notes allow for the application of PRMS principles to the estimation of non-hydrocarbon resources. Accordingly, ERCE has applied the principles of the PRMS to the estimation of the total gas and helium Prospective Resources, noting that such application is outside the scope of the PRMS.

The Tai prospect contains four main prospective reservoir intervals. ERCE has estimated total gas and helium Prospective Resources at the Lake Beds (A, B and C), Nsungwe, Karoo and weathered basement intervals assuming the success case will involve the charging of each prospective reservoir interval with inert gas containing concentrations of helium, which will be produced in a similar manner to a conventional hydrocarbon gas accumulation.

Table 1.2 summarises ERCE's estimates of unrisked total gas and helium Prospective Resources, both gross and net to Helium One, and the Geological Chance of Success (COS) for the prospective reservoir intervals of the Tai prospect.

Table 1.2: Total and Helium Gas Gross Unrisked Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)				COS
	1U	2U	3U	Mean	1U	2U	3U	Mean	
Lake Bed Fm A	6.1	19.3	52.2	36.2	0.09	0.37	1.19	0.55	14%
Lake Bed Fm B	7.5	19.0	44.5	23.5	0.11	0.37	1.01	0.49	14%
Lake Bed Fm C	2.6	7.1	18.0	9.2	0.04	0.14	0.41	0.19	14%
Nsungwe	6.7	17.6	42.9	22.3	0.10	0.34	0.97	0.47	14%
Karoo Sandstone	69.2	138.4	253.9	152.7	0.50	1.42	3.20	1.69	14%
Weathered/Fractured Basement	4.4	10.8	26.3	13.8	0.03	0.11	0.32	0.70	10%
Deterministic Total	**96.5**	**212.2**	**437.8**	**257.7**	**0.9**	**2.8**	**7.1**	**4.1**	

Notes

1. *Helium One's interest in the licence blocks is 100% working interest. Therefore, gross and net working interest, unrisked Prospective Resources are equal.*
2. *The Prospective Resources have not be adjusted for geological chance of success (COS). The COS is an estimate of the probability that drilling the prospect would result in a discovery as defined under SPE PRMS*
3. *In the case of Prospective Resources, there is no certainty that any gas, including helium, will be discovered, nor if discovered will it be commercially viable to produce any portion of the resources.*
4. *The June 2018 SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resources Management System (PRMS) and associated guidance notes allow for the application of PRMS principles to the estimation of non-hydrocarbon resources.*

Accordingly, ERCE has applied the principles of the PRMS to the estimation of the Prospective Resources presented here, noting that such application is outside the scope of the PRMS.

5. *Unrisked mean totals are not representative of the expected total from the prospect and assumes a success case in all reservoir intervals.*
6. *The Prospective Resources have not been adjusted for the chance of development. Quantifying the chance of development (COD) requires consideration of both economic contingencies and other contingencies, such as legal, regulatory, market access, political, social license, internal and external approvals and commitment to project finance and development timing. As many of these factors are out-with the knowledge of ERCE they must be used with caution.*

2. Licence PL 10712 & Licence PL 10713 – The Tai Prospect

2.1. Summary and Description

The Tai prospect is located in licence PL 10712/2015 and PL 10713/2015, onshore Tanzania, within the Rukwa rift, part of the western rift branch of the East African Rift System (Figure 2.1). The prospect is not located near any other helium or hydrocarbon discoveries. Satellite data and surface helium seep studies show higher than background helium concentrations in the area (Danabalan et al 2022). The Itumbula and Ivuna salt ponds located 12km from the Tai prospect contain active surface helium seeps, with measured concentrations up to 10.2% He (measured by Dr Chris Ballantine at the University of Oxford).

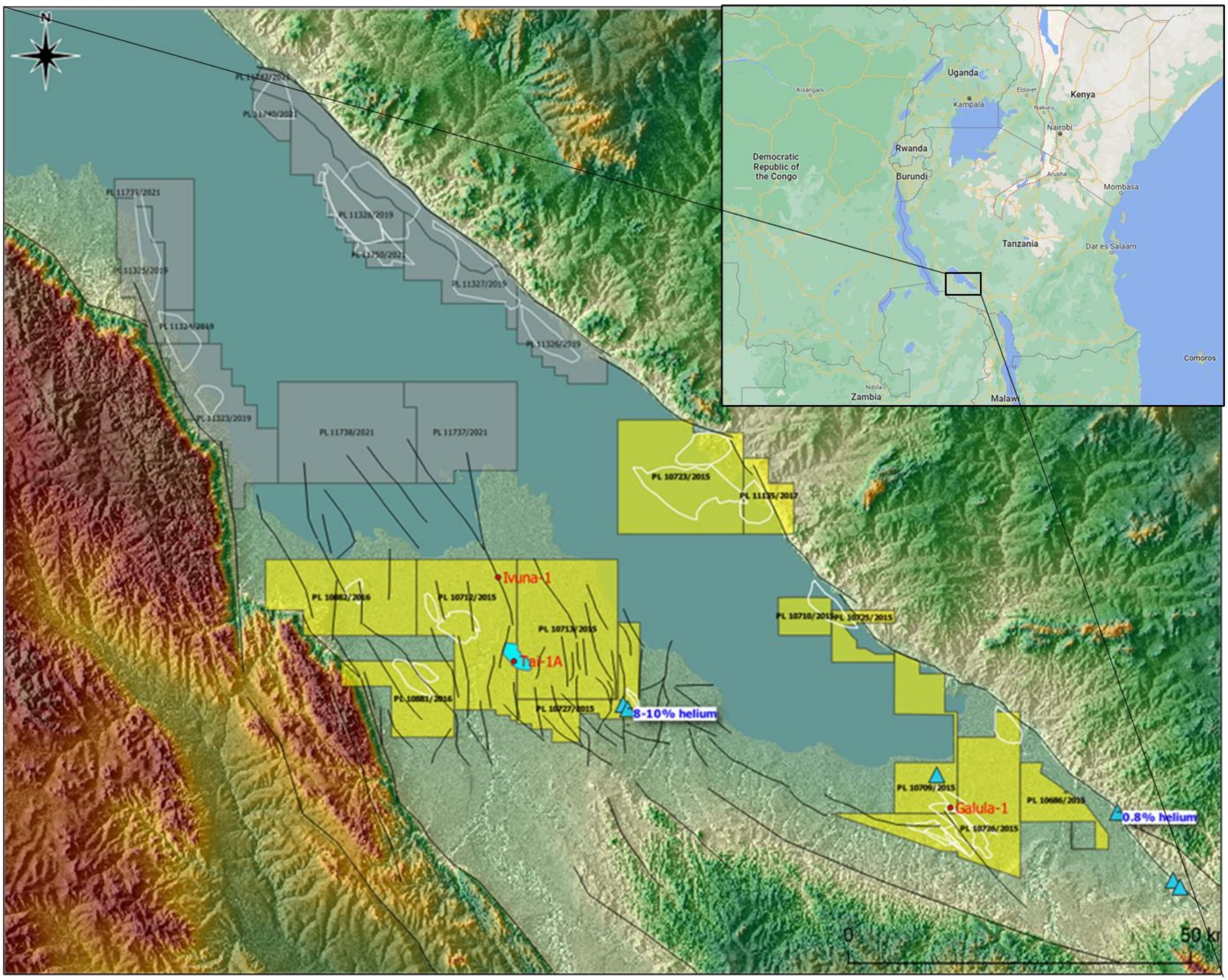

Figure 2.1: PL 10712 & Licence PL 10713 Location Map

(Source: Modified from Helium One & Google Maps)

Helium One holds a 100% interest in the licences and is Operator. The licences were awarded in 2015 and completed the second renewal period in 2022. The licences have been extended by a further 24 months and are set to expire on 17th September 2024. Table 2.1 shows the exploration activity undertaken by Helium One since 2015. Which includes the acquisition of airborne gravity data, the acquisition of infill 2D seismic data and the reprocessing of vintage 2D seismic data acquired by Amoco in the 1980s.

Several noble gas geochemistry sampling campaigns have occurred since 2015 and have recorded helium at surface. Wells Tai-1/1A were drilled in 2021 within PL10712/2015. Tai-1/1A reached a total depth of 1121 MDGL (-287 mTVDSS). Logging of Tai-1/1-A was largely unsuccessful but a QEMSCAN study was performed on the cuttings retrieved while drilling.

The proposed work program for the second renewal period is to continue Phase Two exploration drilling and desktop geoscientific analysis. In a success case at Tai-C, the program would look towards development drilling and continued geoscientific analysis.

Table 2.1: Licence Activity 2015 to 2022

(Source: Helium One)

Year	Activity
2015	Reprocess Amoco 2D seismic data AGG Falcon survey
2016	Soil gas surveys
2015-2022	Basin interpretation
2021-2022	Phase I & Phase II infill 2D seismic Seismic processing and interpretation Lead and prospect generation
2021	Phase 1 drilling Tai-1/1A QEMSCAN study DiRT Exploration
2022	ERT shallow geophysical survey Continued seismic interpretation Planning Phase 2 drilling

The trap style for the Tai prospect is a fault bounded three-way dip closure at multiple stratigraphic levels. The main prospective reservoir interval is the Karoo Sandstone which lies at a depth of ~1050 mTVDSRD (~885 m below ground level) and is Permian in age. There are three other potential reservoir intervals. The shallowest target reservoir is the Lake Bed Formation which lies at ~265 mTVDSRD in the main prospect area and is Upper Tertiary to Quaternary in age. The Oligocene Nsungwe Sands or Red Sandstone Group and is at a depth of ~640 mTVDSRD and finally the weathered basement interval is estimated to be Pre-Cambrian in age and at a depth of ~1240 mTVDSRD at the crest of the Tai structure.

Helium One attempted to drill the Tai prospect in 2021 with Well Tai-1. The well was drilled using a rig designed for mining purposes. The original Tai-1 wellbore was abandoned due to a lost drill pipe at 485 m. A re-spud, Well Tai-1A, was drilled to 1121 mMD but failed to reach basement due to deteriorating hole conditions.

Acquisition of a conventional suite of geophysical logs was attempted in Well Tai-1/1A, but only over the interval 520-860 mMD (which partially covers the Lower Red Sandstone Group and the Karoo shale). Below this depth hole conditions were poor and no logs were recorded except for Qemscan data on cuttings. No wireline logs were acquired over the Lake Bed interval as the logging unit was not mobilised in time.

Even where geophysical logs were acquired, ERCE has been unable to complete formation evaluation for Well Tai-1/1A. Interpretation of reservoir porosity is hindered by hole conditions, and no conventional water saturation can be calculated due to the lack of a valid resistivity log, as the resistivity tool was not calibrated correctly for the salinity of the mud. Although helium shows were recorded, no DSTs were performed, due to the poor hole conditions.

As a result of the inability to complete formation evaluation, ERCE attributes Prospective Resources to the prospective reservoir intervals in the Tai structure.

There are two other wells in the area, Ivuna-1 and Galula-1, that were drilled in the 1980s as part of a hydrocarbon exploration campaign. Both these wells were dry and plugged and abandoned. Geophysical log data were acquired in these wells.

2.2. Reservoir, Source and Seal Characterisation

Four reservoir intervals are identified at the Tai prospect: the Permian Karoo Sandstone, the Tertiary to Quaternary Lake Beds, which could contain multiple stacked reservoirs based on offset well data, the Oligocene Nsungwe Red Sandstones and the Pre-Cambrian weathered basement (Figure 2.2).

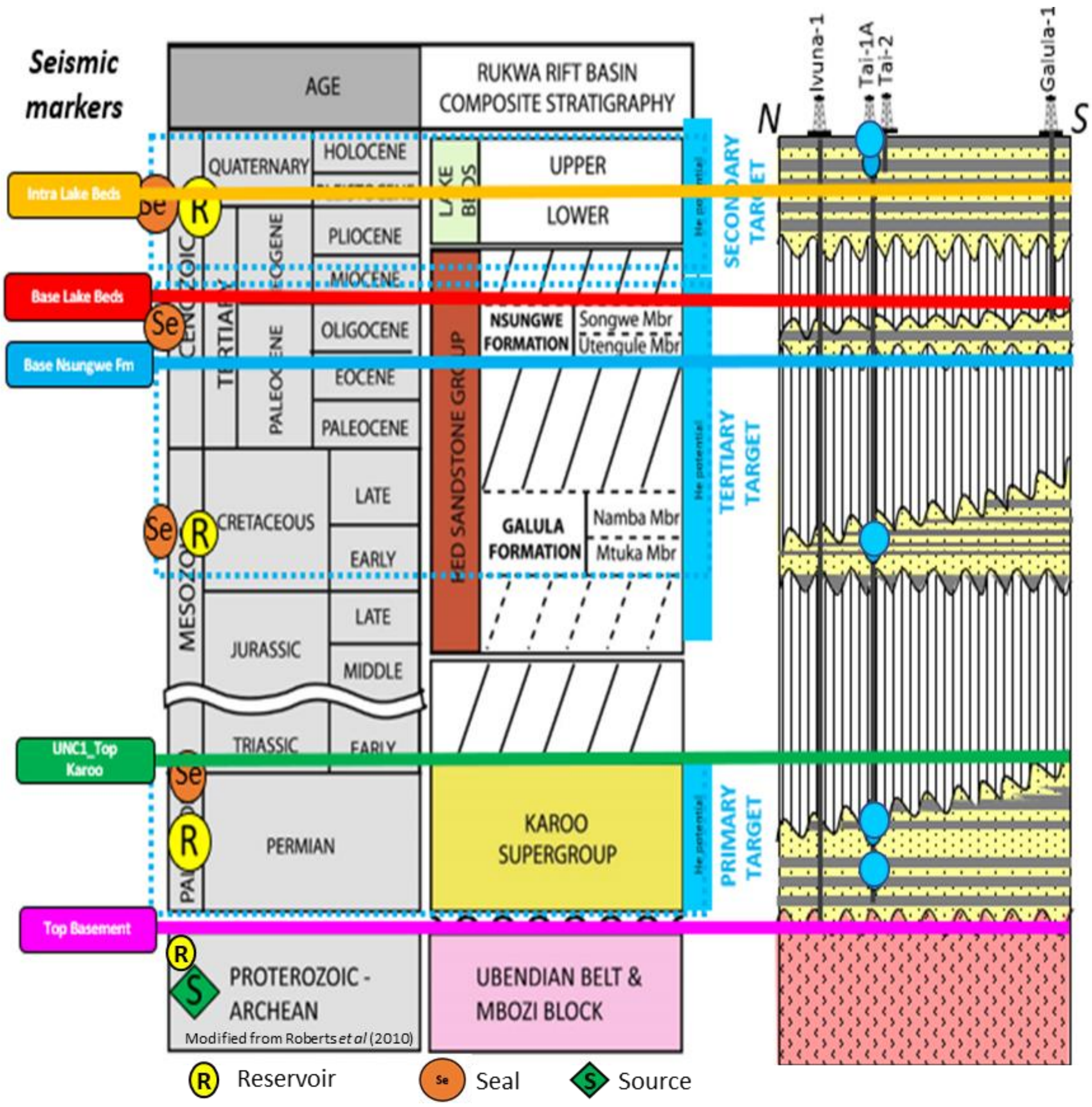

Figure 2.2: Tai Prospect, Regional Stratigraphic Column.

(Source: Helium One)

2.2.1. Karoo Sandstone Reservoir and Seal

The primary exploration target for the Tai prospect is the Karoo Sandstone. The Karoo Sandstone within Well Ivuna-1 consists of a series of coarsening up claystones, siltsones and sandstones ranging from 2 m to 30 m in thickness over a 700 m interval. In some intervals the sands are cemented and are red to brown in colour. In Well Ivuna-1 the Karoo has been interpreted to represent fluvial to fluvial-deltaic sandstones deposited within a floodplian environment.

Reservoir quality in the Karoo Sandstone in the Rukwa rift is likely to vary dependent on the environment of deposition and position within the fluvial-deltaic system.

The proposed top seal for the Karoo Sandstone is formed by shales above the Top Karoo Unconformity. Regional 2D seismic data shows the seal would likely be continuous but of variable thickness.

2.2.2. Lake Bed Formation Reservoir and Seal

The Lake Bed Formation is a stacked succession of sands and shales from various environments of deposition depending on lake level due to rifting, and has a gross thickness ranging between 100 and 300 m. Offset well data give a range of reservoir net to gross (NTG) of 25% to 90%. Observed porosities are between 25% and 30%. Regional data suggest permeabilities could have a large range from 10 mD to 1000 mD. Well Ivuna-1 encountered 700 m of Lake Bed Formation and Well Galula-1 encountered 970 m.

The seals of the Lake Bed Formation are likely to be intraformational shales.

2.2.3. Nsungwe Formation (Red Sandstone Group) Reservoir and Seal

The Red Sandstone Group of Cretaceous to Tertiary age is split into a lower and upper sequence. The Upper sequence is believed to be Neogene in age and is called the Nsungwe Formation. It is comprised of sandstones, siltstones, claystones, tuffs and conglomerates. The Red Sandstone Group thickens towards the east. Well Ivuna-1 encountered 890 m of Red Sandstone Group and Well Galula-1 encountered 556 m of Red Sandstone Group. NTG is likely to be in the range of 20% to 80% based on offset well data. Observed porosities in offset wells are between 15% and 25%. Regional data suggests permeabilities could have a large range from 10 mD to 1000 mD.

The top seal of the Nsungwe Formation is expected to be shales of the lowermost Lake Bed Formation.

2.2.4. Weathered Basement Reservoir and Seal

The weathered basement target has not been penetrated in the area. ERCE has used its experience of similar weathered basement rocks elsewhere in the world to estimate reservoir parameters. The top seal for the basement rock is expected to be shales within the Lower Karoo Supergroup. No well has drilled deep enough to encounter the basement in the region so this play is untested.

2.2.5. Helium Source Rock Potential and Migration

Conventional hydrocarbon play systems can be used to characterise a helium play system, with the elements of the play system identified as source rock, reservoir, seal and migration pathway. Figure 2.3 (after Danabalan (2017)), compares the elements of petroleum systems with those of a helium system.

Stage	Petroleum System	Helium System
Source	Organic matter	U^{238}, U^{235} and Th^{232} decay in the crust produce alpha particles
Maturation	Burial and consequential heating	Time to accumulate (stable crust) vs volume of stable crust
Primary migration	Pressure driven (phase change from solid kerogen to fluid petroleum results in volume increase)	Heating to above mineral closure temperatures, fracturing of rocks and minerals, mineral dissolution
Secondary migration	Buoyancy driven	Groundwater/buoyancy driven/stripping
Accumulation in reservoir	Beneath caprock, capillary entry pressure seal	Exsolution in presence of existing gas phase beneath caprock/degassing of oversaturated groundwater/direct input into trap of a free gas phase
Trap integrity & longevity	Microseepage, capillary failure, fracture failure, tectonic destruction of trap	Microseepage, capillary failure, fracture failure, tectonic destruction of trap

Figure 2.3: Comparison of Helium and Petroleum Systems

(Source Danabalan, 2017)

Inert gases originate from a variety of sources. Radiogenic decay and primordial helium (from the Earth's formation) are the main sources of helium (He - Mamyrim, 1984). For high concentrations of helium to be generated source rocks need to be old or especially rich in uranium and thorium, due to the rate of radioactive decay.

The play model for the Tai prospect area prognoses generation of helium by the radiogenic decay of uranium and thorium within Pre-Cambrian basement (specifically the metamorphic and granitic rocks of the Mbozi block and Ubendian belt). A specific thermal regime is required for the liberation of helium from the source rock. In the Rukwa area of the western East African Rift, upwelling of a mantle plume is the primary cause of rifting and in the play model these thermal perturbations of the stable craton have allowed the release of and migration of helium through the overlying sediments into the Tai prospect structure. The play model requires another inert gas, for example nitrogen (N_2), to also migrate into the structure and sufficient volume of nitrogen must be retained beneath or adjacent to sealing formations to form a gaseous phase, in which the helium is diffusively mixed. The origin of nitrogen in the Rukwa area is uncertain but could be related to the metamorphism of mica minerals.

Surface seep data across Tanzania are dominated by nitrogen gas (N_2 - typically 90% by volume) with helium concentrations ranging from 1 % to 10% in the area of the Tai prospect (Ballentine et al., 2017, Oxford University Seep Study, 2016). In addition, there are helium shows recorded within the gas log of Well Tai-1/1A.

2.3. Seismic Interpretation and Depth Conversion

ERCE was provided with various vintages of 2D seismic data over the Tai prospect (Figure 2.4) and associated interpreted horizons in both time and depth. ERCE has reviewed and accepted Helium One's time interpretation for the Top Karoo Sandstone, Lake Bed Formation and Top Basement. The Nsungwe Formation structural form is derived using the structure maps for the Lake Bed Formation, which is immediately overlying.

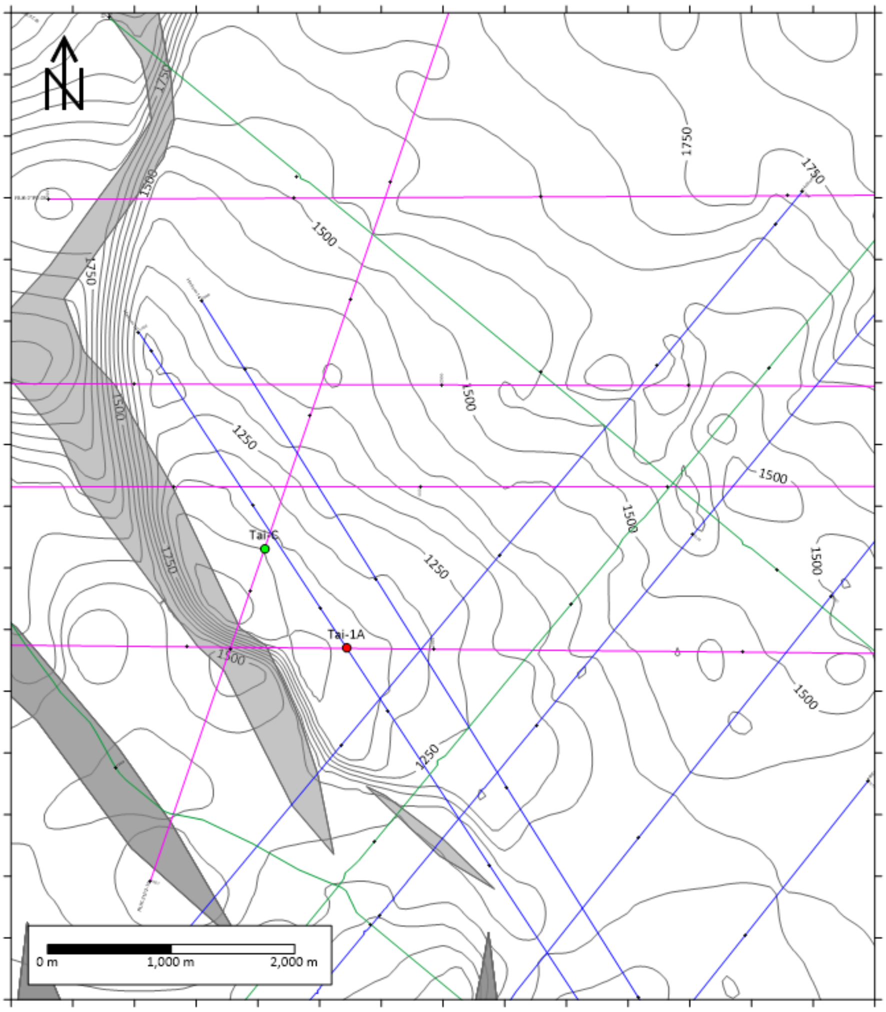

Figure 2.4: Tai prospect - 2DSeismic Line Locations

(Green= Amoco Seismic Data, Blue = Phase I Seismic data 2021 & Pink = Phase II Seismic Data 2021)

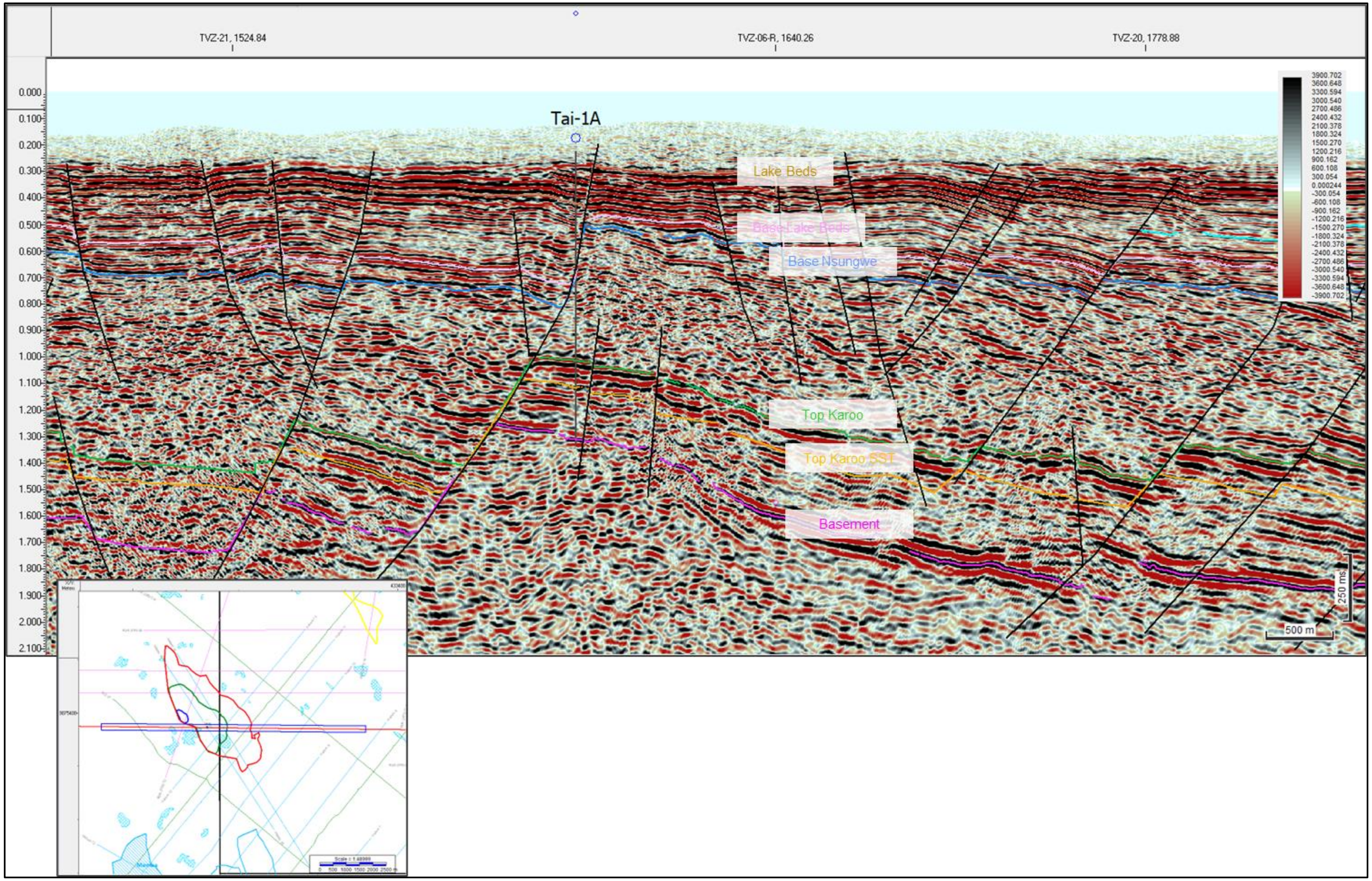

Figure 2.5: Example W-E Oriented TWT Seismic Line - Tai Prospect (Line RUK-21P2-08)

2.3.1. Depth Conversion

ERCE has carried out an independent depth conversion to estimate gross rock volumes (GRV) and areas of closure for the prospective reservoir intervals of the Tai prospect, for use in volumetric estimation. A compaction-based velocity relationship has been used, and the uncertainty in this explored to generate a range GRV and areas of closure for each prospective interval. Low and high case depth maps for each of the prospective reservoir intervals of the Tai prospect are shown in Figure 2.6 to Figure 2.8 respectively. Where ERCE considered the prospective reservoir intervals have stacked pay, an area-net volumetric estimate methodology has been used (Lake Bed A, B and C and the Nsungwe Formation). Otherwise, a GRV methodology has been used (Karoo Sandstone and Weathered/Fractured Basement). Seismic reference datum is 1100 m above mean sea level.

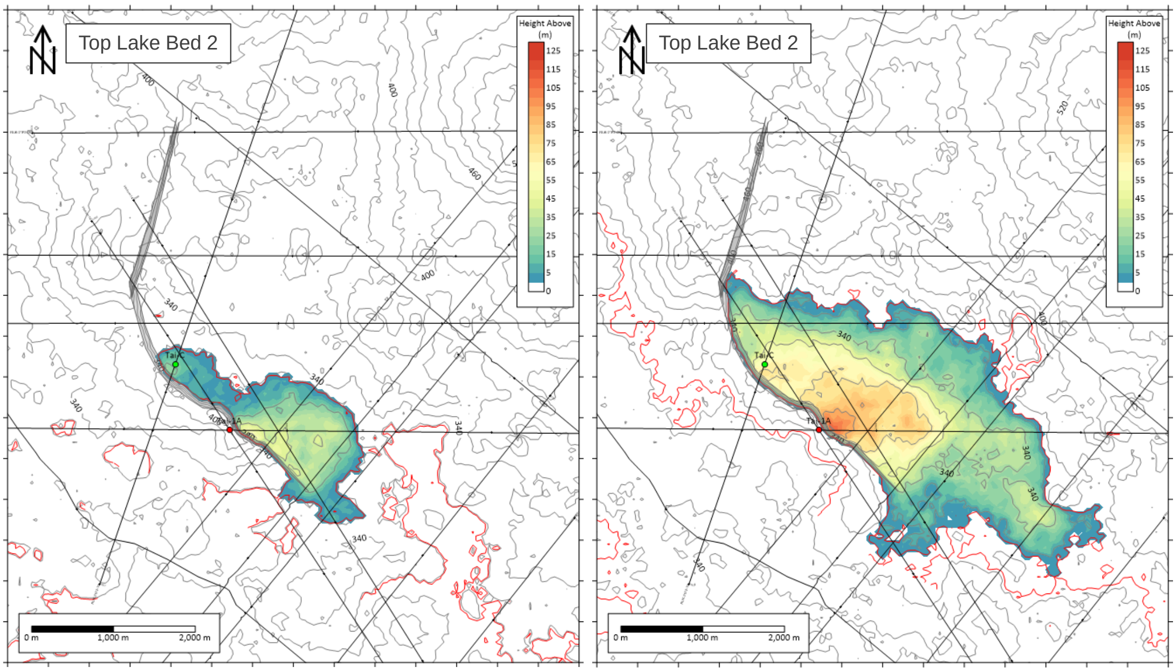

Figure 2.6: Low and High Case Depth Structure Maps (m TVDSRD), Top Lake Beds 2

Colour shading (m) shows area of closure. The location of Well Tai-1 and the planned well (Tai-C) are also shown

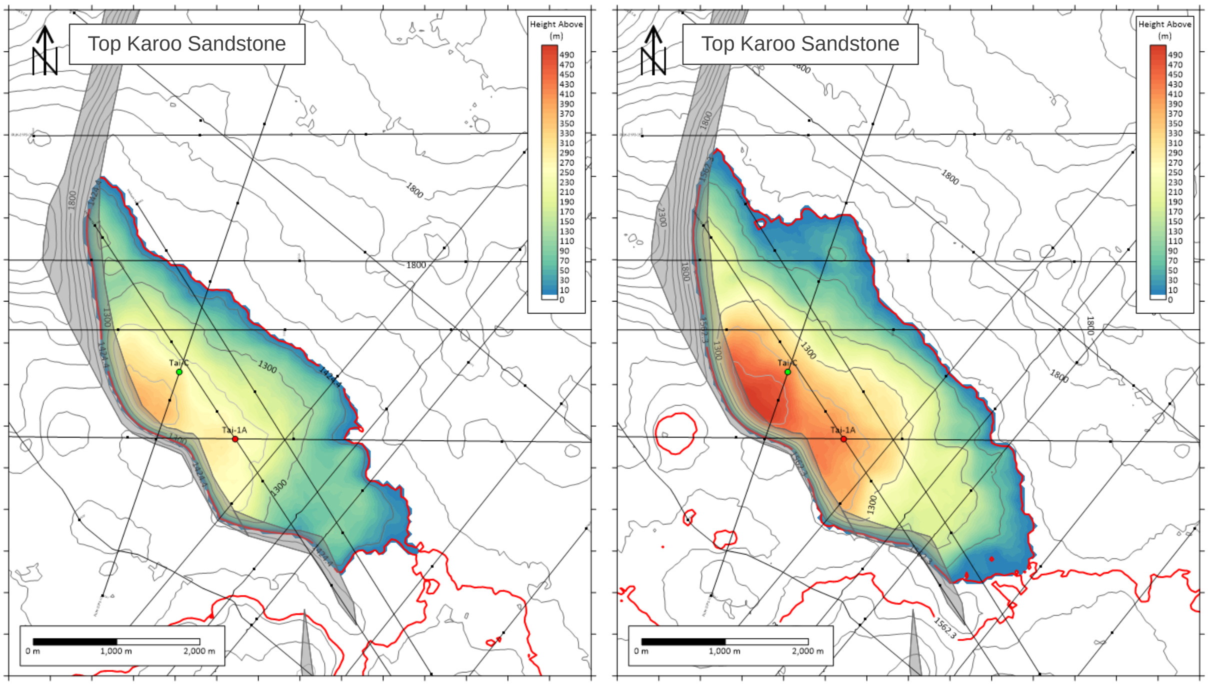

Figure 2.7 Low and High Case Depth Structure Maps (m TVDSRD), Top Karoo Sandstone

Colour shading (m) shows area of closure. The location of Well Tai-1 and the planned well (Tai-C) are also shown

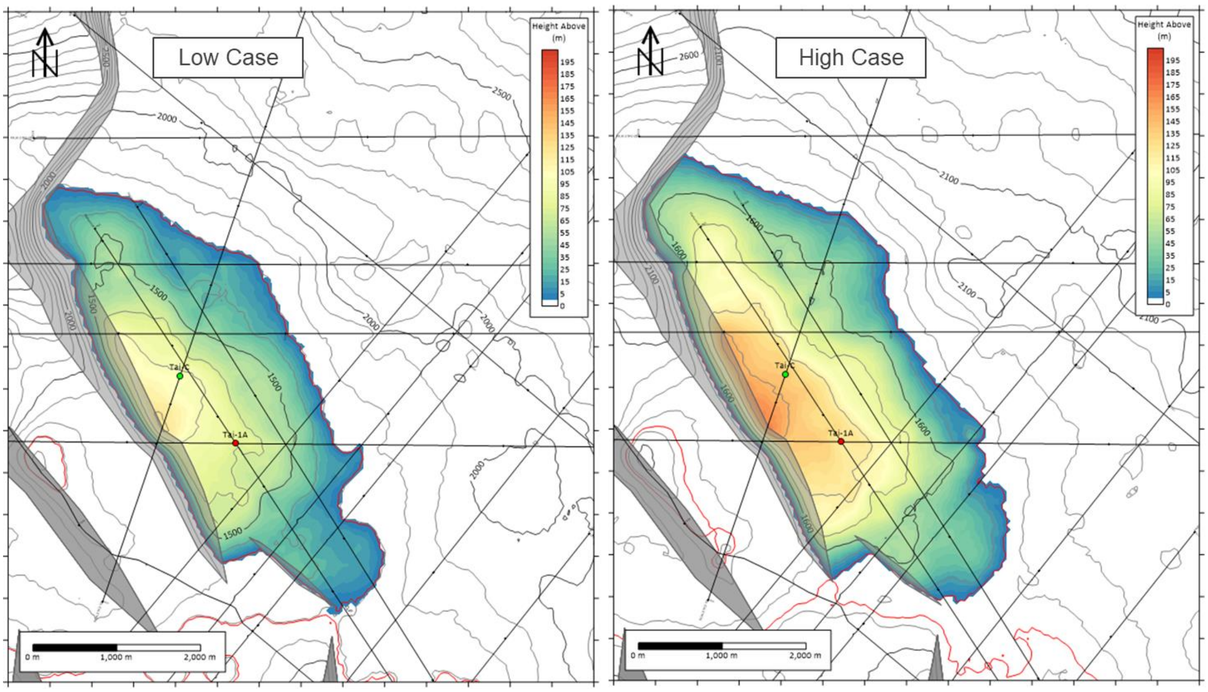

Figure 2.8: Low and High Case Depth Structure Maps (m TVDSRD), Top Basement

Colour shading (m) shows area of closure. The location of Well Tai-1 and the planned well (Tai-C) are also shown

2.4. Petrophysics

Two exploration wells, Well Ivuna-1 and Galula-1 were drilled in 1987 to explore for hydrocarbons in the Rukwa basin area. Well Ivuna-1 was drilled to a TD of 2318m and Well Galula-1 to 1525m. No significant hydrocarbon shows were reported, and the wells were plugged and abandoned as dry.

Conventional logging suites were acquired on the two wells but due to poor hole conditions only partial sections of the logs are suitable for formation evaluation.

ERCE has undertaken an independent evaluation of the geophysical logs in these wells using conventional petrophysical techniques and found the results to be in good agreement with those supplied by the Operator. Computer Processed Interpretations (CPIs) for Wells Ivuna-1 and Galua-1 are shown in Figure 2-9 and Figure 2-10 respectively.

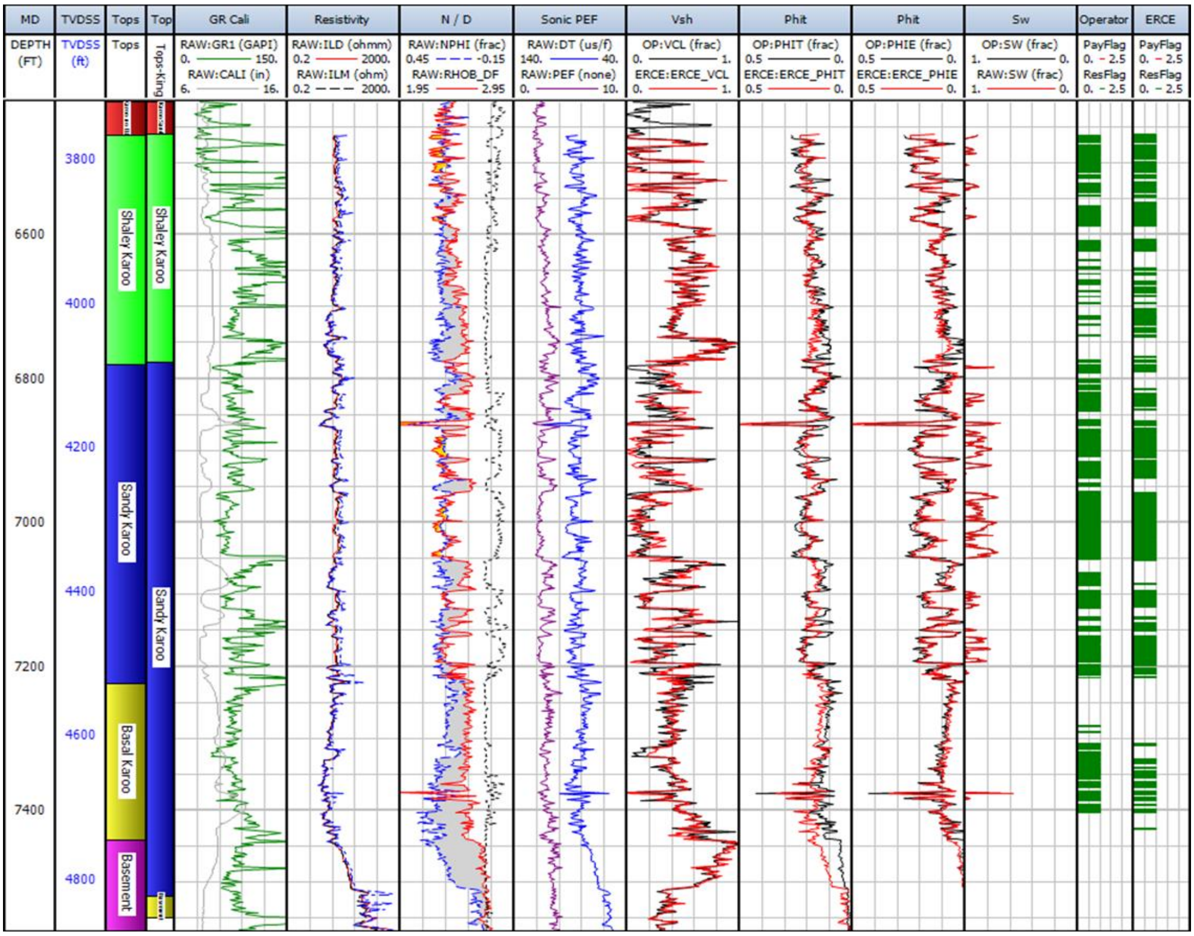

Figure 2-9 Well Ivuna-1 CPI (ERCE interpretation-red, Operator interpretation-black)

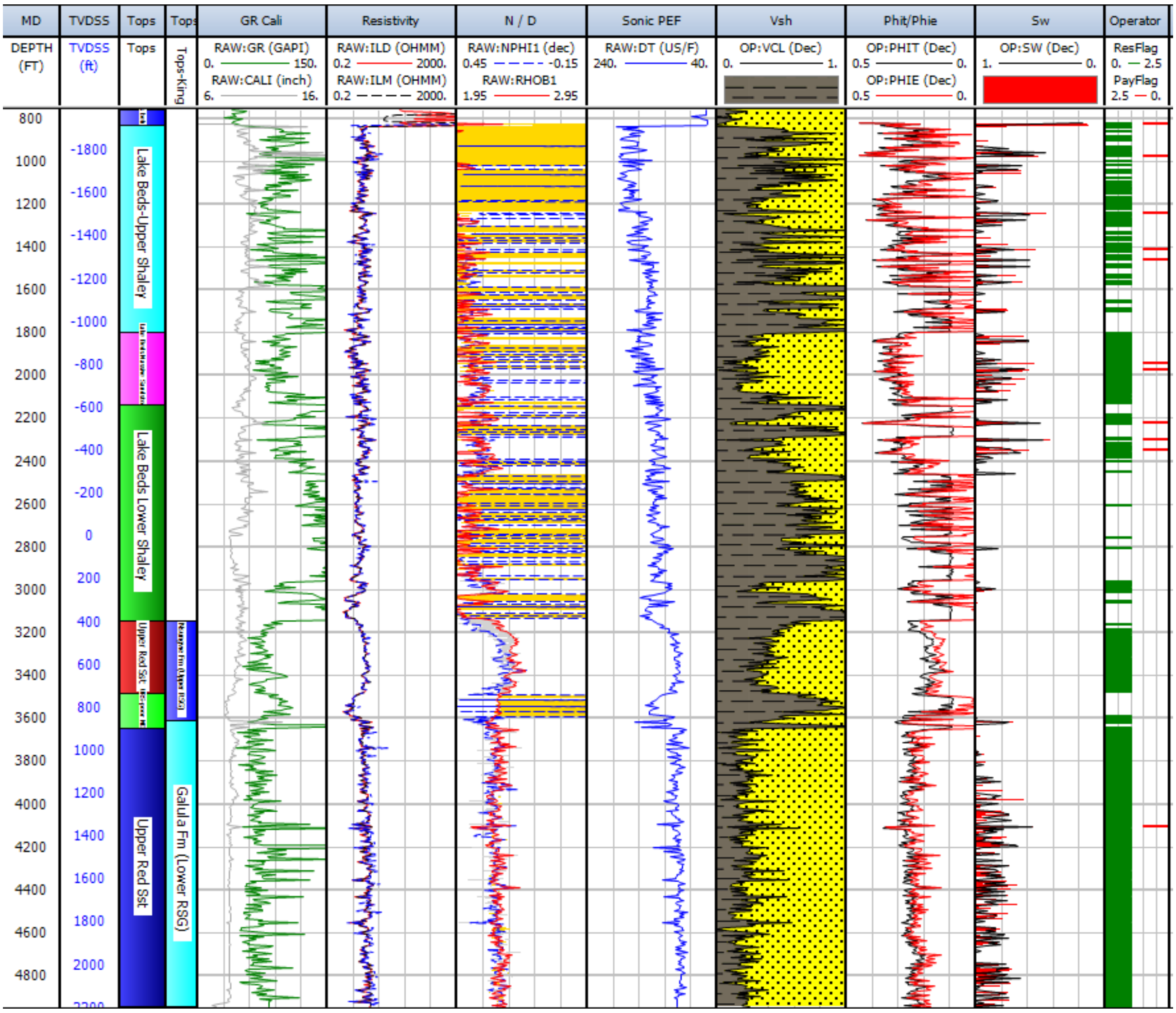

Figure 2-10: Well Galula-1 CPI

Helium One drilled exploration Well Tai-1/-1A in 2021. The original Tai-1 wellbore was abandoned due to a lost drill pipe at 485 m. Sidetrack, Well Tai-1/-1A, was drilled to 1121 mMD but failed to reach basement due to deteriorating hole conditions.

A partial suite of geophysical logs was acquired in Well Tai-1A, but only over the interval 520-860 mMD (which covers the lower Red Sandstone Group and the Karoo shale). Below this depth hole conditions were poor and no logs were recorded. Even where geophysical logs were acquired, ERCE has been unable to complete a formation evaluation for Well Tai-1A. Interpretation of reservoir porosity is hindered by hole conditions, particularly the density log, although the sonic porosity can be calibrated to match the density porosity in sections of good hole. Critically, no conventional water saturation can be calculated due to the lack of a valid resistivity log, as the resistivity tool was not calibrated correctly for the salinity of the mud.

Thus, insufficient geophysical log data were acquired in Well Tai-1/1A to enable a formation evaluation to be completed over the prospective reservoir intervals of the Tai prospect.

2.4.1. Well Tai-1/1A - Gas Indicators

Conventional gas logs and helium logs have been run throughout the drilling of the well. There are indications of concentrations of helium throughout the drilled section. Due to a pump failure, the miniReudi mass spectrometer was out of service during the drilling of Well Tai-1/-1A. Helium was solely recorded by the Geolog micro gas chromatograph.

Table 2.2 summarises helium peaks observed during drilling of Well Tai-1/-1A.

Table 2.2: Summary of Recorded Helium Peaks Observed in Well Tai-1/-1A Whilst Drilling

Zone	ppm			frac		
	Min	Av	Max	Min	Av	Max
Lake Bed Fm	214	11148	22081	0.000214	0.011148	0.022081
Nsungwe	176	1684	3192	0.000176	0.001684	0.003192
Karoo	175	366	557	0.000175	0.000366	0.000557

2.4.2. Formation Evaluation Results

ERCE has applied the following cutoffs to estimate average reservoir parameters for Wells Galula-1 and Ivuna-1: net sand is defined using a vshale cutoff of 50%, net reservoir is defined by using a 10% porosity (PHIE) cutoff. All the wells are considered to be water bearing, therefore no SWE cutoff has been applied. Table 2.3 summarises the resultant reservoir parameters by well.

Table 2.3: Sums and Averages for the Rukwa basin wells

		MD										
Well	Zone	Top MD	Base MD	Gross	Net. Sand	Net. Res.	Net/Gross	Res. Phi	Net. Pay	Pay Phi	Pay SW	H.Thick
		m	m	m	m	m			m			m
Galula-1	Lake Beds behind casing	7.8	254.5	246.7	246.0	2.7	0.011	0.313	2.3	0.343	0.284	0.6
Galula-1	Lake Beds-Upper Shaley	254.5	548.6	294.1	128.3	128.3	0.436	0.297	7.3	0.394	0.520	1.4
Galula-1	Lake Beds Massive Sandstone	548.6	652.0	103.3	95.9	95.9	0.928	0.299	2.4	0.392	0.566	0.4
Galula-1	Lake Beds Lower Shaley	652.0	959.1	307.1	73.9	73.9	0.241	0.254	3.2	0.389	0.512	0.6
Galula-1	Upper Red Sst	959.1	1062.2	103.2	83.8	82.6	0.801	0.149	--	--	--	--
Galula-1	URS-poor NEU	1062.2	1110.7	48.5	10.1	10.1	0.208	0.250	--	--	--	--
Ivuna-1	Lake Beds	312.3	665.4	353.1	124.2	0.0	--	--	--	--	--	--
Ivuna-1	Upper Red Sst	665.4	1616.4	951.0	662.0	0.0	--	--	--	--	--	--
Ivuna-1	Lower Red Sst	1616.4	1815.2	198.9	162.0	0.0	--	--	--	--	--	--
Ivuna-1	Karoo no density	1815.2	1929.8	114.6	72.8	0.0	--	--	--	--	--	--
Ivuna-1	Karoo no ILD	1929.8	1969.8	39.9	36.6	0.0	--	--	--	--	--	--
Ivuna-1	Shaley Karoo	1969.8	2067.0	97.2	55.2	41.1	0.423	0.179	--	--	--	--
Ivuna-1	Sandy Karoo	2067.0	2201.9	134.9	112.2	93.6	0.694	0.183	--	--	--	--
Ivuna-1	Basal Karoo	2201.9	2268.3	66.4	48.0	21.8	0.328	0.134	0.2	0.427	0.576	0.0
Ivuna-1	Basement	2268.3	2308.1	39.8	19.7	0.0	--	--	--	--	--	--

2.5. Reservoir Engineering

2.5.1. Gas Expansion Factors

ERCE has estimated gas expansion factors for the prospective reservoir intervals of the Tai prospect using temperature and pressure gradient from Well Tai-1/-1A. Using these gradient profiles and the estimated gas composition, Z and gas expansion factors for each interval were determined. Table 2.4 below summarises ERCE's estimates of Z and gas expansion factor per layer.

Table 2.4: Estimated Gas Expansion Factors, Tai Prospect

Depth (mMD)	Formation	Gas composition		Z	Gas Expansion factor E
		He %	N2 %		
260	Lake Bed Fm	5	95	1.00	25.31
		0.5	99.5	1.00	25.36
885	Karoo	5	95	1.02	75.22
		0.5	99.5	1.02	75.52
1100	Basement	5	95	1.03	89.62
		0.5	99.5	1.03	89.98

2.5.2. Recovery Factors

ERCE has estimated recovery factors with reference to analogue helium fields assuming that, in the success case, the prospective reservoir intervals are charged with inert gas which is diffusively mixed with helium. Reference is also made to reservoir depth, and the estimated reservoir quality expected at each of the prospective reservoir intervals. The range of recovery factor estimates also takes into account uncertainty in connected aquifer volume and hence water ingress.

ERCE has estimated a recovery factor range of 50%-65%-80% (low-best-high) for all prospective intervals.

2.6. Undiscovered Gas Initially in Place and Prospective Resources

ERCE has estimated undiscovered total gas initially in place and both total gas and helium Prospective Resources for the Karoo Sandstone, Lake Bed Formation (A, B and C), Nsungwe Formation and weathered basement reservoir units of the Tai prospect using a probabilistic methods.

ERCE has made estimates of low and high case GRV using the results of ERCE's independent depth conversion (Section 2.3.1) for the Karoo Sandstone and the weathered/fractured basement reservoir intervals. An area-net approach is used for the Lake Bed Formation and the Nsungwe Formation incorporating stacked pay (reservoir units A, B and C) within the Lake Bed Formation reservoir interval. The Nsungwe Formation lies directly beneath the Lake Bed Formation and ERCE has used the range of areal uncertainty from the Lake Bed Formation in the evaluation of the Nsungwe Formation.

ERCE's low and high case estimates of GRV or area are used to constrain the P90 and P10 of a log-normal distribution in the probabilistic simulation of undiscovered total gas initially in place.

NTG for the Karoo Sandstone and net pay for the Lake Bed and Nsungwe Formations have been estimated from offset well data. Porosity ranges have been estimated from offset well data and benchmarked against regional literature. A suitable shape factor is also estimated where area-net methods are used. Gas expansion factors are estimated as described in Section 2.5.

ERCE has estimated the total gas saturation that would be associated with the inert gas charge, to make estimates of undiscovered total gas initially in place. As no helium discoveries have been made in the area, ERCE has used available analogue data, with reference to the anticipated reservoir quality in the Tai prospect, to estimate a range of gas saturations of 50%-65%-80% in the success case.

These estimates of undiscovered total gas initially in place are combined probabilistically with the estimates of recovery factor as described in Section 2.5 to make estimates of total gas Prospective Resources for the Tai prospect. ERCE then estimates the concentration of helium within this total gas to estimate helium Prospective Resources. As no helium discoveries have been made in the area, ERCE has used available analogue data, with reference to the helium shows observed in Well Tai-1/1A.

Input parameters to and results of the probabilistic simulation are summarised in Table 2.5 to Table 2.20 for each prospective reservoir interval.

Table 2.5: Karoo Sandstone – Volumetric Input Parameter Ranges

Reservoir	GRV (MMm3)			NTG (%)			Porosity (%)			Total Gas Saturation(%)			GEF (scf/rcf)		
	Low	Best	High	Low	Best	High	Low	Best	High	Low	Best	High	Low	Best	High
Karoo Sandstone	1078	1460	1978	30	50	70	16	18	20	50	65	80	65	75	85

Table 2.6: Karoo Sandstone – Undiscovered Total Gas Initially in Place Estimates

Reservoir	Undiscovered GIIP (Bscf)			
	Low	Best	High	Mean
Karoo Sandstone	112.1	216.0	377.8	243.7

Table 2.7: Karoo Sandstone - Gas Recovery Factors and Helium Concentrations

Reservoir	Recovery Factor (%)			Helium Yield (%)		
	Low	Best	High	Low	Best	High
Karoo Sandstone	50	65	80	0.50	1.10	1.75

Table 2.8: Karoo Sandstone - Gross Unrisked Total Gas Resources and Helium Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)			
	1U	2U	3U	Mean	1U	2U	3U	Mean
Karoo Sandstone	69.2	138.4	253.9	152.7	0.50	1.42	3.20	1.69

Table 2.9: Lake Bed Formation – Volumetric Input Parameter Ranges

Reservoir	Area (km2)			Shape Factor (%)			Net thickness (m)		
	Low	Best	High	Low	Best	High	Low	Best	High
Lake Bed Fm A	2.05	4.69	7.33	40	50	60	50	105	160
Lake Bed Fm B	2.05	4.69	7.33	40	50	60	85	95	105
Lake Bed Fm C	2.05	4.69	7.33	40	50	60	25	37	50

Reservoir	Porosity (%)			Gas Saturation (%)			GEF (scf/rcf)		
	Low	Best	High	Low	Best	High	Low	Best	High
Lake Bed Fm A	25	30	35	50	65	80	15	25	35
Lake Bed Fm B	25	30	35	50	65	80	15	25	35
Lake Bed Fm C	25	30	35	50	65	80	15	25	35

Table 2.10: Lake Bed Formation – Undiscovered Total Gas Initially in Place Estimates

Reservoir	Undiscovered GIIP (Bscf)			
	Low	Best	High	Mean
Lake Bed Fm A	9.6	30.3	79.3	39.5
Lake Bed Fm B	11.9	29.6	67.7	36.2
Lake Bed Fm C	4.2	11.2	27.5	14.1

Table 2.11: Lake Bed Formation - Gas Recovery Factors and Helium Concentrations

Reservoir	Recovery Factor (%)			Helium Yield (%)		
	Low	Best	High	Low	Best	High
Lake Bed Fm A	50	65	80	0.10	2.10	3.25
Lake Bed Fm B	50	65	80	0.10	2.10	3.25
Lake Bed Fm C	50	65	80	0.10	2.10	3.25

Table 2.12: Lake Bed Formation - Gross Unrisked Total Gas Resources and Helium Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)			
	1U	2U	3U	Mean	1U	2U	3U	Mean
Lake Bed Fm A	6.1	19.3	52.2	36.2	0.09	0.37	1.19	0.55
Lake Bed Fm B	7.5	19.0	44.5	23.5	0.11	0.37	1.01	0.49
Lake Bed Fm C	2.6	7.1	18.0	9.2	0.04	0.14	0.41	0.19

Table 2.13: Nsungwe Formation – Volumetric Input Parameter Ranges

Reservoir	Area (km2)			Shape Factor (%)			Net thickness (m)		
	Low	Best	High	Low	Best	High	Low	Best	High
Nsungwe	2.05	4.69	7.33	40	50	60	115	138	160

Reservoir	Porosity (%)			Gas Saturation (%)			GEF (scf/rcf)		
	Low	Best	High	Low	Best	High	Low	Best	High
Nsungwe	0.15	0.19	0.25	50	65	80	15	25	35

Table 2.14: Nsungwe Formation – Undiscovered Total Gas Initially in Place Estimates

Reservoir	Undiscovered GIIP (Bscf)			
	Low	Best	High	Mean
Nsungwe	11.0	27.6	65.5	34.4

Table 2.15: Nsungwe Formation - Gas Recovery Factors and Helium Concentrations

Reservoir	Recovery Factor (%)			Helium Yield (%)		
	Low	Best	High	Low	Best	High
Nsungwe	50	65	80	0.10	2.10	3.25

Table 2.16: Nsungwe Formation - Gross Unrisked Total Gas Resources and Helium Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)			
	1U	2U	3U	Mean	1U	2U	3U	Mean
Nsungwe	6.7	17.6	42.9	22.3	0.10	0.34	0.97	0.47

Table 2.17: Weathered Basement – Volumetric Input Parameter Ranges

Reservoir	GRV (MMm3)			NTG (%)			Porosity (%)			Gas Saturation (%)			GEF (scf/rcf)		
	Low	Best	High	Low	Best	High	Low	Best	High	Low	Best	High	Low	Best	High
Weathered Basement	1717	1985	2295	90	95	100	0.2	0.4	1.0	50	65	80	80	90	100

Table 2.18: Weathered Basement – Undiscovered Total Gas Initially in Place Estimates

Reservoir	Undiscovered GIIP (Bscf)			
	Low	Best	High	Mean
Weathered Basement	7.2	17.0	39.4	21.2

Table 2.19: Weathered Basement - Gas Recovery Factors and Helium Concentrations

Reservoir	Recovery Factor (%)			Helium Yield (%)		
	Low	Best	High	Low	Best	High
Weathered Basement	50	65	80	0.50	1.10	1.75

Table 2.20: Weathered Basement - Gross Unrisked Total Gas Resources and Helium Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)			
	1U	2U	3U	Mean	1U	2U	3U	Mean
Weathered Basement	4.4	10.8	26.3	13.8	0.03	0.11	0.32	0.70

Table 2.21: Consolidated Undiscovered Total Gas Initially In Place Estimates

Reservoir	Undiscovered GIIP (Bscf)			
	Low	Best	High	Mean
Lake Bed Fm A	9.6	30.3	79.3	39.5
Lake Beds Fm B	11.9	29.6	67.7	36.2
Lake Beds Fm C	4.2	11.2	27.5	14.1
Nsungwe	11	27.6	65.5	34.4
Karoo Sandstone	112.1	216	377.8	243.7
Weathered/Fractured Basement	7.2	17	39.4	21.2
Deterministic Total	**156.0**	**331.7**	**657.2**	**389.1**

Notes

1. *These in place estimates are unrisked and no recovery factors have been applied to the in place estimates in this table.*

Table 2.22: Consolidated Total and Helium Gas Gross Unrisked Prospective Resources

Reservoir	Total Gas Resources including Inerts (Bscf)				Prospective Total Helium Resources (Bscf)			
	1U	2U	3U	Mean	1U	2U	3U	Mean
Lake Bed Fm A	6.1	19.3	52.2	36.2	0.09	0.37	1.19	0.55
Lake Bed Fm B	7.5	19.0	44.5	23.5	0.11	0.37	1.01	0.49
Lake Bed Fm C	2.6	7.1	18.0	9.2	0.04	0.14	0.41	0.19
Nsungwe	6.7	17.6	42.9	22.3	0.10	0.34	0.97	0.47
Karoo Sandstone	69.2	138.4	253.9	152.7	0.50	1.42	3.20	1.69
Weathered/ Fractured Basement	4.4	10.8	26.3	13.8	0.03	0.11	0.32	0.70
Deterministic Total	**96.5**	**212.2**	**437.8**	**257.7**	**0.9**	**2.8**	**7.1**	**4.1**

Notes

1. *Helium One's interest in the licence blocks is 100% working interest. Therefore, gross and net working interest, unrisked Prospective Resources are equal.*
2. *The Prospective Resources have not be adjusted for geological chance of success (COS). The COS is an estimate of the probability that drilling the prospect would result in a discovery as defined under SPE PRMS*
3. *In the case of Prospective Resources, there is no certainty that any gas, including helium, will be discovered, nor if discovered will it be commercially viable to produce any portion of the resources.*
4. *The June 2018 SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resources Management System (PRMS) and associated guidance notes allow for the application of PRMS principles to the estimation of non-hydrocarbon resources. Accordingly, ERCE has applied the principles of the PRMS to the estimation of the Prospective Resources presented here, noting that such application is outside the scope of the PRMS.*
5. *Unrisked mean totals are not representative of the expected total from the prospect and assumes a success case in all reservoir intervals.*
6. *The Prospective Resources have not been adjusted for the chance of development. Quantifying the chance of development (COD) requires consideration of both economic contingencies and other contingencies, such as legal, regulatory, market access, political, social license, internal and external approvals and commitment to project finance and development timing. As many of these factors are out-with the knowledge of ERCE they must be used with caution.*

2.6.1. Geological Chance of Success

ERCE used a four-component matrix to estimate the Geological Chance of Success (COS) for the prospect (Table 2.23).

Key risk at all prospective reservoir intervals is identified as seal – that is the structure has not retained sufficient inert gas to enable a gaseous phase to develop to the gas saturations required, as a result of the failure of the top seal or side seal formation to retain the gas in the structure. The Karoo Sandstone, Lake Bed Formation and Nsungwe Formation have each been assigned an overall geological chance of success of 14%. The weathered basement interval has been assigned an overall geological chance of success of 10% due to increased reservoir risk.

Table 2.23: Geological Chance of Success – Tai Prospect

Reservoir / Accumulation	Source (Migration)	Reservoir (Presence & Efficacy)	Trap (Definition & Efficacy)	Seal (Presence & Efficacy)	Chance of Success
Karoo Sandstone	70%	70%	70%	40%	14%
Lake Bed Formation	70%	70%	70%	40%	14%
Nsungwe Formation	70%	70%	70%	40%	14%
Weathered Basement	70%	50%	70%	40%	10%

Appendix 1: SPE PRMS Guidelines

This report references the SPE/WPC/AAG/SPEE/SEG/SPWLA/EAGE Petroleum Reserves and Resources Classification System and Definitions, as revised in June 2018 (PRMS). The full text of the PRMS document can be viewed at:

petroleum-resources-management-system-2018 (spe.org)

Definitions of the key PRMS Reserves and Resource classes, categories and a glossary of related terms can be found at the above address.

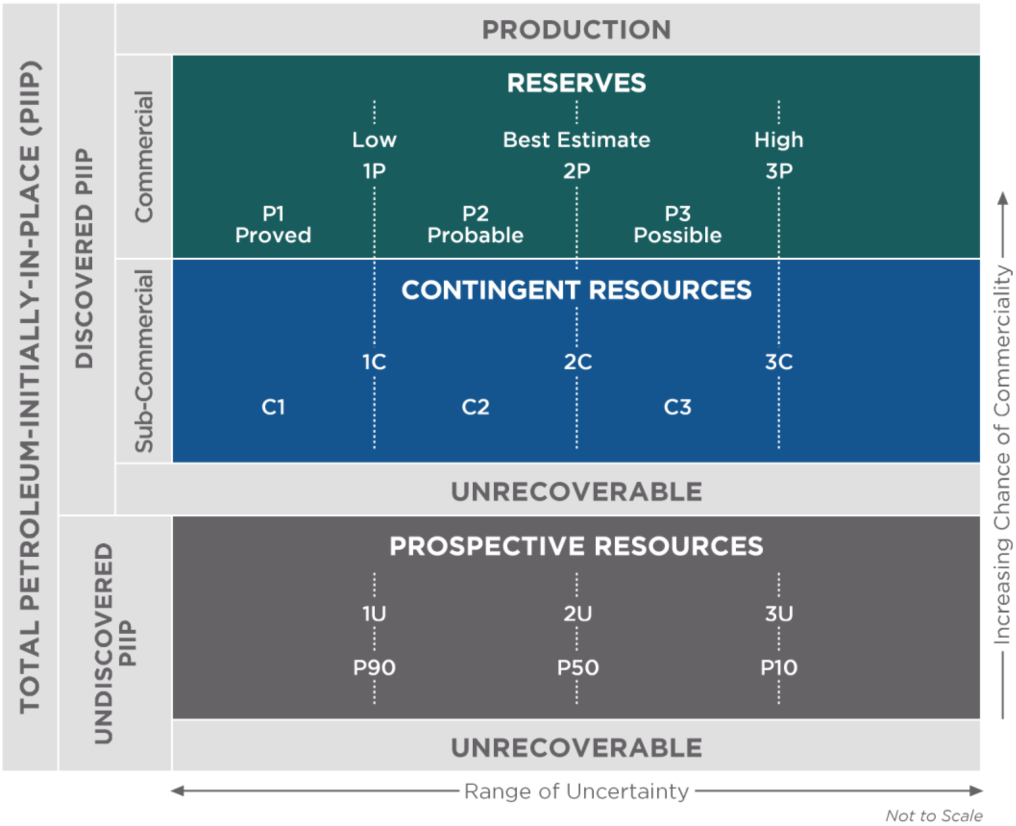

Figure A: PRMS Resources classification framework

(Modified from Petroleum Resources Management System (PRMS) Revised June 2018, page 8, Figure 1.1)

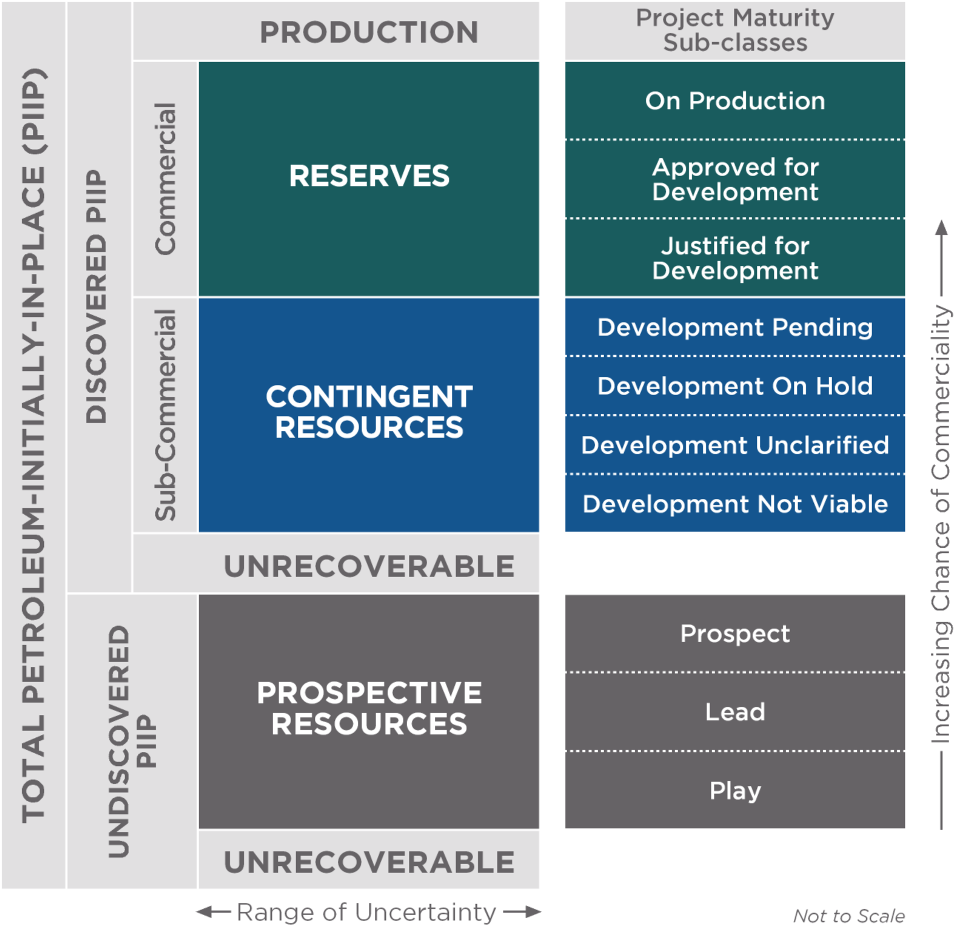

Figure B: PRMS Resources sub-classes

(Modified from Petroleum Resources Management System (PRMS) Revised June 2018, page 8, Figure 2.1)

Table 1: PRMS Recoverable Resources Classes and Sub-Classes

Classes/Sub-classes	Definition	Guidelines
Reserves	Reserves are those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions.	Reserves must satisfy four criteria: discovered, recoverable, commercial, and remaining based on the development project(s) applied. Reserves are further categorized in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterized by the development and production status. To be included in the Reserves class, a project must be sufficiently defined to establish its commercial viability (see Section 2.1.2, Determination of Commerciality). This includes the requirement that there is evidence of firm intention to proceed with development within a reasonable time-frame. A reasonable time-frame for the initiation of development depends on the specific circumstances and varies according to the scope of the project. While five years is recommended as a benchmark, a longer time-frame could be applied where, for example, development of an economic project is deferred at the option of the producer for, among other things, market- related reasons or to meet contractual or strategic objectives. In all cases, the justification for classification as Reserves should be clearly documented. To be included in the Reserves class, there must be a high confidence in the commercial maturity and economic producibility of the reservoir as supported by actual production or formation tests. In certain cases, Reserves may be assigned on the basis of well logs and/or core analysis that indicate that the subject reservoir is hydrocarbon-bearing and is analogous to reservoirs in the same area that are producing or have demonstrated the ability to produce on formation tests.
On Production	The development project is currently producing or capable of producing and selling petroleum to market.	The key criterion is that the project is receiving income from sales, rather than that the approved development project is necessarily complete. Includes Developed Producing Reserves. The project decision gate is the decision to initiate or continue economic production from the project.

Classes/Sub-classes	Definition	Guidelines
Approved for Development	All necessary approvals have been obtained, capital funds have been committed, and implementation of the development project is ready to begin or is under way.	At this point, it must be certain that the development project is going ahead. The project must not be subject to any contingencies, such as outstanding regulatory approvals or sales contracts. Forecast capital expenditures should be included in the reporting entity's current or following year's approved budget. The project decision gate is the decision to start investing capital in the construction of production facilities and/or drilling development wells.
Justified for Development	Implementation of the development project is justified on the basis of reasonable forecast commercial conditions at the time of reporting, and there are reasonable expectations that all necessary approvals/contracts will be obtained.	To move to this level of project maturity, and hence have Reserves associated with it, the development project must be commercially viable at the time of reporting (see Section 2.1.2, Determination of Commerciality) and the specific circumstances of the project. All participating entities have agreed and there is evidence of a committed project (firm intention to proceed with development within a reasonable time-frame}) There must be no known contingencies that could preclude the development from proceeding (see Reserves class). The project decision gate is the decision by the reporting entity and its partners, if any, that the project has reached a level of technical and commercial maturity sufficient to justify proceeding with development at that point in time.
Contingent Resources	Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects, but which are not currently considered to be commercially recoverable owing to one or more contingencies.	Contingent Resources may include, for example, projects for which there are currently no viable markets, where commercial recovery is dependent on technology under development, where evaluation of the accumulation is insufficient to clearly assess commerciality, where the development plan is not yet approved, or where regulatory or social acceptance issues may exist. Contingent Resources are further categorized in accordance with the level of certainty associated with the estimates and may be sub- classified based on project maturity and/or characterized by the economic status.

Classes/Sub-classes	Definition	Guidelines
Development Pending	A discovered accumulation where project activities are ongoing to justify commercial development in the foreseeable future.	The project is seen to have reasonable potential for eventual commercial development, to the extent that further data acquisition (e.g., drilling, seismic data) and/or evaluations are currently ongoing with a view to confirming that the project is commercially viable and providing the basis for selection of an appropriate development plan. The critical contingencies have been identified and are reasonably expected to be resolved within a reasonable time-frame. Note that disappointing appraisal/evaluation results could lead to a reclassification of the project to On Hold or Not Viable status. The project decision gate is the decision to undertake further data acquisition and/or studies designed to move the project to a level of technical and commercial maturity at which a decision can be made to proceed with development and production.
Development on Hold	A discovered accumulation where project activities are on hold and/or where justification as a commercial development may be subject to significant delay.	The project is seen to have potential for commercial development. Development may be subject to a significant time delay. Note that a change in circumstances, such that there is no longer a probable chance that a critical contingency can be removed in the foreseeable future, could lead to a reclassification of the project to Not Viable status. The project decision gate is the decision to either proceed with additional evaluation designed to clarify the potential for eventual commercial development or to temporarily suspend or delay further activities pending resolution of external contingencies.
Development Unclarified	A discovered accumulation where project activities are under evaluation and where justification as a commercial development is unknown based on available information.	The project is seen to have potential for eventual commercial development, but further appraisal/evaluation activities are ongoing to clarify the potential for eventual commercial development. This sub-class requires active appraisal or evaluation and should not be maintained without a plan for future evaluation. The sub-class should reflect the actions required to move a project toward commercial maturity and economic production.

Classes/Sub-classes	Definition	Guidelines
Development Not Viable	A discovered accumulation for which there are no current plans to develop or to acquire additional data at the time because of limited production potential.	The project is not seen to have potential for eventual commercial development at the time of reporting, but the theoretically recoverable quantities are recorded so that the potential opportunity will be recognized in the event of a major change in technology or commercial conditions. The project decision gate is the decision not to undertake further data acquisition or studies on the project for the foreseeable future.
Prospective Resources	Those quantities of petroleum that are estimated, as of a given date, to be potentially recoverable from undiscovered accumulations.	Potential accumulations are evaluated according to the chance of geologic discovery and, assuming a discovery, the estimated quantities that would be recoverable under defined development projects. It is recognized that the development programs will be of significantly less detail and depend more heavily on analog developments in the earlier phases of exploration.
Prospect	A project associated with a potential accumulation that is sufficiently well defined to represent a viable drilling target.	Project activities are focused on assessing the chance of geologic discovery and, assuming discovery, the range of potential recoverable quantities under a commercial development program.
Lead	A project associated with a potential accumulation that is currently poorly defined and requires more data acquisition and/or evaluation to be classified as a Prospect.	Project activities are focused on acquiring additional data and/or undertaking further evaluation designed to confirm whether or not the Lead can be matured into a Prospect. Such evaluation includes the assessment of the chance of geologic discovery and, assuming discovery, the range of potential recovery under feasible development scenarios.
Play	A project associated with a prospective trend of potential prospects, but that requires more data acquisition and/or evaluation to define specific Leads or Prospects.	Project activities are focused on acquiring additional data and/or undertaking further evaluation designed to define specific Leads or Prospects for more detailed analysis of their chance of geologic discovery and, assuming discovery, the range of potential recovery under hypothetical development scenarios.

Table 2: PRMS Reserves Status Definitions and Guidelines

Status	Definition	Guidelines
Developed Reserves	Expected quantities to be recovered from existing wells and facilities.	Reserves are considered developed only after the necessary equipment has been installed, or when the costs to do so are relatively minor compared to the cost of a well. Where required facilities become unavailable, it may be necessary to reclassify Developed Reserves as Undeveloped. Developed Reserves may be further sub-classified as Producing or Non-producing.
Developed Producing Reserves	Expected quantities to be recovered from completion intervals that are open and producing at the effective date of the estimate.	Improved recovery Reserves are considered producing only after the improved recovery project is in operation.
Developed Non-Producing Reserves	Shut-in and behind-pipe Reserves.	Shut-in Reserves are expected to be recovered from (1) completion intervals that are open at the time of the estimate but which have not yet started producing, (2) wells which were shut-in for market conditions or pipeline connections, or (3) wells not capable of production for mechanical reasons. Behind-pipe Reserves are expected to be recovered from zones in existing wells that will require additional completion work or future re-completion before start of production with minor cost to access these reserves. In all cases, production can be initiated or restored with relatively low expenditure compared to the cost of drilling a new well.
Undeveloped Reserves	Quantities expected to be recovered through future significant investments.	Undeveloped Reserves are to be produced (1) from new wells on undrilled acreage in known accumulations, (2) from deepening existing wells to a different (but known) reservoir, (3) from infill wells that will increase recovery, or (4) where a relatively large expenditure (e.g., when compared to the cost of drilling a new well) is required to (a) recomplete an existing well or (b) install production or transportation facilities for primary or improved recovery projects.

Table 3: PRMS Reserves Category Definitions and Guidelines

Category	Definition	Guidelines
Proved Reserves	Those quantities of petroleum that, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable from a given date forward from known reservoirs and under defined economic conditions, operating methods, and government regulations.	If deterministic methods are used, the term “reasonable certainty” is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability (P90) that the quantities actually recovered will equal or exceed the estimate. The area of the reservoir considered as Proved includes (1) the area delineated by drilling and defined by fluid contacts, if any, and 2) adjacent undrilled portions of the reservoir that can reasonably be judged as continuous with it and commercially productive on the basis of available geoscience and engineering data. In the absence of data on fluid contacts, Proved quantities in a reservoir are limited by the LKH as seen in a well penetration unless otherwise indicated by definitive geoscience, engineering, or performance data. Such definitive information may include pressure gradient analysis and seismic indicators. Seismic data alone may not be sufficient to define fluid contacts for Proved. Reserves in undeveloped locations may be classified as Proved provided that: A. The locations are in undrilled areas of the reservoir that can be judged with reasonable certainty to be commercially mature and economically productive. B. Interpretations of available geoscience and engineering data indicate with reasonable certainty that the objective formation is laterally continuous with drilled Proved locations. For Proved Reserves, the recovery efficiency applied to these reservoirs should be defined based on a range of possibilities supported by analogs and sound engineering judgment considering the characteristics of the Proved area and the applied development program.
Probable Reserves	Those additional Reserves that analysis of geoscience and engineering data indicates are less likely to be recovered than Proved Reserves but more certain to be recovered than Possible Reserves.	It is equally likely that actual remaining quantities recovered will be greater than or less than the sum of the estimated Proved plus Probable Reserves (2P). In this context, when probabilistic methods are used, there should be at least a 50% probability that the actual quantities recovered will equal or exceed the 2P estimate. Probable Reserves may be assigned to areas of a reservoir adjacent to Proved where data control or interpretations of available data are less certain. The interpreted reservoir continuity may not meet the reasonable certainty criteria. Probable estimates also include incremental recoveries associated with project recovery efficiencies beyond that assumed for Proved.

Possible Reserves	Those additional reserves that analysis of geoscience and engineering data indicates are less likely to be recoverable than Probable Reserves.	The total quantities ultimately recovered from the project have a low probability to exceed the sum of Proved plus Probable plus Possible (3P), which is equivalent to the high-estimate scenario. When probabilistic methods are used, there should be at least a 10% probability (P10) that the actual quantities recovered will equal or exceed the 3P estimate. Possible Reserves may be assigned to areas of a reservoir adjacent to Probable where data control and interpretations of available data are progressively less certain. Frequently, this may be in areas where geoscience and engineering data are unable to clearly define the area and vertical reservoir limits of economic production from the reservoir by a defined, commercially mature project. Possible estimates also include incremental quantities associated with project recovery efficiencies beyond that assumed for Probable.
Probable and Possible Reserves	See above for separate criteria for Probable Reserves and Possible Reserves.	The 2P and 3P estimates may be based on reasonable alternative technical interpretations within the reservoir and/or subject project that are clearly documented, including comparisons to results in successful similar projects. In conventional accumulations, Probable and/or Possible Reserves may be assigned where geoscience and engineering data identify directly adjacent portions of a reservoir within the same accumulation that may be separated from Proved areas by minor faulting or other geological discontinuities and have not been penetrated by a wellbore but are interpreted to be in communication with the known (Proved) reservoir. Probable or Possible Reserves may be assigned to areas that are structurally higher than the Proved area. Possible (and in some cases, Probable) Reserves may be assigned to areas that are structurally lower than the adjacent Proved or 2P area. Caution should be exercised in assigning Reserves to adjacent reservoirs isolated by major, potentially sealing faults until this reservoir is penetrated and evaluated as commercially mature and economically productive. Justification for assigning Reserves in such cases should be clearly documented. Reserves should not be assigned to areas that are clearly separated from a known accumulation by non-productive reservoir (i.e., absence of reservoir, structurally low reservoir, or negative test results); such areas may contain Prospective Resources. In conventional accumulations, where drilling has defined a highest known oil elevation and there exists the potential for an associated gas cap, Proved Reserves of oil should only be assigned in the structurally higher portions of the reservoir if there is reasonable certainty that such portions are initially above bubble point pressure based on documented engineering analyses. Reservoir portions that do not meet this certainty may be assigned as Probable and Possible oil and/or gas based on reservoir fluid properties and pressure gradient interpretations.

Table 4: Glossary of Terms Used in PRMS

Term	Definition
1C	Denotes low estimate of Contingent Resources.
2C	Denotes best estimate of Contingent Resources.
3C	Denotes high estimate of Contingent Resources.
1P	Denotes low estimate of Reserves (i.e., Proved Reserves). Equal to P1.
2P	Denotes the best estimate of Reserves. The sum of Proved plus Probable Reserves.
3P	Denotes high estimate of reserves. The sum of Proved plus Probable plus Possible Reserves.
1U	Denotes the unrisked low estimate qualifying as Prospective Resources.
2U	Denotes the unrisked best estimate qualifying as Prospective Resources.
3U	Denotes the unrisked high estimate qualifying as Prospective Resources.

Appendix 2: Nomenclature

(where not already described in Appendix 1)

3D	three-dimensional
API	American Petroleum Institute
Bo	oil formation volume factor, in rb/stb
Bscf	billion standard cubic feet
bbl	barrel
CO_2	carbon dioxide
cm	centimetres
cp or cP	centipoise
CPI	computer processed interpretation
DST	drill stem test
frac	fraction
ft	feet
GCOS	geological chance of success
GDT	gas down to
GRV	gross rock volume
GWC	gas water contact
kh	permeability thickness
km	kilometres
m	metre
M MM	thousands and millions respectively
md or mD	millidarcy
MDT	modular dynamic tester
NTG	net to gross ratio
ODT	oil down to
OWC	oil water contact
P*	extrapolated initial pressure, derived from well test analysis
PBU	pressure build-up
PI	productivity index, in stb/d/psi for oil or MMscf/d/psi or Mscf/d/psi for gas
ppm	parts per million
psi	pressure, measured in pounds per square inch
psia	absolute pressure, measured in pounds per square inch
PVT	pressure volume temperature experiment

rb	reservoir barrels
rcf	reservoir cubic feet
RFT	repeat formation tester
s	seconds
SCAL	special core analysis
scf	standard cubic feet measured at 14.7 pounds per square inch and 60 degrees Fahrenheit
stb	stock tank barrel (42 US gallons measured at 14.7 pounds per square inch and 60 degrees Fahrenheit)
STOIIP	stock tank oil initially in place
TVDSS	true vertical depth sub-sea
TWT	two way time
WOR	water oil ratio

Appendix 3: References

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