Rialtas na hÉireann
Government of Ireland

APPENDIX D – RADIOMETRIC DATING

Merlin Energy Resources Ltd

PIP
Petroleum Infrastructure Programme

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APPENDIX D – RADIOMETRIC DATING

INTRODUCTION

To assist the evaluation of the age of selected igneous rock units, 10 new radiometric dating analyses were carried out within this project. The wells and igneous rocks selected for this new analysis were chosen from the full database listed in **Table A4 (Chapter A)** with a focus on cases where no previous dating had been carried out, or where spurious and inconsistent results had been returned from historical analysis. The choice of rock units for new analysis was selected following suggestions from the project Steering Committee. The wells and boreholes chosen for the radiometric dating analysis are shown in **Figure A6 (Chapter A).** Of those igneous rocks analysed, those that are considered to be extrusive have been named and described in the appropriate section of **chapter D, Stratigraphic Intervals**, of this Atlas. The named rock units that have been analysed radiometrically are; Púca Member (?Galley Formation), Druid Formation (Stronsay Group), Merrow Member (Cot Sandstone Formation), Selkie Member (?Dursey Formation), Sheerie Member (Bradán Formation) and the Péist Member (Gweedore Formation). Photographs of the core samples and thin sections are provided as illustrative figures supporting the descriptions of these rock units in **chapter D** of the Atlas.

While the initial project scope required that K-Ar dating method be used, during the project the requirement was changed such that all analyses were carried out using the Ar-Ar method on the advice of the project steering committee, which expressed the opinion that this method was likely to yield better results. The igneous samples originally chosen for radiometric dating were described, including thin section analysis by Dr Carl Stevenson (University of Birmingham, UK) who also made recommendations regarding the feasibility of obtaining reliable dating results (Stevenson, 2017). The radiometric dating analyses were carried out by ActLabs, Ontario, Canada. Following the receipt of results, in February 2018 (Actlabs 2018), considerable discussion of the results, and their implications, ensued between the project stratigraphers, PAD/PIP, Dr Stevenson (email to P. Copestake) and Professor J. Stephen Daly (University College Dublin) who was recommended by the project steering committee to provide further independent professional opinion. The results were discussed in a conference call (summarised by ISPSG Secretariat, 2018) following which Daly provided an updated assessment of the results (Daly, 2018). Following this internal discussion, the project stratigraphers interpreted the results and those radiometric dates that are considered to be reliable have been incorporated into the overall stratigraphic evaluations carried out for this project. Summary comments on these Merlin consortium interpretations are provided in **Table A.D. 1** and **Table A.D. 2,** together with a summary of key data from Stevenson (2017), Actlabs (2018) and Daly (2018) and details of all samples analysed radiometrically. These tables also summarise all the key results of the radiometric dating, with core photographs and thin section micrographs. Key reports from this work are provided as digital addenda to this atlas (see below).

The focus was on obtaining samples from cores; however, in one well 26/30-1, samples were taken from cuttings in order to try and obtain an age for crystalline basement. In addition, the samples analysed from the Peist Member are from ditch cuttings.

PETROGRAPHY & DESCRIPTION OF VOLCANIC SAMPLES ANALYSED FOR RADIOMETRIC DATING

Candidate samples were first described and studied in thin section by an independent geochemical expert Dr Carl Stevenson (Stevenson, 2017, which is included in the Digital Addenda of this Atlas) and an example of a thin section is shown in **Figure A.D. 1**. A range of igneos rock types were encountered in wells drilled in the Irish offshore basins. Interpreted origins vary from extrusive (lavas and tuffs) to intrusive (sills and or dykes). Recommendations were made for new radiometric dating along with suggestions for the types of minerals to be analysed and potential risks that could affect the accurate radiometric dating, such as degree of mineral alteration. Alteration of primary minerals (principally feldspar to clay) was recognised as a significant limitation for at least five of the ten samples. Despite the results of the feasibility study, the ISPSG members requested that Ar-Ar analysis be carried out on all ten samples.

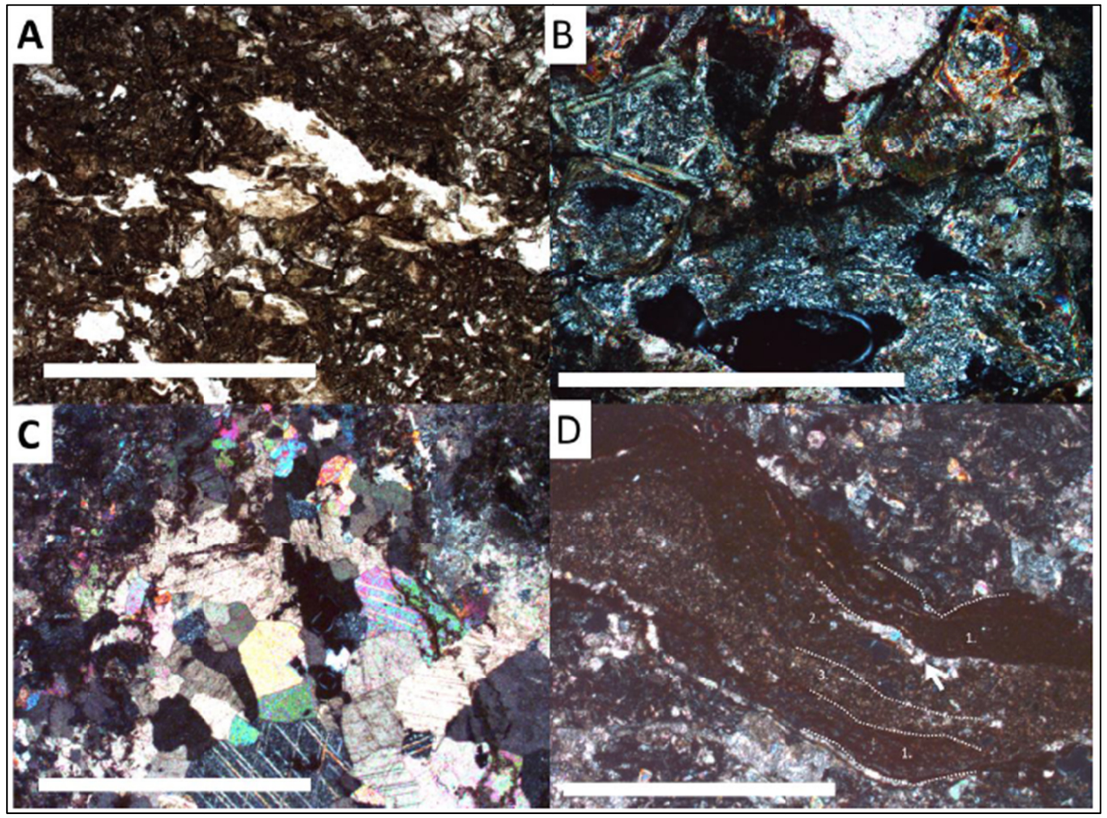


Figure A.D. 1 ***Example photomicrographs from sample 12/2-1z 3963.0m (Merrow Member) showing a range of altered textures and secondary mineralisation.***

A) Plane polarised light, scale bar = 2 mm. Greenish brown sericitisation and chlorite dominating groundmass. B) Crossed polarised light, scale bar = 1 mm. Micro sphericular zeolite dominates view and mainly replaces primary igneous minerals. Calcite is present (top middle) and fibrous serpentinite veins remain where olivine has been replaced by zeolite and iddingsite. C) Crossed polarised light, scale bar = 2 mm. Sparry calcite replacing much of the rock. D) Plane polarised light, scale bar = 2 mm. Fine grained material in a vein is opaque and calcite. Multiple stages of vein growth (fine dotted lines and numbers) indicate multiple phases of hydrothermal fluid flow. White arrow highlights a fragment of calcite captured during early vein formation indicating early pervasive replacement alteration before veining, modified after Stevenson (2017).

RADIOMETRIC DATING METHODOLOGY

Ten samples were submitted to ActLabs, Ontario, Canada for Ar-Ar geochronology; four samples as mineral separates and the rest as whole rock samples.

The samples were pretreated for the Ar-Ar test; the $^{40}Ar/^{39}Ar$ age was obtained by the incremental heating method using the Noblesse Noble Gas static mass spectrometer. The samples were irradiated in the nuclear reactor at McMaster University, along with the LP-6 flux monitors. Individual J-values for each sample were calculated by parabolic extrapolation of the measured flux gradient against irradiation height and typically give 0.2-0.3% uncertainties (1σ). The Ar isotope composition was measured in a Noblesse Noble Gas static mass spectrometer (NU Instrument Ltd.). 1200ºC blank of ^{40}Ar did not exceed $n*10^{-11}$ cc STP.

Where appropriate, Ar-Ar dating was undertaken on unaltered mineral separates (typically feldspars) to reduce the tendency for contamination in altered specimens and boost the concentration of key isotopes. Such an approach is best used when dealing with phenocrystic rocks with large feldspar crystals. It was therefore diffciult in some cases to isolate ideal specimens, a problem most often encountered when dealing with lavas and rapidly cooled doleritic intrusions.

All ages were calculated using the corrected Steiger & Jäger (1977) decay constant of $5.530 \pm 0.097 \times 10^{-10}$ 1/yr (2σ) as reported by Min *et al*. (2000). For all other constants used in the age calculations refer to Table 2 in Koppers *et al*. (2003).

Note: Plateaux were not observed in the majority of the samples. Also, isochrone could not be plotted. It could be attributed to the complex composition of the samples (see Ca/K ratio graphs) and to the likelihood of mineralogical alteration such as illitisation of feldspars". Probability Density Age Graphs were plotted for each sample. Using geological description, petrography study and probability density graphs the ages of main geological events can be concluded for this study.

RADIOMETRIC DATING RESULTS

The findings of the igneous rock analysis including petrography and radiometric dating are summarised in **Table A.D. 1** and **Table A.D. 2.** Additional details of the radiometric dating analyses are provided in the Actlabs (2018) end of job report which is included in the Digital Addenda of this Atlas.

RADIOMETRIC DATING CONCLUSIONS, COMMENTS AND RECOMMENDATIONS

Whilst other methods e.g. K-Ar and U-Pb were considered, Ar-Ar was considered to give the highest probability of yielding reliable radiometric ages given the limited number of samples and sample runs available. An acknowleded limitation of the study is therefore the inability to run repeat samples to ensure a reliable measure of accuracy in the outcomes.

Of the 10 samples analysed, several returned ages considered to be consistent with previous published analysis or inferred ages deduced from geological investigations and logical controls e.g. lava extruded onto a Paleocene sediment must be Paleocene or younger in age. The large numbers of reatively even peaks in the Probability Density plots for each sample suggest low confidence in the results. Ideally, such a plot should exhibit a single dominant peak corresponding to the correct age bracket. Multiple ages could represent distinct cooling and alteration events, however, there are several examples where peaks in the Actlabs plots do not correspond to logical or credible explanations. Third party expertise was sought to further establish the validity of the data and determine the relative credibility of any age assertions made by the consortium

The interpretation of the new data by independent geochemical expert, Professor J. Stephen Daly (Daly (2018); included in the Digital Addenda of this Atlas), indicates up to 7 of the 10 samples analysed are thought to have returned questionable or unsubstantiatable ages e.g. lava extruded onto a Paleocene sediment must be Paleocene or younger in age and cannot possess a crystallization age dating back to the Precambrian (unless crystals have been incorporated from an earlier cooling episode).

The results of new radiometric dating therefore demonstrate the difficulty in obtaining reliable dates for samples subjected to natural alteration. Whilst single samples have not, in some cases, yielded reliable ages, it is possible that more comprehensive follow-up studies involving multiple samples from the same rock could improve the reliability of the plateau ages and therefore improve the accuracy of the study. However, the generally highly altered nature of many of the samples will always hamper the process of seeking reliable radiometric dates.

The final comments on the radiometric dating, included in **Table A.D. 1** and **Table A.D. 2** summarise the current Merlin consortium view of the age of the rock units that have been analysed. This takes into account all available stratigraphic data together with any inferences on stratigraphic position arising from the interpretation of seismic data near the samples in question. The latter approach has been quite revealing, particularly in the cases where the studied rocks lie beneath the Base Cretaceous seismic horizon as interpreted in this study.

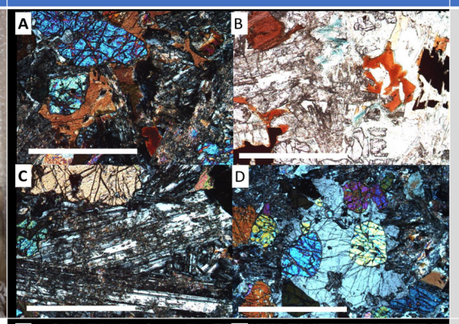
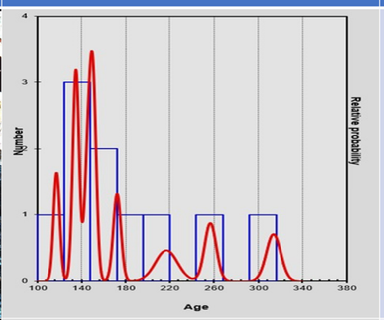
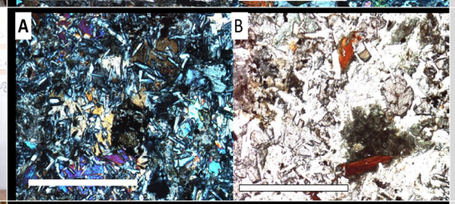
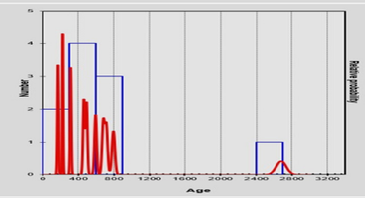
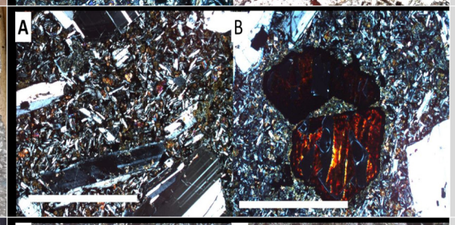
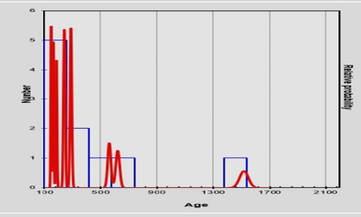
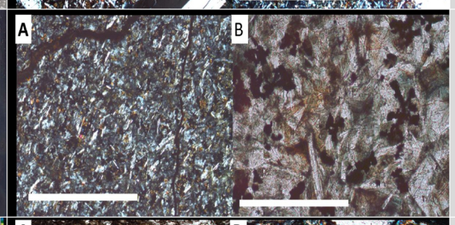
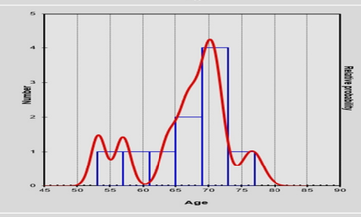
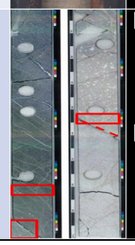
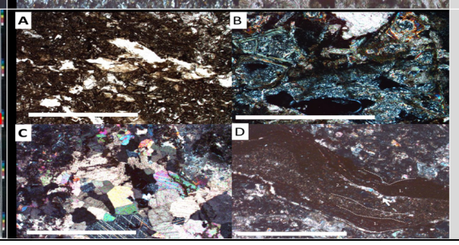
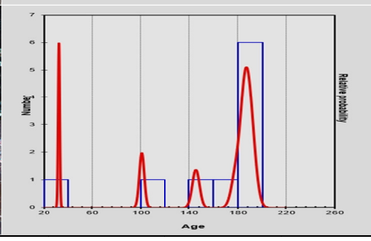
Well+Sample Name [rock unit name]	Sample Description (Stevenson, 2018)	Hand Specimen Photograph	Photomicrograph (Stevenson, 2018)	Probability Density Plot (Actlabs, 2018)	Interpreted Age (Actlabs, 2018)	Stevenson (2018) Comments (email to P. Copestake, 5th March 2018; comments below are verbatim)	Daly (2018) Comments	Conclusions (this study)
56/26-1. A17-12872-1 Fastnet Basin "Gabbro". Feldspar separate. **2950m** [unnamed, present at TD below Glenbeg Fm]	Medium-coarse grained, weakly porphyritic (phaneritic holocrystalline), orthocumulate gabbro. Sample 1(Feldspar): From the crushed ~0.5 mm obtained a separate by heavy liquid separation and paramagnetism on the 0.063 to 0.5 mm. Recovering a 3.1g separate from the heavy liquid floats; SEM: checks confirms mostly Plagioclase (Ca>Na>K), minor Calcite and Mica.				150.28 Tithonian	*Feldspar separate* *170 Ma from existing K-Ar on biotite. So 150 Ma seems young here. Thin section shows alteration affecting feldspars. It is also possible that Ar loss (again from open system alteration) may play a role.*	Stevenson's report refers to this sample as an olivine microgabbro intruding Lower Jurassic sediments (Hettangian-Sinemurian), i.e. < 191 Ma. Although the majority of age steps are younger than c. 191 Ma, no plateau age is defined (a "plateau" is present when three consecutive age steps representing at least 50% of the 39Ar (39K) in the sample coincide within analytical uncertainty). This sample dispays a highly irregular age spectrum. Moreover the Ca/K spectrum is also highly irregular and does not correlate in a readily interpretable manner with the ages. The Ca/K values can be used as a measure of sample purity. For plagioclase (presumably the feldspar in this case is plagioclase), a uniform high Ca/K value would be expected. Lower Ca/K values could indicate the presence of a K-bearing alteration mineral such as illite, or igneous minerals such as biotite or hornblende. This sample is probably a mixture of the intended target (plagioclase) and an alteration product e.g. illite. **Conclusion:** The mineral separate is a mixture and no useful age information can be obtained from these data.	Dated by BP (Operator) and described by Caston *et al.* (1995) as Middle Jurassic. No reliable age information can be obtained from radiometric data. This also calls into question the Middle Jurassic dating of previous authors.
35/13-1. A17-12872-2 Porcupine Basin. Gabbro. Feldspar separate. **3834.22m** [unnamed, intrudes Bradán Fm]	Fine-med dark greenish holocrystalline dolerite or microgabbro. Plagioclase and pyroxene dominate with some olivine phenocrysts; some alteration. Sample 2:(Feldspar): From the crushed ~0.5 mm obtained a separate by heavy liquid separation and paramagnetism on the 0.063 to 0.25 mm. Recovering a 0.3g separate from the heavy liquid floats SEM check confirms: Plagioclase(Ca>Na) and minor Calcite, Quartz and Fe stain.				229.5 Triassic	*Feldspar separate* *229 Ma is older than expected (L. Cretaceous ~113 Ma). Again the age spectrum does not provide a plateau and we may have some open system excess Ar.*	This is a gabbro intrusion cutting Lower Cretaceous sediments. This sample displays a highly irregular age spectrum in which all age steps are impossibly old, i.e. they significantly exceed the age of the enclosing sediments, interpreted as indicating the presence of excess radiogenic argon. There is a tendency for older ages to correlate with the Ca/K ratio. **Conclusion:** No useful age information can be obtained from these data.	This is a gabbro intrusion cutting Lower Cretaceous (Late Albian Bradán Formation) and must be Early Cretaceous or younger in age. Considering this, it is concluded that the radiometric data are not reliable.
62/7-1. A17-12872-3 Goban Spur Basin. Basalt. Mineral Separate. **9627ft** [Púca Member, ?Galley Fm]	Porphyritic basalt with a trachytic texture indicating trachybasalt or trachydacite. Sample 3:(Feldspar): From the crushed ~0.5 mm obtained a separate by heavy liquid separation and paramagnetism on the 0.063 to 0.5 mm. Recovering a 2.7g separate from the heavy liquid floats. SEM check confirms Plagioclase (Ca>Na>>K), minor Calcite, Mica and Fe stain.				154.4 Kimmeridgian	*Feldspar separate* *154 Ma (Kimmeridgian) new date is older than 133 Ma age. A possible Jurassic age was suggested by Colin et al. (1592) (see also seismic line from discussion with Merlin). Although no plateau age, this new age seems stratigraphically more plausible.*	Stevenson's 2017 report (quoting Colin *et al.*, 1992) states that this sample is a phyric basalt overlain by Bathonian sediments*, implying a maximum age of c. 166 Ma. A younger age is, of course, possible if the rock is intrusive. Most age steps are well in excess of 166 Ma. One age step (169.9 ± 3.4) is within error of 166 Ma (i.e., the end of the Bathonian Stage, but the adjacent steps (c. 154 and 191 Ma) are far off defining a plateau. These also show a significant variation in Ca/K ratio. **Conclusion:** No useful age information can be obtained. *note this quote from Stevenson (2017) pre dated the final Merlin interpretation of the Base Cretaceous seismic horizon being above this igneous rock in the 62/7-1 well.	The ActLabs Kimmeridgian age is consistent with the position of the rock (named as the new Púca Member herein), beneath the Base Cretaceous seismic horizon, which would suggest a Late Jurassic or older age. The member is questionably allocated to the Galley Formation within the Hook Group, by correlation with the Fastnet Basin stratigraphy. The lava is overlain by Hauterivian rocks (Gurnard Formation, Cromer Knoll Group) and is immediately underlain by undated (but possible Late Jurassic) sediments. Various radiometric dates for the lava have been previously published by Esso (Colin *et al.*, 1982; Bathonian), 130-137 Ma (Valanginian) (Tate & Dobson, 1988), 93.8 Ma (Turonian) (BGS, 2009). The Actlabs age is the most plausible stratigraphically.
19/13-Sb02 (BH1A). A17-12872-4 Northern Slyre Basin. Basalt. Whole-rock **106.00m** [Druid Formation, Stronsay Gp]	Dark and very fine grained, aphanitic almost glassy basalt				70.5 (66.6+/- 6.6 Concordia) Maastrichtian	*This was on whole rock (fine grained)* *70 Ma is older than expected (Eocene 54 Ma). Concordia age at 66.6 might appear closer but this has a very poor MSWD of 795. Low Ca/K coinciding with young age on the age spectra might indicate some hydrothermal alteration.* *Ar loss in samples due to weathering of the groundmass would affect final radiometric ages from the 19/13-sb02 (BH 1A) well, and the 65 Ma age is therefore unlikely to be a reliable date.*	The data do not define a plateau. However two successive steps (nos 4 and 5) yield an average age of c. 65 Ma corresponding to c. 40% of the gas evolved. These (and adjacent) steps are characterised by low but nearly constant Ca/K ratios. This age is consistent with the (admittedly limited) stratigraphic constraint. The data also define a very scattered (high MSWD = 795) Ar-Ar isochron age of 66.6 ± 6.6 Ma. However the 36Ar/40Ar intercept value is similar to that of atmospheric argon suggesting that little if any excess radiogenic argon is present. **Conclusion:** It is likely that the age of this sample is close to c. 65 Ma, i.e. consistent with a Palaeocene age	This sample is from the Druid Formation which is considered to be of Eocene age in this study. Constraining the age is difficult on stratigraphic grounds, as the lava is overlain by young Cenozoic section, typically Hebrides Margin Group but overlies Upper Cretaceous Chalk Group. Radiometric K/Ar dating carried out previously suggests early to middle Eocene ages; 40-43 Ma from the 18/20-1 well and 54.3 Ma from the 19/13-sb02 (BH-1A) borehole (Dancer *et al.*, 1999; Dancer *et al.*, 2005).
12/2-1z A17-12872-5 Rockall Basin. Amygdaloidal/ vesicular basalt. **3963.60 m** [Merrow Member, Cot Sandstone Fm]	Pale green, highly altered amygdaloidal basalt. Dominant texture is a fine grained, chlorite and epidote dominated matrix (groundmass) with 2-5 mm rounded, circular to irregular amygdales or white sparry calcite.				Highest Probability Denstiy 33.1 Rupelian	*Debate about whether the igneous rocks here are basalts or intrusions. Texture at margins could be pepperitic or some kind of mobilisation of sediments due to intrusion, or it could be a surface breccia on top of a lava. Following this a young age would tend to support the former, old the latter. Eocene and Triassic K-Ar dates have been reported. Although no plateau is produced in the new dates, it does get close at around 180 or at least L. Jurassic. That said, the probability density plot seems to favour 33 Ma just squeaking in upper most Eocene. I'm not sure I'd go with the 33 Ma based on the probability density as the Age Spectra seems to be going toward a weak plateau at the older age. We could probably make use of the Ca/K spectra here but this doesn't seem to be provided.*	The age spectrum displays a steady increase in age with successive heating steps. This is consistent with slow cooling of a single K-bearing phase and is supported by the near constant Ca/K ratio, which is also rather low. The data do not define a plateau but the three final steps, with a very define a weighted average age of 187.2 ± 1.9 Ma corresponding to c. 30% of the evolved gas. Their very low Ca/K ratio suggests a single K-bearing phase is responsible. This could correspond to K-feldspar, which is interpreted by Stevenson to be a metasomatic replacement of plagioclase. **Conclusion:** It is possible that the c. 187 Ma age is meaningful and dates the formation of metasomatic K-feldspar. This would also provide a minimum age for the basaltic host, it would be older than c. 187 Ma, i.e., early Pliensbachian.	The member occurs within the Cot Sandstone Formation. Seismic interpretation places this formation below the Base Cretaceous Unconformity and above the Carboniferous. Lithologically, the Cot Sandstone is more similar to the Triassic Sherwood Sandstone Group than any other pre-Cretaceous lithostratigraphic unit, hence the formation, and the Merrow Member, are tentatively placed within the Triassic in this study. Previously carried out radiometric K/Ar dating by Shell (2004) revealed an age of 250 Ma in the Early Triassic. This K/Ar age aligns with the overall stratigraphic favoured herein.

Table A.D. 1 ***Summary of radiometric Ar-Ar analyses carried out in this study, including sample descriptions and interpretations from this study, part 1.***

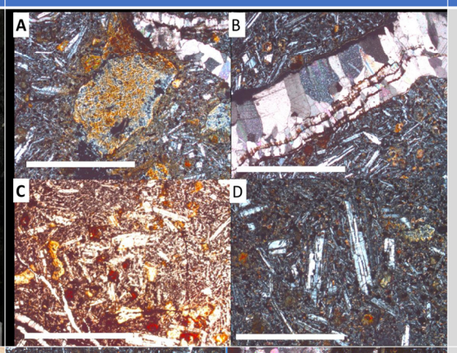
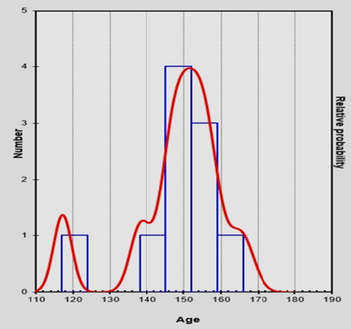
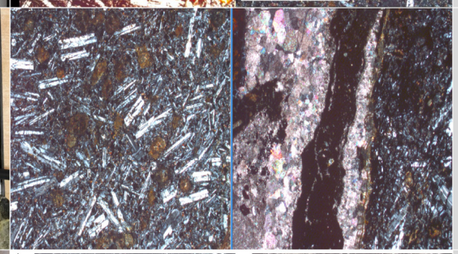
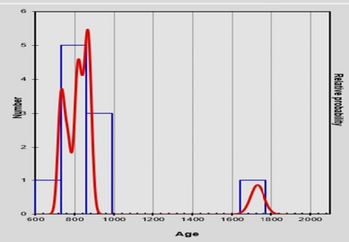
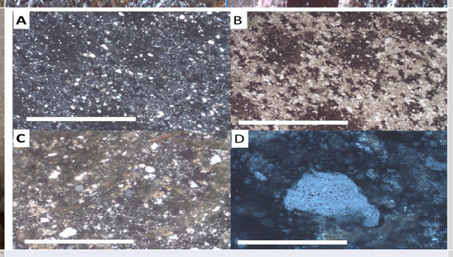
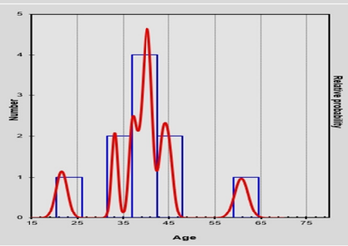
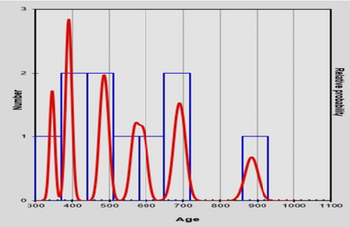
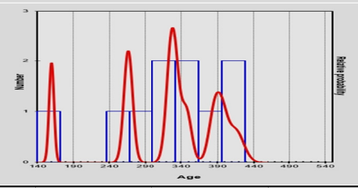
Well+Sample Name [rock unit name]	Sample Description (Stevenson, 2018)	Hand Specimen Photograph	Photomicrograph (Stevenson, 2018)	Probability Density Plot (Actlabs, 2018)	Interpreted Age (Actlabs, 2018)	Stevenson (2018) Comments (email to P. Copestake, 5th March 2018; comments below are verbatim)	Daly (2018) Comments	Conclusions (this study)
16/28-Sb01 A17-12872-6 Whole-rock. Basalt. **147.76 m** [Selkie Member, ?Dursey Fm]	Moderately veined with 1-4 mm thick white (calcite or zeolite) veins. Veins are flanked by paler (alteration) rock. Away from veins but in patches are darker, fine grained but apparently holocrystalline, possibly primary basaltic rock. Sample 6 (Feldspar): From the crushed ~0.5 mm obtained a separate by heavy liquid separation and paramagnetism on the 0.063 to 0.5 mm. Recovering a 0.04g separate from the heavy liquid floats. SEM check confirms mostly Calcite and low Mica+Plagioclase+Fe stain.				Plateau 150.5 +/-1.2, Highest Probability Density 152.07 Concordia 149+/-10 Tithonian/Kimmeridgian	*Whole rock* *Haughton et al. (2005) suggested a Cretaceous age for the lava. This is the only sample to produce a plateau age of 150.5 Ma +/- 1.2. Concordia age of 149+/- 10 less precise an MSWD (I'd go with plateau).* *Upper Jurassic may be stratigraphically feasible depending on BCU pick from relevant seismic.*	A plateau age of 150.5 ± 1.2 Ma has been calculated from six steps and this is supported by the isochron age of 149 ±10 Ma, which has a 36Ar/40Ar intercept consistent with the atmospheric value. However the Ca/K values are highly variable. The first step is very different for the rest suggesting that several K-bearing phases are responsible. In addition the six steps used to calculate the plateau age do not all overlap within error. Steps 6 and 7 are not identical. **Conclusion:** The relationships of this sample need to be further evaluated, in particular to assess the possibility that the sample was erupted into wet sediment. If this was the case and if the enclosing sediment is of Cretaceous age, the plateau age would have to be considered doubtful. However, as it stands, the c. 150 Ma age can be considered valid.	Extrusive basaltic lava, Late Jurassic, Tithonian Selkie Member (Dursey Fm), supported by position of lava below Base Cretaceous seismic horizon.
16/28-Sb01 A17-12872-7 Macdara Basin. Feldspar separate. Basalt. **148.25 m** [Selkie Member, ?Dursey Fm]	Basaltic, dark coloured breccia with fine grained, holocrystalline aphanitic matrix. Sample 7 (Feldspar): From the crushed ~0.5 mm obtained a separate by heavy liquid separation and paramagnetism on the 0.063 to 0.5 mm. Sending a 0.1g separate from the heavy liquid floats. SEM: check confirms Plagioclase (Ca>Na,trace-K), lower Calcite and trace Fe stain				Highest Probability Density 870.4 Pre-Cambrian	*The unusually old age for 16/28-sb01 (148.25m) is puzzling. This was done on a mineral separate. The old date could be either the inclusion of some very old basement lithology as an inclusion in the sample (unlikely due to lack of a plateau and this is on a mineral separate), but is more likely due to excess Ar caused by hydrothermal alteration (pervasive alteration of plagioclase). No plateau but very old ages seem to coincide with low Ca/K ratio.*	All age steps exceed 700Ma and are highly variable. No plateau can be defined. The Ca/K ratios are also variable and are all lower than in the whole-rock sample. This is unexpected if this is a plagioclase separate, although it may be the result of the reported extensive alteration. Presumably the old ages are due to incorporation of excess radiogenic argon during alteration. **Conclusion:** No useful age information can be obtained from these data.	Extrusive basaltic lava, Late Jurassic, Tithonian Selkie Member (Dursey Fm), supported by position of lava below Base Cretaceous seismic horizon.
35/8-1 A17-12872-8 Porcupine Basin. Whole rock. Pyroclastic Tuff. **10668'** [Sheerie Member, Bradán Fm]	Tuff comprising medium-fine grained ash, light grey, speckled, low density (pumaceous), quartz grains in feldspathic matrix, patchy alteration to clay.				Highest Probability Density 40.38 Concordia 44+/-10 Bartonian	*Tuff overlain by Albian-Aptian sediment so should be older than 113 Ma. New date suggests very young ca 40 Ma. Age spectra has no plateau but trying to get close around 40 (as per probability density plot). Isochron age with MSWD of 838 should be viewed with caution. Sample is altered and we do have a low Ca/K ratio coinciding with the most likely age steps on the age spectra so we could be dealing with a young hydrothermal event. Not quite as young though as the nearby dolerite (ca. 18 Ma).*	Most of the age steps are close to 40Ma but no plateau age can be defined and the Ca/k ratio is highly variable. **Conclusion:** No useful age information can be obtained from these data.	The rock is named as the new Sheerie Member (Bradán Fm) in this study, of Early to Middle Albian age, based on biostratigraphy.
26/30-1 A17-12872-9 North Porcupine Basin. Whole rock. **5620'** (Cuttings) [unnamed]	Washed cuttings (5610', 5620') include ca. 60% large clear mica flakes (some may be from drilling mud additive). Rock fragments 0.1-3 mm include K feldspar, quartz, biotite, ferromagnesian and plagioclase. Proportions seem to be consistent with a more alkali feldspar rich granitoid. Rock fragments at consistent with a monzogranite or possibly granodiorite		No thin sections made.		Highest Probability Density 392.4 Mid Devonian	*No plateau and age spectra a real mess. That said 392 Ma is consistent with basement.*	It is not clear to me what was analysed but no plateau can be defined and the Ca/K ratio is extremely variable. **Conclusion:** No useful age information can be obtained from these data.	The sample represents granitic basement, of unknown age, but which is likely to be pre Carboniferous given the presence of Carboniferous rocks above the granite in the 26/20-1 well.
43/13-1 A17-12872-10 Porcupine Basin. Basalt. Whole rock. **2550-2560m** cuttings [Péist Member, Gweedore Fm]	Very fine basalt (with some epidote), white specs (quite friable/crumbly – probably zeolite), bluish very fine-fine silt siltstone, red brown friable mudstone. Basalt and pale (bluish) silt predominate.	NA	No thin sections made.		330.08 Mississippian (E.Carb)	*Whole rock – basalt fragments (cuttings)* *Expected to be Early Paleocene* but coming out as 330 Ma (Mississippian). Reported to be heavily altered and no plateau so I would not read too much into this.* * At the time the radiometric dating work was done, this basalt was thought to be most likely Early Paleocene in age. This age interpretation has since changed based on new seismic and biostratigraphic interpretation in this study.	The data define very variable ages close to c. 350 Ma, with extremely variable Ca/K ratios. No plateau age can be calculated from these data. **Conclusion:** No useful age information can be obtained from these data.	No reliable age can be defined on the basis of the Ar/Ar analysis. The Peist Member is considered to be Ypresian, Early Eocene, determined by palynology data in claystones above and below the member. Biostratigraphic aging compliments a 2D seismic interpretation of post-Paleocene age, where top Thanetian seismic horizons terminate against the Danian Mangach Formation, Chalk Group downdip of the well.

Table A.D. 2 ***Summary of radiometric Ar-Ar analyses carried out in this study, including sample descriptions and interpretations from this study, part 2.***