

NOTES – NOTISER

A Comment. Reconnaissance Rb–Sr Investigation of Salic, Mafic and Ultramafic Rocks in the Øksfjord Area, Seiland Province, Northern Norway

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In a recent paper Brueckner (1973) presented the results of Rb–Sr investigations in the Øksfjord area of north Norway from which he concluded that, ‘some portions of the Øksfjord area had a pre-Cambrian origin’. In other areas of the Seiland petrographic province, notably Sørøy, Seiland and Loppa, the country rocks are of Cambrian age or younger (Holland & Sturt 1970, Ramsay 1971, Worthing 1971, Armitage et al. 1971), and hence attained their present metamorphic and structural state during the Caledonian Orogeny. However, it is possible that some of the country rocks in the Øksfjord area may be older (Armitage et al. 1971), and thus Brueckner’s proposed pre-Cambrian age for the gneisses in this area is not disputed, although the assumptions made in interpreting the analytical data are queried.

Three basic conditions which must be satisfied before an ‘isochron’ plot will define an age are:

All samples are the same age.

The initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio was the same in all samples.

All samples have remained closed systems during the time under consideration.

From the data presented by Brueckner it seems improbable that all of these conditions are satisfied for the three ‘isochrons’ upon which his conclusions are based.

The data plotted in fig. 3 (Brueckner 1973) for the ‘massive rocks’, include analytical results for rock types ranging from peridotite to syenite perthosite. Since the perthosites’ ‘relationship to other rock types with igneous textures is uncertain’, there seems to be little justification in plotting data from all of these rock types on the same diagram. Brueckner, in discussing these data, in fact rejects the basic and ultra-basic data points and considers only the perthosites. This treatment gives an age of 625 ± 135 m.y. assuming that the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio for sample IV–1–C is .7100 as plotted in fig. 3 and not .7010 as given in table 2. Brueckner comments that a 625 m.y. age is unusual in the Caledonides and should not be accepted uncritically and remains to be explained. In his discussion he assumes an error of ± 17

m.y. whereas the uncertainty for the 3 point perthosite line is ± 135 m.y., a figure which would, in fact, allow the intrusion to be Caledonian. However, there is another explanation for the 625 m.y. apparent age and the apparent contemporaneous nature of the basic to ultra-basic country rocks and this perthosite. The three perthosite analyses presented by Brueckner conform to the same linear trend as 9 analyses of samples from a perthosite on Sørøy and 6 from a perthosite on Seiland (Pringle & Sturt, paper in preparation on: The age of the Seiland petrographic province and the Kalak Nappe). These three intrusions are similar mineralogically, have similar intrusive relationships and, most significantly, all contain small relict xenoliths of the gabbroic rocks. The interpretation of these data proposed by Pringle & Sturt (in prep.) to explain the geologically untenable apparent age (in Sørøy and Seiland at least) of 600–625 m.y. is that there was no isotopic homogenization between the xenoliths and perthosites at the time of intrusion and that the apparent isochron giving 600–625 m.y. is not an isochron but a mixing line. Such a line has no direct geochronological significance and if, as appears possible, from both geological and isotopic evidence, the Øksfjord perthosites may be interpreted in the same manner as those from Sørøy and Seiland, there is no 625 ± 135 m.y. date to be explained.

If this line is a mixing line the colinearity of the data points for the basic to ultra-basic and perthosite rocks obviously does not necessarily imply a similar age. However, the limited number of analytical results from Øksfjord does not allow a decision to be made between an isochron or a mixing line interpretation.

The data for the foliated rocks plotted in fig. 4 (Brueckner 1973) together with two reference isochrons (reference lines are not normally given error limits as this implies a calculated result of known precision) are again for a wide variety of rock types which, as is stated in the discussion, probably have different origins and different ages. Hofmann (1972) has demonstrated that, in northern Idaho, amphibolite grade metamorphism has not caused isotopic homogenization in whole rock samples on a regional or even an outcrop scale. Thus, although the rocks in Øksfjord may be of higher metamorphic grade, there is no apparent justification in plotting these data on the same isochron diagram and to quote Brueckner 'a best fit age to all these data should probably be rejected as meaningless', a statement with which the present writer concurs. At least three of the best fit lines computed for various selections of these data do not conform to the basic isochron requirements. However, one possible age which could be derived from these data is the 1035 ± 200 m.y. date for the quartz bearing gneisses or, considering the probability of the various gneisses having different origins, preferably from the three quartz rich gneisses. The present writer feels that the derivation of any other 'ages' is quite unjustified and even this age is somewhat tenuous when based on a maximum of only five data points.

If required to draw any tentative conclusions from these preliminary, or reconnaissance, results from this geologically complex area with almost no

geological control, the present writer would only be prepared to conclude that:

The gabbroic rocks of unknown age have a normal initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of approximately 0.703.

A three point isochron for a perthosite indicates an apparent age of 625 ± 135 m.y. and, although this may be a true age, evidence from similar rocks elsewhere in the same petrographic province suggests that the line is a mixing line with no geochronological significance.

A five, or preferably three, point isochron for a quartz rich gneiss gives an apparent age of 1035 ± 200 m.y., which could well indicate a pre-Cambrian origin for some of the country rocks in the area.

A single biotite/whole rock age of 445 m.y. supports the geological evidence that this area was affected by the Caledonian Orogeny.

It must be emphasized that these are exceedingly tentative deductions and in the writer's opinion should only be used to assess the suitability of the area for further geochronological work.

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