

## Comments on ACTlabs Ar-Ar dating results for PIP project IS16/04

Professor J. Stephen Daly, April 2018

### **56/26-1** Fastnet Basin “Gabbro”. Feldspar separate.

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  $^{39}\text{Ar}$  ( $^{39}\text{K}$ ) in the sample coincide within analytical uncertainty). This sample displays 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.

### **35/13-1** Porcupine Basin. Gabbro. Feldspar separate.

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.

### **62/7-1** Goban Spur. Basalt. Feldspar separate.

Stevenson’s report (quoting Collins 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 ( $169.9 \pm 3.4$ ) 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 from these data.

### **19/13-BH1A** Northern Slyne Basin. Basalt Whole-rock.

This appears to be the same as 19/13-sb01 discussed by Stevenson. The basalt is overlain by Pliocene sands. 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. The data also define a very scattered (high MSWD = 795) Ar-Ar isochron age of  $66.6 \pm 6.6$  Ma. However, the  $^{36}\text{Ar}/^{40}\text{Ar}$  intercept value is similar to that of atmospheric argon suggesting that little if any excess radiogenic argon is present. **Conclusion:** It is possible that the age of this sample is close to c. 65 Ma, i.e. Palaeocene. However, this basalt has been correlated with basalt occurring in several wells in the region, which have been biostratigraphically dated as Eocene. Hence the Palaeocene age is doubtful.



**12/2-1z 3963.6 m** Dooish. Amygdaloidal basalt.

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  $187.2 \pm 1.9$  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 Pliensbechian.

**16/28-sb01 147.76 m** Rockall Basin. Basalt Whole-rock.

A plateau age of  $150.5 \pm 1.2$  Ma has been calculated from six steps and this is supported by the isochron age of  $149 \pm 10$  Ma, which has a  $^{36}\text{Ar}/^{40}\text{Ar}$  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.

**16/28-sb01 148.25 m** Rockall Basin. Basalt. Feldspar separate.

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.

**35/8-1 10,668 ft** Porcupine Basin. Tuff. Whole-rock.

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.

**26/30-1 5620 ft** North Porcupine Basin. Cuttings.

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.

**43/13-1 2550-2560 m** Porcupine Basin. Basalt cuttings.

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.

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