ARK MINES LTD.

ASX ANNOUNCEMENT

28 March 2023

ASX: AHK

Corporate Directory

Directors

Executive Chairman
Roger Jackson

Executive Director
Ben Emery

Non-Executive Director
Ian Mitchell

Projects

- Gunnawarra Nickel-Cobalt
- Mt Jesse Iron – Copper
- Sandy Mitchell – Rare Earths
- Pluton Gold

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HISTORICAL METALLURGY FROM SANDY MITCHELL ADVANCED RARE EARTHS PROJECT CONFIRMS ROBUST NdPr RATIOS

HIGHLIGHTS

- **Ark's team has gained access to extensive historical data and reports produced by Japan Organization for Metals and Energy Security ('JOGMEC') which undertook extensive sampling and mineralogical investigation at the Sandy Mitchell Rare Earths Project in 2010**
- **Metallurgical reports confirm significant levels of neodymium-praseodymium (NdPr) with NdPr ratios recorded of up to 25% as a percentage of Total Rare Earth Oxides**
- **Very high historical TREO grades* including high grade pan concentrates of magnet metals and NdPr ratios of:**

Sample number	TREO	NdPr Ratio as % of TREO
451	18.4%	24.6%
450	17.4%	24.5%
452	15.8%	24.2%
430	15.3%	25.0%
452A2	12.3%	23.7%

**Historical data, Not to JORC 2012 code standards*; *refer to image 2 for sample locations*

- **As well as the Rare Earths there are robust commercial grades of Heavy Minerals measured, including 13.46% Titanium (Ilmenite/Rutile) and 8.15% Zircon, which broaden Sandy Mitchell's commercial appeal.**
- **The dominant minerals in the panned concentrate samples are zircon, ilmenite, monazite and Fe-rich chlorite, providing for simple mineralogy that can be separated in situ at a low cost.**
- **Report confirms that Rare Earths at Sandy Mitchell are amenable to panning a concentrate (refer Table 1); Planned low-cost, fast start up, straightforward on-site beneficiation by gravity processing.**
- **Review of historical data is ongoing with Ark's team now seeking to fast-track works program including planned in-fill drill program and follow-up metallurgical test work.**

Ark Mines Ltd (ASX: AHK, "Ark" or the "Company") is pleased to provide this update on its 100%-owned *'Sandy Mitchell'* Rare Earths Project located in North Queensland, acquired in early March. AHK's priority since acquiring the project has been to secure and review all historical data. Initial reports reviewed include those produced by JOGMEC (refer highlight above) which confirms that Sandy Mitchell's Rare Earths contain significant levels of Neodymium-Praseodymium (NdPr).

Neodymium-Praseodymium (NdPr) are two critical rare earth elements integral to the manufacture of rare earth permanent magnets. Rare earth permanent magnets are used in electric vehicles, wind turbines and advanced weapon systems.

The presence of heavy minerals such as Ilmenite, Rutile, Titanium and Zircon are also evident from the reports which significantly adds to the commercial appeal of the project.

JOGMEC undertook a sampling and mineralogical investigation of a mineral sand sample using QEMSCAN particle mineral analysis methods which shows the project will be simply beneficiated by gravity processes. The samples were taken as a bulk sample and then panned.

Ark is now fast-tracking a planned infill drilling program with further details to be announced shortly. As well, the Company will undertake its own metallurgical test work and gravity separation testing to confirm that Sandy Mitchell's material is amenable to panning a concentrate and a commercial low-cost, fast start up gravity separation processing operation can be developed.

MANAGEMENT COMMENTARY

Executive Chairman Roger Jackson said: *"The significant levels of Neodymium-Praseodymium at our Sandy Mitchell Rare Earth project in North Queensland are indeed most encouraging, so too is the presence of some valuable heavy minerals, most notably ilmenite, rutile, titanium and zircon. With the current deficit of NdPr oxide globally, and its importance in the energy transition, Sandy Mitchell has excellent commercial prospects and we are now fast-tracking key works programs to bring the project into the development phase more rapidly. JOGMEC's quality historical data is proving to be very valuable in this regard and giving us great insight into how we shape our forward works program. We anticipate a fuller update on pending works very shortly."*

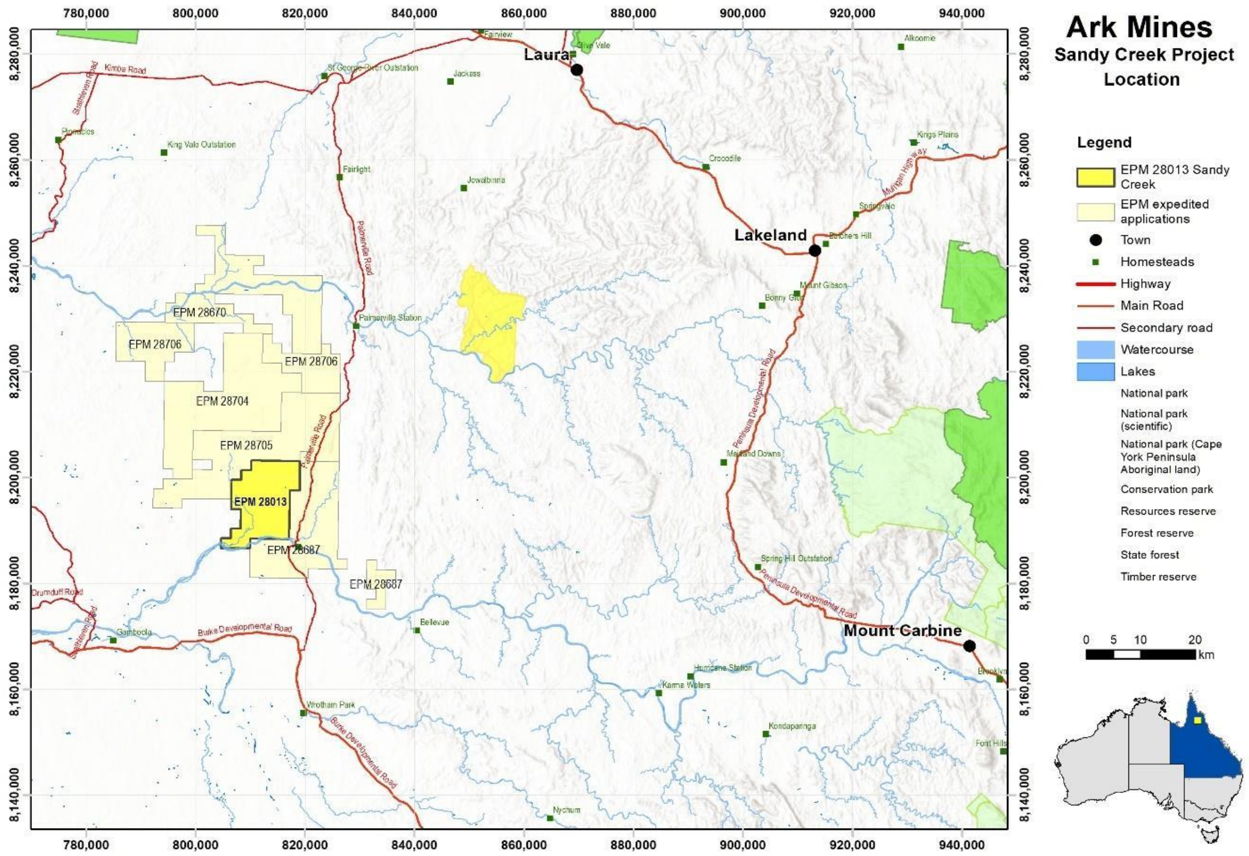

Image 1: Location of 147km² EPM 28013 'Sandy Mitchell' and surrounding EPMs applied for.

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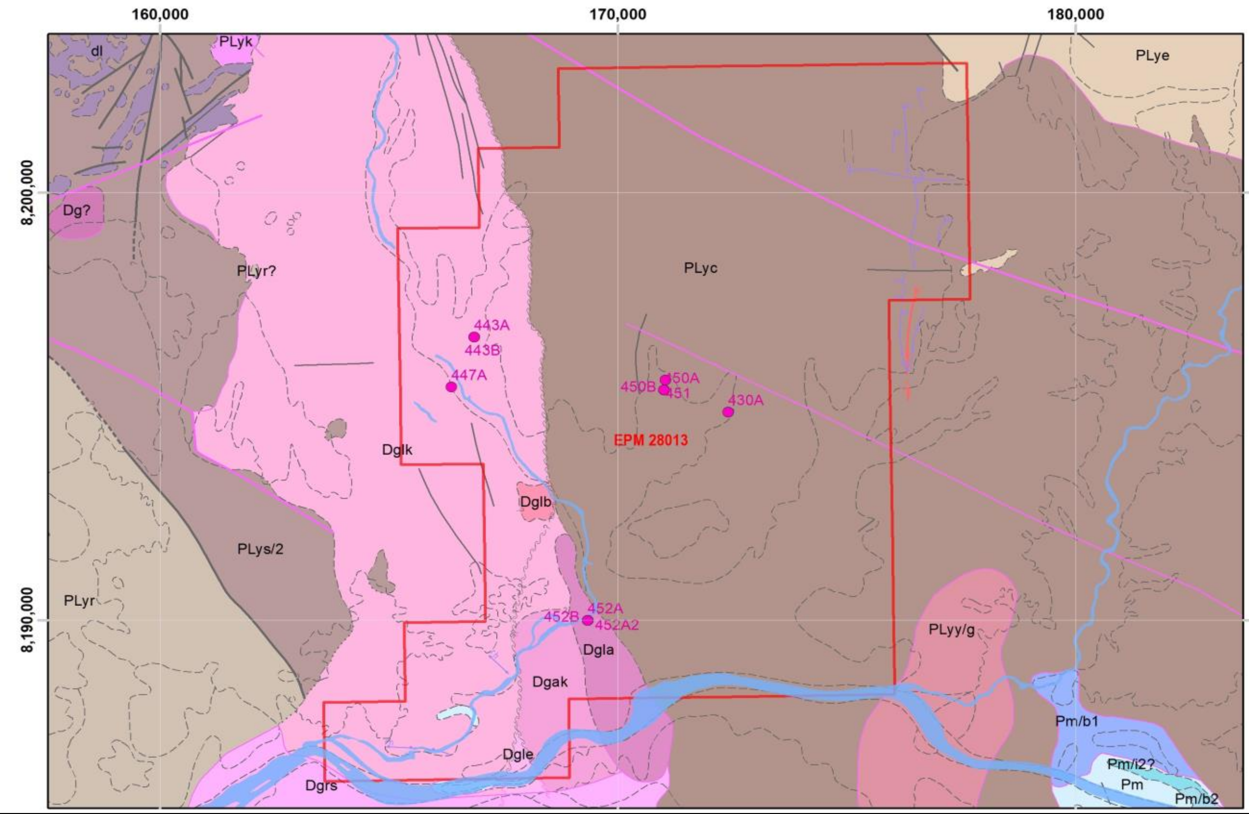

Image 2: *Location of high-grade Pan Concentrate samples which define follow-up exploration targets*

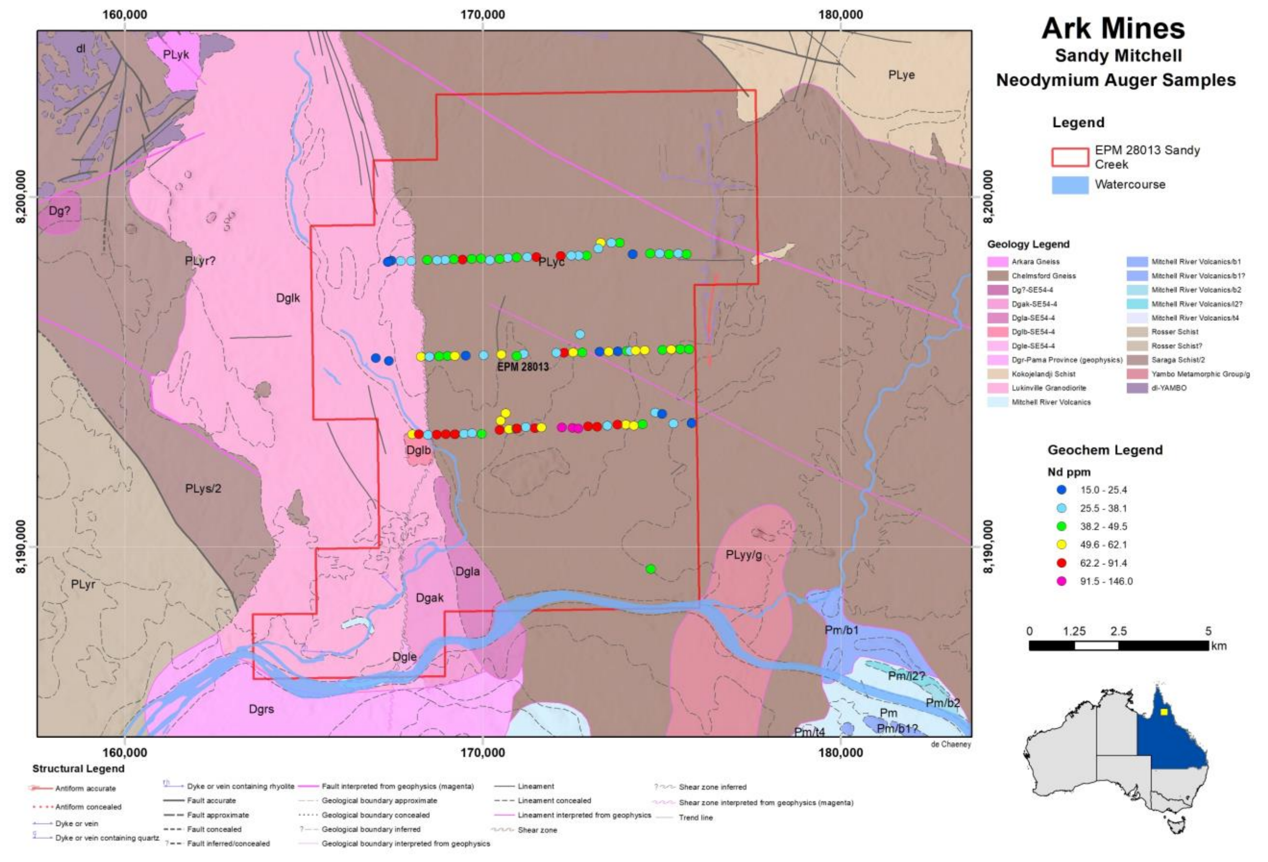

Image 3*: Location of historical augur drill holes*

Sample	E	N	Samp Type	TREO	LREO	HREO	CREO	Mag Reo	Sc_2O_3	La_2O_3	CeO_2	Pr_6O_{11}	Nd_2O_3	Sm_2O_3	Eu_2O_3	Y_2O_3	Tb_4O_7	Dy_2O_3	Ho_2O_3	Er_2O_3	Tm_2O_3	Yb_2O_3
	MGA94z54	MGA94z54		ppm	%	%	%	%	ppm	%	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
430A	813624	8195067	Pan Con	153,969	95.4	4.6	23.7	25.9	225.5	3.26	7.10	8,288	2.9976	4,650	120.4	4,749	349.3	1,285	174.1	354.5	29.7	160.56
443A	808124	8196989	Pan Con	94,180	95.5	4.5	23.1	25.3	220.9	2.05	4.34	5,014	1.7846	2,876	88.5	2,806	197.6	797	103.8	215.0	19.6	109.77
443B	808125	8196989	Pan Con	17,554	91.1	8.9	25.5	24.3	309.8	0.35	0.76	887	0.3126	513	25.5	1,062	46.6	211	37.1	99.0	13.6	90.185
447A	807601	8195835	Pan Con	47,376	95.0	5.0	23.7	25.6	123.0	1.02	2.16	2,525	0.904	1,450	56.0	1,549	120.0	457	58.2	114.4	9.7	50.786
450A	812239	8195625	Pan Con	174,126	95.9	4.1	23.0	25.6	171.8	3.75	8.11	9,351	3.3359	5,369	135.5	4,661	407.0	1,400	173.0	335.0	25.9	133.23
450B	812239	8195625	Pan Con	17,929	90.6	9.4	26.1	24.6	300.6	0.35	0.77	904	0.3231	525	24.0	1,156	47.0	220	39.7	109.0	15.0	100.21
451	812274	8195859	Pan Con	184,777	95.8	4.2	23.1	25.6	199.4	3.99	8.59	9,895	3.5459	5,624	162.1	5,029	441.1	1,515	184.4	355.6	28.1	144.61
452A	810407	8190286	Pan Con	158,691	95.8	4.2	22.7	25.2	170.3	3.48	7.37	8,518	2.9743	4,859	143.6	4,407	381.1	1,308	162.7	313.3	24.3	125.26
452B	810407	8190286	Pan Con	30,334	93.8	6.2	24.4	25.3	233.1	0.63	1.36	1,583	0.5715	914	36.6	1,261	74.9	304	45.0	107.0	12.6	79.14
452A2	810408	8190286	Pan Con	123,058	95.7	4.3	22.8	24.7	135.0	2.73	5.72	5,932	2.3211	3,792	118.1	3,467	297.6	1,002	131.7	268.7	19.8	112.73

***Table 1**: Pan concentrate samples as per Image 2 above*

Released through: Ben Jarvis, Six Degrees Investor Relations, +61 413 150 448 and authorised for release by the Board of Ark Mines Ltd.

FURTHER INFORMATION

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ABOUT ARK MINES LIMITED

Ark Mines is an ASX listed Australian mineral exploration company focused on developing its 100% owned projects located in the prolific Mt Garnet and Greenvale mineral fields of Northern Queensland. The Company's exploration portfolio consists of three high quality projects covering 200km^2 of tenure that are prospective for copper, iron ore, nickel-cobalt and porphyry gold:

Gunnawarra Nickel-Cobalt Project

- Comprised of 11 sub-blocks covering 36km^2.
- Borders Australian Mines Limited Sconi project - the most advanced Cobalt-Nickel-Scandium project in Australia.
- Potential synergies with local processing facilities with export DSO Nickel/Cobalt partnership options.

Mt Jesse Copper-Iron Project

- Project covers a tenure area of 12.4km2 located ~25km west of Mt Garnet.
- Centred on a copper rich magnetite skarn associated with porphyry style mineralization
- Three exposed historic iron formations.
- Potential for near term production via toll treat and potential to direct ship.

Pluton Porphyry Gold Project

- Located ~90km SW of Cairns near Mareeba, QLD covering 18km^2.
- Prospective for gold and associated base metals (Ag, Cu, Mo).
- Porphyry outcrop discovered during initial field inspection coincides with regional scale geophysical interpretation.

RELIANCE ON HISTORIC DATA

All sample data reported in this release, as disclosed in the body of the release, in the tables in the Appendix and in the JORC table is based on data compiled by the Competent Person from other sources and quoted in their original context. These sources have been referenced in the text and the original Competent Persons statements may be found with the relevant documents. Some of this information is publicly available but has not been reported in accordance with the provisions of the JORC Code and a completed Table 1 of the JORC Code and Competent Persons statement is attached to this Release. Whilst every effort has been made to validate and check the data, these results should be considered in the context in which they appear and are subject to field verification by the Company.

CAUTIONARY STATEMENT

The panned concentration samples were taken by Stuart Foster. And the reported assay results supplied to MKY Resources Ltd and Delminco Pty Ltd (2007 to 2009). Stuart Foster, the present owner of the tenement has supplied a hard copy of the panned concentrate results to Ark. Mr Foster has also supplied a statement pertaining to the sampling procedures undertaken. There is however some information which is not available, and cannot be included in the Table 1. Sample results were sent to SGS Townsville for assaying the assay technique is yet to be determined and the assay receipts have not been sited. It is possible that following further evaluation and/or exploration work that the confidence in the prior exploration results may be reduced when reported under the JORC Code 2012. However, nothing has come to the attention of Ark that causes it to question the accuracy or reliability of S Fosters exploration results. The Company however has not independently validated the former explorer's exploration results and therefore is not to be regarded as reporting, adopting or endorsing those results.

COMPETENT PERSONS STATEMENT

The Information in this report that relates to exploration results, mineral resources or ore reserves is based on information compiled by Mr Roger Jackson, who is a Fellow of the Australian Institute of Mining and Metallurgy and a Fellow of the Australasian Institute of Geoscientists. Mr Jackson is a shareholder and director of the Company. Mr Jackson has sufficient experience which is relevant to the style of mineralisation and type of deposits under consideration and to the activity that he is undertaking to qualify as a Competent Person as defined in the 2012 edition of the `Australian Code for Reporting Exploration Results, Mineral Resources and Ore Reserves' (the JORC Code). Mr Jackson consents to the inclusion of this information in the form and context in which it appears in this report. Mr Jackson confirms information in this market announcement is an accurate representation of the available data for the exploration areas being acquired.

FORWARD LOOKING STATEMENTS AND IMPORTANT NOTICE

This report contains forecasts, projections and forward-looking information. Although the Company believes that its expectations, estimates and forecast outcomes are based on reasonable assumptions it can give no assurance that these will be achieved. Expectations and estimates and projections and information provided by the Company are not a guarantee of future performance and involve unknown risks and uncertainties, many of which are out of Ark Mines' control.

Actual results and developments will almost certainly differ materially from those expressed or implied. Ark Mines has not audited or investigated the accuracy or completeness of the information, statements and opinions contained in this announcement. To the maximum extent permitted by applicable laws, Ark Mines makes no representation and can give no assurance, guarantee or warranty, express or implied, as to, and takes no responsibility and assumes no liability for the authenticity, validity, accuracy, suitability or completeness of, or any errors in or omission from, any information, statement or opinion contained in this report and without prejudice, to the generality of the foregoing, the achievement or accuracy of any forecasts, projections or other forward looking information contained or referred to in this report.

Investors should make and rely upon their own enquiries before deciding to acquire or deal in the Company's securities.

ARK MINES LTD.

Appendix A: JORC Code, 2012 Edition – Table 1

Section 1 Sampling Techniques and Data

(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
Sampling techniques	• *Nature and quality of sampling (e.g., cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (eg 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information.*	Data taken from W. Scott and Partners EPM18308 2014 Annual Report CR075376 **Augur Sampling** • Auger programme, using 6m auger • Total soils were collected by hand from the collar to give a composite sample of 5m or depth of refusal, • Sample was split by 25/75 riffle splitter to yield a 3 to 4 kg aliquot per hole Data provided by Stuart Foster and pertaining to the panned concentration samples. • Stream and soil samples were panned to yield a heavy mineral concentrate. The panned residual material was placed in calico sample bags and sent to SGS for assaying. • Jogmec samples were sampled from a bulk sample and panned to make a concentrate

Drilling techniques	• *Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	**Augur Samples** • Augur Drilling • 6-inch diameter • 5m depth • Vertical hole **Panned Concentrates** • No drilling undertaken • Jogmec sampled as a Bulk sample and panned.
Drill sample recovery	• *Method of recording and assessing core and chip sample recoveries and results assessed.* • *Measures taken to maximise sample recovery and ensure representative nature of the samples.* • *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.*	**Augur Samples** • Recoveries were not recorded. • Relationships between sample recovery and grade could not be determined without original sample weight data, however the CP does not believe a material relationship exists given it was Augur sampling. Short hole auger soil sampling is not known to cause significant material fractionation as might be expected with RAB or RC techniques. **Panned Concentrates** • No drilling undertaken
Logging	• *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* • *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.* • *The total length and percentage of the relevant intersections logged.*	**Augur Samples** • Samples were not logged. • Total Counts per second were taken. **Panned Concentrates** • Not logged

Sub-sampling techniques and sample preparation	• *If core, whether cut or sawn and whether quarter, half or all core taken.* • *If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.* • *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* • *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	**Augur Samples** • Samples were composited over the full length of the Augur depth. • Total soils were collected progressively by hand from the collar to give a composite sample of 5m or depth of refusal, • Sample was split by 25/75 riffle splitter to yield a 3 to 4 kg aliquot per hole. • The samples size are appropriate to the grain size of the material sampled: Sand to very fine sand. **Panned Concentrates** • No compositing undertaken • The sample size would be appropriate to the grain size of the material sampled. Sand to very fine sand.
Quality of assay data and laboratory tests	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established.*	**Augur Samples** • Drill samples were sent to SGS Laboratories Townsville. • Aliquots were collected from the splitter in calico sample bags and submitted to SGS Townsville for assay by ICP-OES • Duplicate samples were produced at a rate of 1 in 13 and assayed. • Twin auger holes were drilled at a rate of 1 in 100 with sample and assay as per other holes. • The laboratory procedure was SGS ICP95A for major elements and IMS41Q for REE. **Panned Concentrates** • The samples were sent to SGS Laboratories Townsville. • The laboratory procedure was SGS ICP95A for major elements and IMS41Q for REE. • Duplicate samples were taken Refer to the panned concentrate table.

		JOGMEC SAMPLE • The sample was micro – riffled and a representative aliquot of each was mounted in permanent epoxy resin. A 30mm diameter polished block was prepared. The samples were carbon- coated prior to analysis using the QEMSCAN system. • Particle mineral analysis was undertaken using full x ray mapping.
Verification of sampling and assaying	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.* • *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	**Augur Samples** • The work was undertaken by others. • There is no way of verifying the sampling or the data other than observation of its spatial relationships and internal consistency. • Assay data yielding elemental concentrations for rare earths (REE) within the sample are converted to their stoichiometric oxides (REO) in a calculation performed within the database using the conversion factors in the table below. • Rare Earth oxide is the industry accepted form for reporting rare earths. The following calculations have been used for reporting throughout this report; **TREO** = La2O3 + Ce02 = Pr6O11 + Nd2O3 + Sm2O3 + Eu2O3 + Gd2O3 + Tb4O7 + Dy2O3 + Ho2O3 + Er2O3 + Tm2O3 + Yb2O3 + Lu2O3+ Y2O3 **CREO** = Nd2O3 + Eu2O3 + Tb4O7 + Dy2O3 + Yb2O3 **LREO** = La2O3 + Ce02 = Pr6O11 **HREO** = Sm2O3 + Eu2O3 + Gd2O3 + Tb4O7 + Dy2O3 + Ho2O3 + Er2O3 + Tm2O3 + Yb2O3 + Lu2O3+ Y2O3 ND/Pr = Nd2O3 + Pr6O11 TREO – Ce = TREO – CeO2 • %NdPr + NdPr/TREO

Element Name	Element Oxide	Oxide Factor
Ce	CeO2	1.2284
Dy	Dy2O3	1.1477
Er	Er2O3	1.1435
Eu	Eu2O3	1.1579
Gd	Gd2O3	1.1526
Ho	Ho2O3	1.1455
La	La2O3	1.1728
Lu	Lu2O3	1.1371
Nd	Nd2O3	1.1664
Pr	Pr6O11	1.2081
Sc	Sc2O3	1.5338
Sm	Sm2O3	1.1596
Tb	Tb4O7	1.1762
Th	ThO2	1.1379
Tm	Tm2O3	1.1421
U	U3O8	1.1793
Y	Y2O3	1.2699
Yb	Yb2O3	1.1387

Panned Concentrates

- The work was undertaken by others.
- There is no way of verifying the sampling or the data other than observation of its spatial relationships and internal consistency.

Location of data points

- *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.*
- *Specification of the grid system used.*
- *Quality and adequacy of topographic control.*

Augur Samples

- All collar coordinates were located with hand held GPS with an accuracy of ±5m.
- All coordinates were converted from WGS84 UTM z 54, to MGA94 z 54 by the GPS.
- Current topographic control is by AGSO DEM derived 10m contours which are of greater accuracy than the ±50m available from hand held GPS. This is sufficient for the current stage of pre-resource exploration.

Panned Concentrates

- All collar coordinates were located with hand held GPS with an accuracy of ±5m.
- All coordinates were converted from WGS84 UTM z 54, to MGA94 z 54 by the GPS.

	• Current topographic control is by AGSO DEM derived 10m contours which are of greater accuracy than the ±50m available from hand held GPS. This is sufficient for the current stage of pre-resource exploration.
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* • *Whether sample compositing has been applied.*	**Augur Samples** • Augur drilling was undertaken over three E-W fences of auger holes approximately each 9 km long • Hole spacings at approximately 250 metres. • Samples were composited at the sampling stage. • These factors result in some data gaps that require infill. • Variography to determine appropriateness of grade continuity for resource estimation has not yet been carried out but the current spacing is not expected to support resource estimation. • No resource or reserve is reported. **Panned Concentrates** • Samples were taken randomly in areas with a high radiometric reading. • No resource or reserve is reported.
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	**Augur Samples** • Drill holes were drilled vertically which is appropriate for horizontal regolith profile. • Any sampling bias resultant from the orientation of drilling and possible structural offsets of mineralisation is considered to be minimal. • The fence of augur holes running east west cross the North south alluvial patterns. • The orientation of the drilling is considered appropriate for testing the lateral and vertical extent of mineralisation without any bias. **Panned Concentrates** • The sampling is random • There is no relationship of sampling to mineralisation orientation

Sample security	• *The measures taken to ensure sample security.*	• Samples were farmed on the remote site with batches transported and delivered to SGS by company personnel.
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	• Data was audited in mid Feb 2023 by independent geologists of Empirical Earth Science. The data was found to be acceptable for the current stage of exploration with recommendation that the original assay returns and laboratory QAQC be sourced from the previous owner or SGS Townsville.

Section 2 Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
Mineral tenement and land tenure status	• *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* • *The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.*	• **EPM 28013 Sandy Mitchell** is 100% owned by Ark Mines Limited. It was purchased on the 23rd of February 2023. • This tenement was formally EPM18308 • There are no third party agreements • No known issues impeding on the security of the tenure of Ark Mines ability to operate in the area exist.
Exploration done by other parties	• *Acknowledgment and appraisal of exploration by other parties.*	A number of companies and individuals have explored the area for gold and base metals and for heavy minerals. The summaries presented below are from the IRTM source: • ATP 597M was granted to Laskan Minerals Pty Ltd in 1969 over the Reid Creek area, north of the Mitchell River. From assays of rock chip and stream sediment samples, it was concluded that there was little chance of economic mineralisation occurring in the Authority.

Criteria	JORC Code explanation	Commentary
		Although good monazite grades were obtained, the samples were from creeks with little available wash. Good concentrations of monazite and ilmenite were present in large areas of sandy, alluvial sheet wash in the Reid's Creek area. It was believed that there was a potential for economic exploitation if the monazite concentrations occurred in a large enough volume of sandy material. No further work was reported. • In 1970, Altarama Search Pty Ltd was granted ATP 833M over the Mitchell River in the Reid Creek, Sandy Creek and Mount Mulgrave Homestead area. Four hundred stream sediment samples, at an average density of 1.25 samples/km^2, were collected for assay. Copper and lead contents were low. Half of the zinc results were considered to be possibly anomalous. A two population distribution was obtained for zinc, with a standard threshold of about 15 ppm. It was suggested that the two population distributions represented normal background ranges present in different strata. No other work was carried out. • ATP 2580M was granted to Tacam Pty Ltd over Sandy Creek and its tributaries. Stream sediment samples averaged 0.18% monazite (0.01 to 0.45%), 0.07% rutile (0.15% in terraces), and 0.06% zircon (0.14% in terraces). The area had low economic potential and the Authority was abandoned in August 1981. • The principals involved in Tacam Pty Ltd combined with Metcalfe Holdings Pty Ltd in 1986 to take up 4 Authorities to Prospect - 4400,4401,4402 and 4403 centred on Mt Mulgrave, Arkara Creek, Sandy Creek and the Kennedy River respectively.

Criteria	JORC Code explanation	Commentary
		The investigations were for the possibility of locating large-scale heavy minerals in association with major drainages and lower slope eluvial deposits associated with Cretaceous weathering as indicated in previous investigations. EPM 4400, 4401, 4402 and 4403 • Barron and O'Toole focused on Mt Mulgrave for Ilmenite, rutile, REE, Monzonite, Zircon, and Gold.Tenement EPM 4400 consisted of 96 sub-blocks centred on Mount Mulgrave (7665, 7765), EPM 4401 consisted of 97 sub-blocks centred on Arkara Creek (7665), EPM 4402 consisted of 100 sub- blocks centred on Sandy Creek (7665) and EPM 4403 consisted of 86 sub-blocks centred on Kennedy River (7666, 7766) were granted to P.T.C. Barron, A. O'Toole and Metcalfe Holdings Pty Ltd on 22 September 1986 to explore for heavy minerals and precious metals. After three years of exploration the EPMs were surrendered on 22 August 1989. • Tenement EPM 10185 consisted of 157 sub-blocks was granted to Palmer Gold Pty Ltd on 25 October 1994 for an initial 2 year period. The exploration permit was renewed for a further 3 years on 25 October 1996 and surrendered on 3 October 2001. The tenement was situated 200km west of Cooktown. **Rationale** Significant gold-silver, tin and base metal deposits are known from the Georgetown and southern Dargalong Inliers to the south of EPM 10185 (e.g. Etheridge, Croydon and Oaks goldfields), from the Hodgkinson Province to the east (e.g. Palmer, Hodgkinson, Russell River, Starcke, Jordon Ck, Mareeba and Mount Peter goldfields, and Herberton-Mt Garnet tinfield), and the Coen Inlier to the north (e.g. Alice River & Potallah

Criteria	JORC Code explanation	Commentary
		goldfields). However, other than brief reference to sub-economic alluvial gold occurrences near the junction of the Palmer and Mitchell Rivers, and in the Staaten, Lynd and Walsh Rivers (Culpeper 1993), no precious or base metal deposits are known to occur within rocks of the Yambo Inlier. Application for the area was made after structural interpretation of the region showed prospectivity for gold occurrence. Base metal anomalies delineated from previous exploration were also targeted for follow-up work. • In 2007 exploration activity was carried out by BHP Billiton Minerals Pty Ltd under an extremely large area (2,850 sub-blocks) of the Coen Yambo area from 2005 to 2007. EPM's 14438 and 14445 covered the majority of the Yambo Inlier. BHP targeted Ni sulphide and PGM and carried out AEM surveying, field mapping and sampling and drilling. The AEM targets were found to be related to sedimentary lithological units or obvious shear zones. • In 2007 - 2009 - MTY Resources Ltd undertook bulk sampling program along with a Panned Concentrate sampling program as reported in this report. • In 2012 Waverley Nominees undertook an Augur sampling program as set out in this report
Geology	• *Deposit type, geological setting and style of mineralisation.*	The tenement covers portion of the southern extent of the Yambo Inlier, one of the several Proterozoic inliers to the west of the Palmerville Fault System. Rocks of the Yambo Inlier covered by the tenement comprise those of the middle Proterozoic Yambo Metamorphic Group of mainly amphibolites and gneisses ranging in age from ~1690 Ma to ~1585 Ma. These rocks have been intruded by Silurian-Devonian granites of the

Criteria	JORC Code explanation	Commentary
		Lukinville Suite which form an integral part of the Cape York Batholith. Within the tenement they form a belt roughly 10 km wide trending NNW. Extensive intrusions of Carboniferous-Permian dolerites occur throughout the Inlier, with only a few occurrences within the tenement. The tenement is largely gold deficient except for the gold reporting to sediments within the Palmer River. Recent Governmental radiometric surveys have highlighted areas of anomalous radiometric emission within the Yambo Inlier. The project tenements cover the majority of the anomalous radiometric areas. There are many stream systems within the Mulgrave/Sandy Mitchell tenements and they contain concentrations of rare earth minerals. These minerals have been derived from the now denuded remnant Jurassic-Cretaceous sandstone-pebble conglomerates and quartz sandstones, with the greater volumes being associated with the breakdown of the Mesoproterozoic basement rocks. Isolated areas of high garnet concentrations are derived from irregular zones of highly garnetiferous dolerites and schists.
Drill hole Information	• *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:* o *easting and northing of the drill hole collar* o *elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar* o *dip and azimuth of the hole* o *down hole length and*	**Augur Samples** • Refer to Table in Appendices C **Panned Concentrate** • Refer to Table in Appendices B

Criteria	JORC Code explanation	Commentary
	interception depth ○ *hole length.* • *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.*	
Data aggregation methods	• *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.* • *Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* • *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	• No high or Low-grade top/bottom-cut has been applied. • The total data set is reported in Appendix C • REE Equivalent TREO (total REE oxides) is reported as this is the industry standard for presentation of REE data. Stoichiometric calculation of REE oxide equivalents were performed in units of ppm, with TREO, LREO (light REE oxides), HREO (heavy REE Oxides), CREO (critical REE oxides) and Mag REO (magnet production REE oxides), as per Table 1 page 2 and 3, yielding these factors as concentrations and percentages of TREO concentration. **Panned Concentrates** • The total data set is reported in Appendix X
Relationship between mineralisation widths and intercept lengths	• *These relationships are particularly important in the reporting of Exploration Results.* • *If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.* • *If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').*	**Augur Samples** • All holes sample assays are based on sampling of the whole hole length. • The mineralisation is interpreted to be flat lying and drilling is vertical perpendicular to mineralisation. Any internal variations to REE distribution within the horizontal layering was not defined, therefore the true width is considered not known at the current stage of development. **Panned Concentrates** • Not relevant to soil samples

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Criteria	JORC Code explanation	Commentary
Diagrams	• *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.*	• See plan image 2 and 3.
Balanced reporting	• *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	• Results reported include all recovered assay, both low and high grade, for all holes. • See Appendix B and C for full data.
Other substantive exploration data	• *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.*	• All data material to this report that has been collected to date has been reported textually, graphically or both. • Absent material data includes, Drill collar RLs, bulk density, the nature, quality and appropriateness of the assaying and laboratory procedures , water table height and geotechnical characteristics is absent from the historical data record recovered so far, and current data is still undergoing analysis. These data are not relevant to the current pre-resource drill data release.
Further Work	• *The nature and scale of planned further work.*	• Ark plans to undertake further infill Augur drilling, further beneficiation test work, pilot plant test work. Resourcing and reserve studies.

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Appendix B: Panned Concentrate Table

Sample ID	E MGA94z54	N MGA94z54	Samp Type	TREO	LREO	HREO	CREO	Mag Reo	Sc_2O_3	La_2O_3	CeO_2	Pr_6O_{11}	Nd_2O_3	Sm_2O_3	Eu_2O_3	Gd_2O_3	Y_2O_3	Tb_4O_7	Dy_2O_3	Ho_2O_3	Er_2O_3	Tm_2O_3	Yb_2O_3	Lu_2O_3	Note
				ppm	%	%	%	%	ppm	%	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
430A	813624	8195067	Pan Con	153,969	95.4	4.6	23.7	25.9	225.5	3.26	7.10	8,288	2.9976	4,650	120.4		4,749	349.3	1,285	174.1	354.5	29.7	160.56		
443A	808124	8196989	Pan Con	94,180	95.5	4.5	23.1	25.3	220.9	2.05	4.34	5,014	1.7846	2,876	88.5		2,806	197.6	797	103.8	215.0	19.6	109.77		
443B	808125	8196989	Pan Con	17,554	91.1	8.9	25.5	24.3	309.8	0.35	0.76	887	0.3126	513	25.5		1,062	46.6	211	37.1	99.0	13.6	90.185		twin
447A	807601	8195835	Pan Con	47,376	95.0	5.0	23.7	25.6	123.0	1.02	2.16	2,525	0.904	1,450	56.0		1,549	120.0	457	58.2	114.4	9.7	50.786		
450A	812239	8195625	Pan Con	174,126	95.9	4.1	23.0	25.6	171.8	3.75	8.11	9,351	3.3359	5,369	135.5		4,661	407.0	1,400	173.0	335.0	25.9	133.23		
450B	812239	8195625	Pan Con	17,929	90.6	9.4	26.1	24.6	300.6	0.35	0.77	904	0.3231	525	24.0		1,156	47.0	220	39.7	109.0	15.0	100.21		twin
451	812274	8195859	Pan Con	184,777	95.8	4.2	23.1	25.6	199.4	3.99	8.59	9,895	3.5459	5,624	162.1		5,029	441.1	1,515	184.4	355.6	28.1	144.61		
452A	810407	8190286	Pan Con	158,691	95.8	4.2	22.7	25.2	170.3	3.48	7.37	8,518	2.9743	4,859	143.6		4,407	381.1	1,308	162.7	313.3	24.3	125.26		
452B	810407	8190286	Pan Con	30,334	93.8	6.2	24.4	25.3	233.1	0.63	1.36	1,583	0.5715	914	36.6		1,261	74.9	304	45.0	107.0	12.6	79.14		twin
452A2	810408	8190286	Pan Con	123,058	95.7	4.3	22.8	24.7	135.0	2.73	5.72	5,932	2.3211	3,792	118.1		3,467	297.6	1,002	131.7	268.7	19.8	112.73		duplicate

Note:

TREO: Total REE Oxides = $Sc_2O_3 + La_2O_3 + CeO_2 + Pr_6O_{11} + Nd_2O_3 + Sm_2O_3 + Eu_2O_3 + Gd_2O_3 + Y_2O_3 + Tb_4O_7 + Dy_2O_3 + Ho_2O_3 + Er_2O_3 + Tm_2O_3 + Yb_2O_3 + Lu_2O_3$ (includes Sc & Y)

NB: Gd & Lu not asayed

LREO: Light REE Oxides = $Sc_2O_3 + La_2O_3 + CeO_2 + Pr_6O_{11} + Nd_2O_3 + Sm_2O_3 + Eu_2O_3 + Gd_2O_3$ (includes Sc)

NB: Gd not asayed

HREO: Total REE Oxides = $Y_2O_3 + Tb_4O_7 + Dy_2O_3 + Ho_2O_3 + Er_2O_3 + Tm_2O_3 + Yb_2O_3 + Lu_2O_3$ (includes Y)

NB: Lu not asayed

CREO: Critical REE Oxides = $Nd_2O_3 + Eu_2O_3 + Y_2O_3 + Tb_4O_7 + Dy_2O_3$ (US Dept' Energy Definition)

Mag REO: Magnet Production REE Oxides = $Pr_6O_{11} + Nd_2O_3 + Tb_4O_7 + Dy_2O_3$

Appendix C: Panned Concentrate Sample Location

QUEMSCAN 650 Pan Con Sample location

		Easting	Northing
Sandy Ck West	447A	807601	8195835

Appendix D: Augur Sample Table

Sample ID	E MGA94z54	N MGA94z54	Samp Type	TREO	LREO	HREO	CREO	Mag Reo	Sc_2O_3	La_2O_3	CeO_2	Pr_6O_{11}	Nd_2O_3	Sm_2O_3	Eu_2O_3	Gd_2O_3	Y_2O_3	Tb_4O_7	Dy_2O_3	Ho_2O_3	Er_2O_3	Tm_2O_3	Yb_2O_3	Lu_2O_3	Note
				ppm	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
SM-01	809133	8193543	Auger	368.93	97.15	2.85	18.48	23.15	17.6	78.3	162.1	18.7	60.3	10.3	1.5	9.5		1.11	5.3	1.09	2.3	0.38		0.38	
SM-02	809383	8193538	Auger	457.05	97.72	2.28	18.68	23.65	12.3	99.0	208.8	24.0	77.3	12.9	1.3	10.9		1.21	5.5	1.03	2.1	0.32		0.31	
SM-03	809634	8193515	Auger	270.14	97.16	2.84	18.21	22.73	13.2	56.3	121.0	13.4	43.4	7.4	1.2	6.6		0.81	3.8	0.80	1.7	0.29		0.27	
SM-04	809873	8193517	Auger	479.30	97.30	2.70	18.56	23.22	23.9	101.0	211.3	24.2	79.2	13.6	1.8	11.4		1.38	6.5	1.37	2.7	0.46		0.44	
SM-05	810135	8193520	Auger	515.48	97.81	2.19	19.34	24.54	13.2	116.2	226.0	28.2	91.0	15.3	1.4	12.9		1.38	6.0	1.11	2.2	0.34		0.33	
SM-6A	810388	8193515	Auger	350.92	96.85	3.15	18.33	22.73	24.7	70.6	151.1	17.3	56.0	9.6	1.8	8.8		1.11	5.4	1.19	2.5	0.42		0.42	
SM-6B	810388	8193515	Auger	424.01	97.80	2.20	18.60	23.54	12.7	91.0	194.1	22.1	71.6	12.1	1.1	9.9		1.15	4.9	0.92	1.8	0.26		0.24	*duplicate*
SM-6B-2	810388	8193515	Auger	470.40	97.78	2.22	18.46	23.43	14.1	101.8	215.0	24.6	78.7	13.2	1.3	11.2		1.32	5.5	1.01	2.1	0.29		0.27	*duplicate*
SM-07	810641	8193513	Auger	237.47	96.50	3.50	17.91	21.98	19.5	45.7	103.1	11.1	36.3	6.3	1.4	5.8		0.79	4.0	0.88	1.9	0.33		0.35	
SM-08	810866	8193524	Auger	276.48	96.77	3.23	18.19	22.53	18.7	56.9	119.2	13.4	43.6	7.7	1.4	6.7		0.88	4.4	0.95	2.1	0.34		0.34	
SM-09	811134	8193498	Auger	307.50	97.88	2.12	18.52	23.45	9.7	67.9	138.8	16.1	51.8	8.7	0.9	7.1		0.80	3.4	0.63	1.3	0.19		0.18	
SM-10	811638	8193602	Auger	481.23	97.76	2.24	19.70	25.03	11.7	108.7	208.8	26.8	86.5	14.5	1.1	12.2		1.35	5.7	1.05	2.1	0.31		0.28	
SM-11	811823	8194069	Auger	401.64	96.93	3.07	18.38	22.89	23.6	83.6	174.4	19.9	64.6	11.4	1.8	9.9		1.20	6.2	1.31	2.7	0.43		0.43	
SM-12	811672	8193858	Auger	367.71	97.92	2.08	18.12	22.94	8.3	81.9	169.5	19.0	60.0	10.8	1.2	9.5		1.08	4.4	0.70	1.3	0.15		0.10	
SM-13	811904	8193610	Auger	391.60	97.15	2.85	18.38	22.99	23.2	81.5	170.7	19.7	63.7	10.7	1.6	9.3		1.14	5.5	1.17	2.5	0.41		0.42	
SM-14	812103	8193624	Auger	342.34	97.23	2.77	18.51	23.22	19.3	70.6	149.9	17.4	56.1	9.7	1.3	8.5		1.06	4.9	0.96	1.9	0.30		0.30	
SM-15	812371	8193862	Auger	234.51	97.55	2.45	18.31	22.97	9.8	50.8	104.7	12.1	38.3	6.6	1.1	5.4		0.66	2.9	0.58	1.3	0.18		0.18	
SM-16	812620	8193624	Auger	512.77	98.05	1.95	19.04	24.17	11.5	117.2	227.3	27.8	89.3	15.4	1.5	12.8		1.40	5.4	0.96	1.8	0.24		0.18	
SM-17	812812	8193635	Auger	418.58	98.04	1.96	18.41	23.19	9.4	94.4	191.6	21.7	69.8	11.9	1.8	9.8		1.09	4.5	0.77	1.5	0.19		0.17	
SM-18	812128	8193628	Auger	484.67	97.91	2.09	19.59	24.79	12.0	110.2	210.1	26.7	86.5	14.8	1.5	12.7		1.38	5.5	1.00	1.8	0.24		0.18	
SM-19	813376	8193613	Auger	670.81	98.27	1.73	19.21	24.54	15.8	156.0	294.8	37.5	119.0	19.1	1.7	15.3		1.65	6.5	1.10	1.9	0.23		0.16	
SM-20	813667	8193602	Auger	628.88	97.93	2.07	20.09	25.51	13.2	141.9	272.7	35.5	115.9	19.1	1.4	16.0		1.75	7.2	1.24	2.3	0.29		0.22	
SM-21	813828	8193570	Auger	976.52	98.61	1.39	18.57	23.80	12.0	197.0	481.5	52.3	170.3	27.8	1.2	20.7		2.03	7.8	1.20	2.2	0.23		0.15	
SM-22	814104	8193626	Auger	546.97	98.09	1.91	19.40	24.78	13.7	124.3	238.3	30.8	97.9	17.0	1.4	13.1		1.35	5.5	1.01	2.1	0.29		0.25	
SM-23	814360	8193613	Auger	450.85	98.03	1.97	18.77	23.87	8.9	98.0	207.6	24.0	77.7	13.5	1.1	11.2		1.19	4.7	0.86	1.7	0.23		0.19	
SM-24A	814650	8193627	Auger	377.89	97.21	2.79	17.98	22.52	20.9	78.8	167.1	18.7	60.0	10.9	1.6	9.5		1.14	5.3	1.11	2.3	0.38		0.36	
SM-24B	814650	8193627	Auger	244.44	96.22	3.78	19.71	24.37	21.5	53.6	89.9	12.7	41.3	7.3	1.3	7.6		1.00	4.6	0.97	2.1	0.32		0.31	*duplicate*
SM-25	814929	8193655	Auger	611.92	97.84	2.16	19.07	24.28	17.3	143.1	264.1	33.5	106.6	17.6	1.6	14.9		1.60	6.9	1.35	2.6	0.39		0.39	
SM-26	815167	8193650	Auger	445.58	97.36	2.64	18.19	23.00	16.4	95.8	201.5	22.8	72.4	12.4	1.4	11.1		1.26	6.0	1.21	2.5	0.41		0.41	
SM-27	815390	8193605	Auger	431.86	97.38	2.62	18.19	22.86	20.7	91.4	192.9	21.7	70.0	11.7	1.6	10.6		1.26	5.7	1.15	2.4	0.39		0.36	
SM-28	815633	8193638	Auger	356.82	97.46	2.54	18.02	22.63	16.9	76.6	159.7	17.8	57.4	9.6	1.3	8.5		1.02	4.6	0.93	1.9	0.30		0.30	
SM-30	815633	8193638	Auger	155.48	85.87	14.13	29.02	23.27	16.7	20.6	54.0	6.0	26.5	4.5	1.2	3.9	13.71	0.05	3.7	0.56	2.2	0.23	1.4	0.20	*twin*
SM-342	813963	8196260	Auger	200.68	87.40	12.60	27.52	22.55	17.8	35.2	70.3	7.6	33.4	5.5	1.3	4.5	16.25	0.54	3.8	0.60	2.3	0.22	1.4	0.23	
SM-343	817006	8193634	Auger	106.98	90.70	9.30	24.36	21.84	6.6	17.8	45.6	3.9	17.5	2.8	0.6	2.3	6.03	0.26	1.7	0.25	0.9	0.11	0.6	0.09	
SM-345	816502	8193639	Auger	197.98	89.20	10.80	27.08	23.81	15.2	34.6	72.4	8.0	35.2	5.7	1.0	4.6	13.46	0.51	3.4	0.53	1.9	0.18	1.1	0.18	
SM-346	816001	8193966	Auger	230.41	88.45	11.55	27.64	23.75	19.5	38.9	82.2	9.1	40.7	6.8	1.1	5.4	17.02	0.61	4.2	0.63	2.3	0.23	1.4	0.22	
SM-347	816186	8193926	Auger	143.18	86.95	13.05	28.09	23.22	16.1	21.9	48.0	5.5	24.4	4.2	0.8	3.6	11.59	0.42	3.0	0.47	1.7	0.17	1.1	0.18	
SM-348	815504	8198504	Auger	178.71	88.90	11.10	23.79	20.15	14.1	24.0	79.6	5.8	26.2	4.6	0.7	3.7	11.66	0.47	3.4	0.54	1.9	0.22	1.4	0.20	
SM-349	815750	8189504	Auger	304.94	90.68	9.32	26.97	25.04	14.1	56.5	117.4	13.2	57.7	9.4	1.0	7.1	18.03	0.75	4.7	0.68	2.4	0.25	1.4	0.23	
SM-350	815995	8198510	Auger	290.74	90.77	9.23	26.07	23.99	14.3	52.3	117.6	12.0	52.6	8.1	0.9	6.1	17.14	0.65	4.5	0.62	2.3	0.22	1.3	0.20	
SM-351	816251	8198508	Auger	217.75	90.69	9.31	26.13	24.06	14.4	39.5	82.9	9.0	39.4	6.4	0.8	5.0	12.67	0.51	3.4	0.49	1.8	0.16	1.0	0.15	
SM-352	816518	8198477	Auger	249.05	92.03	7.97	25.98	25.29	10.6	47.7	97.8	10.8	47.7	7.8	0.8	6.0	11.67	0.60	3.9	0.53	1.8	0.16	1.0	0.15	
SM-353A	816776	8198493	Auger	277.32	91.48	8.52	26.14	24.68	13.8	52.3	107.7	11.8	51.9	8.6	0.9	6.7	14.86	0.66	4.1	0.56	2.1	0.17	1.0	0.16	
SM-353B	816776	8198493	Auger	230.12	88.60	11.40	27.38	23.80	18.1	39.9	83.2	9.1	40.6	6.7	1.0	5.3	16.38	0.56	4.5	0.86	2.2	0.22	1.4	0.19	*duplicate*
SM-354	817003	8198465	Auger	315.87	92.02	7.98	22.08	20.35	16.7	47.5	152.3	10.9	48.2	7.9	1.1	6.1	15.24	0.65	4.6	0.63	2.3	0.23	1.4	0.23	
SM-355	815147	8198842	Auger	268.89	92.52	7.48	26.19	25.69	11.0	50.3	106.7	11.8	53.0	8.7	0.7	6.5	12.43	0.62	3.7	0.49	1.7	0.15	0.9	0.13	
SM-356	814908	8198851	Auger	220.76	91.41	8.59	26.43	25.24	11.7	38.5	87.0	9.4	42.3	7.0	0.7	5.3	11.35	0.52	3.4	0.47	1.8	0.16	1.0	0.16	
SM-357	814616	8198858	Auger	309.23	93.39	6.61	25.23	25.52	10.6	59.0	126.5	13.9	60.2	10.2	0.9	7.5	12.05	0.72	4.1	0.50	1.8	0.15	0.9	0.14	
SM-358	814545	8198699	Auger	225.90	90.20	9.80	26.71	24.19	15.3	40.3	84.9	9.3	41.2	6.8	0.8	5.1	14.10	0.54	3.7	0.52	1.8	0.18	1.1	0.17	
SM-359	814206	8198499	Auger	269.92	92.60	7.40	26.08	26.09	7.1	51.8	109.1	12.0	53.5	8.9	0.9	6.7	11.07	0.67	4.2	0.56	2.1	0.18	1.0	0.15	
SM-360	813986	8198506	Auger	231.10	91.31	8.69	26.62	25.36	9.7	43.0	90.5	9.9	44.4	7.3	0.8	5.3	12.00	0.58	3.7	0.53	1.9	0.17	1.0	0.16	
SM-361	813785	8198514	Auger	181.29	91.36	8.64	26.20	24.84	8.4	33.4	71.5	7.7	34.1	5.6	0.7	4.3	9.40	0.45	2.9	0.40	1.5	0.13	0.8	0.14	
SM-362	813493	8198516	Auger	406.64	94.55	5.45	25.69	27.11	4.0	80.8	172.0	19.2	85.3	13.2	0.9	9.1	12.55	0.82	4.9	0.63	2.2	0.15	0.8	0.13	
SM-363	812808	8198504	Auger	441.18	92.24	7.76	26.30	25.62	16.7	82.8	176.9	19.6	86.4	13.5	1.3	9.8	21.33	0.93	6.1	0.84	3.0	0.26	1.6	0.24	
SM-364	812551	8198516	Auger	224.98	88.52	11.48	27.56	24.17	14.4	37.6	84.5	9.1	40.5	6.6	1.2	5.2	15.49	0.56	4.2	0.68	2.6	0.26	1.7	0.25	
SM-365	812256	8198506	Auger	260.18	92.38	7.62	26.27	26.17	5.8	49.4	106.5	11.7	52.0	8.3	0.7	5.9	11.21	0.60	3.8	0.55	2.1	0.19	1.3	0.18	
SM-366	812003	8198507	Auger	202.06	89.41	10.59	28.02	25.83	10.0	35.2	75.3	8.7	39.2	6.6	0.7	5.1	12.42	0.55	3.8	0.58	2.3	0.21	1.4	0.20	
SM-367	811778	8198482	Auger	253.72	91.88	8.12	26.26	25.66	8.9	48.1	100.6	11.1	49.3	8.0	0.9	6.1	11.72	0.61	4.0	0.57	2.1	0.19	1.3	0.18	
SM-368	811502	8198455	Auger	216.73	93.76	6.24	25.54	25.97	5.7	43.2	88.1	9.8	42.7	7.1	1.3	5.4	7.63	0.54	3.2	0.39	1.1	0.09	0.5	0.07	
SM-369	811259	8198504	Auger	230.85	93.36	6.64	26.20	26.44	9.8	42.3	91.8	10.2	46.5	7.7	1.2	6.0	8.47	0.60	3.7	0.45	1.4	0.10	0.6	0.09	
SM-370	810998	8198511	Auger	227.65	96.19	3.81	24.08	26.47	3.1	47.6	97.9	10.6	46.9	7.3	0.6	5.0	4.58	0.45	2.3	0.25	0.8	0.03	0.2	0.03	
SM-371	810748	8198496	Auger	407.97	95.19	4.81	25.32	26.98	6.1	83.7	169.5	19.2	85.1	13.9	1.0	9.7	11.43	0.89	4.8	0.53	1.5	0.08	0.3	0.05	
SM-372	810505	8198509	Auger	267.59	94.08	5.92	25.45	26.11	7.2	53.7	109.0	12.1	53.0	8.7	1.5	6.7	8.83	0.72	4.1	0.45	1.3	0.08	0.3	0.05	
SM-373	810253	8198502	Auger	169.40	93.31	6.69	26.55	26.58	5.2	33.8	66.0	7.6	34.2	5.7	1.1	4.5	6.44	0.47	2.8	0.31	0.9	0.06	0.3	0.05	
SM-374	810033	8198495	Auger	166.01	94.26	5.74	25.07	25.73	5.5	32.7	67.8	7.4	32.5	5.5	0.9	4.1	5.32	0.41	2.4	0.26	0.8	0.06	0.2	0.05	
SM-375	809762	8198509	Auger	255.68	94.57	5.43	25.72	26.67	4.4	52.2	104.4	11.7	52.7	8.6	1.4	6.3	7.89	0.55	3.2	0.39	1.3	0.08	0.5	0.06	
SM-377	809308	8198495	Auger	178.99	93.07	6.93	26.12	25.72	4.3	35.8	71.9	7.9	34.9	5.9	1.3	4.6	7.33	0.47	2.8	0.34	1.0	0.08	0.3	0.06	
SM-378	809012	8198503	Auger	166.59	92.91	7.09	26.27	25.98	4.1	32.3	67.1	7.3	32.8	5.7	1.2	4.4	6.64	0.44	2.8	0.34	1.0	0.08	0.5	0.07	
SM-379	808758	8198518	Auger	141.46	94.20	5.80	25.40	26.22	1.4	28.6	59.0	6.5	28.2	5.1	0.7	3.8	4.60	0.34	2.1	0.23	0.7	0.03	0.2	0.03	
SM-380	808672	8198494	Auger	180.31	90.19	9.81	26.97	25.13	7.5	33.0	69.8	7.6	33.9	5.6	0.9	4.4	9.97	0.47	3.3	0.50	1.9	0.17	1.1	0.17	
SM-381	808656	8198483	Auger	151.78	89.31	10.69	27.72	25.34	6.7	26.9	57.7	6.4	28.6	4.8	0.8	3.7	9.17	0.41	3.1	0.47	1.7	0.17	1.0	0.16	
SM-383	808248	8195749	Auger	148.57	89.25	10.75	27.01	24.47	7.7	26.3	57.1	6.1	26.8	4.2	0.8	3.6	9.09	0.40	3.0	0.44	1.7	0.16	1.0	0.16	
SM-385	808604	8195657	Auger	137.27	87.71	12.29	27.57	23.42	12.3	22.8	48.3	5.3	23.6	3.9	0.9	3.3	10.10	0.39	2.9	0.45	1.7	0.16	1.0	0.17	
SM-390A	809500	8195751	Auger	192.43	92.88	7.12	25.87	25.35	5.5	37.4	78.0	8.3	37.0	6.3	1.5	4.7	7.84	0.49	3.0	0.38	1.3	0.10	0.6	0.08	
SM-390B	809500	8195751	Auger	366.85	93.81	6.19	25.18	25.50	10.0	73.8	151.1	16.4	71.4	11.8	1.3	8.4	13.97	0.81	4.9	0.53	1.7	0.10	0.6	0.07	*duplicate*
SM-391A	809742	8195743	Auger	187.05	93.93	6.07	24.87	25.05	5.8	38.0	76.7	8.3	35.7	5.8	1.1	4.3	6.86	0.42	2.4	0.29	0.9	0.07	0.3	0.05	
SM-391B	809742	8195743	Auger	188.45	94.03	5.97	25.24	25.84	3.2	39.4	77.6	8.4	36.9	6.0	1.1	4.5	6.16	0.44	3.0	0.30	0.9	0.07	0.3	0.06	*duplicate*
SM-392	810010	8195746	Auger	263.79	92.93	7.07	25.66	25.36	8.4	52.1	106.3	11.7	51.1	8.5	1.1	6.1	11.38	0.59	3.6	0.48	1.6	0.13	0.8	0.11	
SM-393	810249	8195750	Auger	245.11	91.15	8.85	26.87	25.82	5.1	49.3	96.4	10.9	47.9	7.4	0.9	5.5	12.53	0.58	3.9	0.60	2.3	0.22	1.4	0.22	
SM-394	810449	8195750	Auger	302.74	91.43	8.57	26.89	25.72	8.6	61.1	116.5	13.2	59.0	9.7	1.3	7.4	15.37	0.75	4.9	0.70	2.5	0.24	1.3	0.18	
SM-395	810750	8195752	Auger	157.69	89.19	10.81	26.88	24.01	9.7	26.9	60.4	6.4	27.9	4.6	1.3	3.6	9.63	0.42	3.2	0.47	1.8	0.17	1.1	0.17	
SM-399	811250	8195749	Auger	199.92	91.83	8.17	26.86	25.90	4.8	38.2	79.1	8.8	39.1	7.0	1.3	5.4	9.46	0.58	3.3	0.44	1.5	0.13	0.8	0.11	
SM-402	811750	8195753	Auger	306.06	92.34	7.66	26.10	25.67	8.4	60.3	122.8	13.4	59.7	9.6	1.1	7.1	13.59	0.73	4.7	0.63	2.2	0.19	1.3	0.18	
SM-403	813749	8195752	Auger	342.72	93.38	6.62	25.69	25.95	8.1	66.7	141.3	15.2	68.2	11.2	1.1	8.1	13.21	0.78	4.7	0.62	2.2	0.16	0.9	0.14	
SM-404	813498	8195744	Auger	427.77	94.03	5.97	25.73	26.69	8.1	85.5	175.7	19.8	87.9	14.1	1.4	9.7	14.35	0.92	5.5	0.73	2.5	0.19	1.1	0.18	
SM-405	813284	8195751	Auger	179.50	92.62	7.38	26.20	25.75	7.2	34.4	70.8	7.9	35.2	5.7	0.8	4.3	7.95	0.41	2.6	0.34	1.1	0.09	0.6	0.09	
SM-409	812375	8195753	Auger	217.96	93.83	6.17	24.71	25.30	6.1	40.7	93.0	9.5	42.0	7.1	0.8	5.3	7.44	0.53	3.1	0.38	1.3	0.10	0.6	0.07	
SM-410	812181	8195699	Auger	281.21	91.35	8.65	26.49	25.35	9.7	54.3	110.4	12.0	53.9	8.8	1.1	6.7	14.10	0.69	4.7	0.63	2.4	0.23	1.4	0.20	
SM-411	814008	8195748	Auger	244.87	93.52	6.48	25.34	25.94	6.1	48.1	101.1	11.0	48.6	7.8	0.8	5.5	8.78	0.55	3.3	0.44	1.6	0.14	0.9	0.13	
SM-413	814500	8195745	Auger	187.91	92.62	7.38	21.79	21.05	13.8	28.6	86.2	6.6	29.6	4.8	0.7	3.7	7.37	0.41	2.9	0.41	1.5	0.15	1.0	0.15	
SM-414	814754	8195747	Auger	352.82	93.68	6.32	25.79	26.42	8.6	67.0	146.2	15.8	71.5	11.6	1.2	8.6	12.37	0.85	5.0	0.64	2.1	0.16	1.0	0.14	
SM-415	815005	8195749	Auger	147.86	94.32	5.68	24.09	25.17	8.1	27.0	60.8	6.4	28.6	4.8	0.4	3.5	4.33	0.34	2.0	0.25	0.9	0.08	0.5	0.07	
SM-416	815258	8195750	Auger	277.60	91.55	8.45	27.19	26.34	8.0	54.8	106.3	12.6	55.5	8.9	1.3	6.8	13.59	0.67	4.4	0.64	2.4	0.22	1.4	0.20	
SM-417	815347	8195748	Auger	254.12	87.48	12.52	27.22	22.29	28.2	41.9	86.5	9.4	41.8	7.3	1.1	6.2	20.83	0.69	4.8	0.76	2.6	0.25	1.6	0.24	
SM-418	815503	8195748	Auger	314.24	92.65	7.35	25.44	25.23	9.8	60.2	129.0	13.5	60.3	9.9	1.1	7.4	13.08	0.74	4.7	0.63	2.3	0.21	1.3	0.19	
SM-419	815755	8195749	Auger	311.62	92.25	7.75	25.80	25.37	10.1	60.0	125.3	13.5	60.0	10.0	1.2	7.4	13.71	0.75	4.8	0.69	2.4	0.21	1.4	0.20	
SM-420	816250	8195749	Auger	257.83	93.31	6.69	25.47	25.80	4.3	52.8	105.9	11.6	50.9	8.2	0.8	6.1	10.01	0.58	3.4	0.46	1.6	0.14	0.9	0.11	
SM-421A	816500	8195751	Auger	455.07	93.42	6.58	25.67	26.19	9.4	91.0	186.7	20.7	91.2	14.5	1.3	10.4	17.02	0.99	6.3	0.81	2.9	0.24	1.5	0.23	
SM-421B	816500	8195751	Auger	356.82	93.04	6.96	25.75	25.95	8.9	70.1	145.0	15.9	70.8	11.6	1.1	8.5	14.10	0.81	5.0	0.71	2.5	0.22	1.3	0.19	*duplicate*
SM-423	816748	8195750	Auger	270.66	92.82	7.18	25.69	25.66	7.4	52.0	111.3	12.0	53.1	8.5	1.0	6.1	11.09	0.60	3.8	0.54	1.9	0.18	1.1	0.15	
SM-424	816998	8195747	Auger	254.01	91.77	8.23	26.50	25.63	7.7	49.8	100.1	11.1	49.6	8.0	1.1	5.8	12.17	0.58	3.9	0.57	2.1	0.19	1.3	0.18	

Appendix E: QEMSCAN Table

Sample 650	
	%
Si (QEMSCAN)	6.81
Fe (QEMSCAN)	18.05
Ti (QEMSCAN)	13.46
Mg (QEMSCAN)	2.75
Al (QEMSCAN)	2.40
Mn (QEMSCAN)	0.25
Ca (QEMSCAN)	0.14
K (QEMSCAN)	0.02
P(QEMSCAN)	1.81
Zr (QEMSCAN)	8.15
Hf (QEMSCAN)	0.30
Ce (QEMSCAN)	2.80
La (QEMSCAN)	1.38
Nd (QEMSCAN)	1.41
Th (QEMSCAN)	1.23
Y (QEMSCAN)	0.35
Dy (QEMSCAN)	0.003
Er (QEMSCAN)	0.003
Yb (QEMSCAN)	0.006
Gd (QEMSCAN)	0.001
U (QEMSCAN)	0.000

QEMSCAN calculated chemical analyses (wt %)