Rb-Sr Isochron Age of Caledonian Acid Volcanics from Stord, Western Norway

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An eight-point Rb–Sr whole-rock isochron from Caledonian rhyolites at Stord in western Norway defines an age of 455 ± 5 m.y. and an initial $^{87}Sr/^{86}Sr$ of 0.7071 ± 0.0018 ($\lambda^{87}Rb = 1.39 \times 10^{-11}/a$; errors with 95 percent confidence limits). This places the volcanism in the Upper Ordovician, close to the Ordovician/Silurian boundary.

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The island of Stord, some 45 km south of Bergen in western Norway, lies at the southwestern extremity of the Norwegian Caledonides. Geologically, the island is divided by a NW dipping thrust zone into two tectonic units, a sequence of folded metasediments with interbedded spilitic metavolcanics in the southeast and an igneous complex in the west (Fig. 1). The igneous complex is mainly composed of saussurite gabbro and metavolcanics (basic and acid lavas and pyroclastics) intruded by granodiorite and microcline granite (Kvale 1937). It is believed that this complex is allochthonous, forming part of a large Caledonian nappe (Strand 1972). The metasedimentary sequence to the southeast consists of greywackes, argillites, conglomerates, and limestones; in its youngest part it contains fossiliferous horizons which can be placed in the Ashgill and Lower Llandovery (Skordal 1948).

A Rb–Sr isochron study has been made on eight whole-rock samples of acid volcanics from Kattnakken in the igneous complex. All rocks are of rhyolitic composition and have been only slightly affected by low-grade metamorphism, approximately in the lower greenschist facies. The Rb and Sr contents and Rb/Sr ratios have been determined by X-ray fluorescence spectrometry. Strontium isotope ratios were normalized to $^{88}Sr/^{86}Sr = 8.3752$ and adjusted to $^{87}Sr/^{86}Sr = 0.7085$ in the Eimer & Amend $Sr(CO_3)_2$ standard. The maximum relative errors in the Rb/Sr and $^{87}Sr/^{86}Sr$ ratios are estimated at 2.0 and 0.5 per cent, respectively. The analytical techniques follow those described by Priem et al. (1973). In the map of Fig. 1 the sampling sites are shown, while the analytical results are plotted in the isochron diagram and listed in Table I. All Rb–Sr ages mentioned in this paper are based upon the ^{87}Rb decay constant of $1.39 \times 10^{-11}/a$.

The Rb–Sr data of the eight samples are very well linearly correlated, defining an age of 455 ± 5 m.y. with initial $^{87}Sr/^{86}Sr = 0.7071 \pm 0.0018$ (least-squares regression analysis according to York 1966, 1967). Both errors

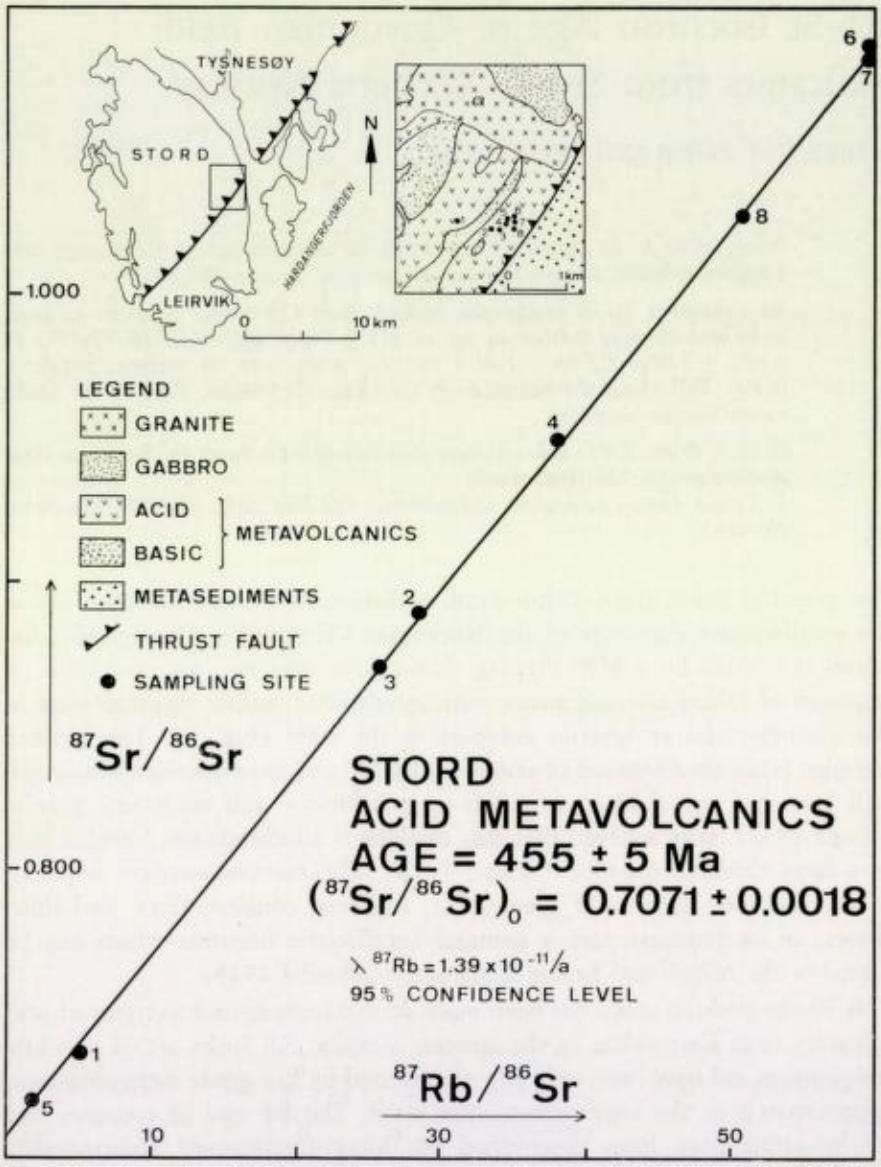

Fig. 1. Isochron plot of eight whole-rock samples from the Caledonian acid volcanics at Stord, western Norway. The inset gives a geological sketch map of the area (simplified after Kvale 1937, and Skordal 1948), showing the locations of the investigated samples. The numbers 1 to 8 correspond to the samples 72 Sto 1 to 8 in Table 1.

are given with the 95 percent confidence limits as calculated from the analytical data.

It is difficult to fit this date in the Ordovician–Silurian time-scale, as very few reliable dates critical to the stratigraphic horizons are available (Lambert 1971). Of particular importance to the present investigation is the Rb–Sr isochron age of 438 ± 4 m.y. measured by Bofinger et al. (1970) on volcanics in the Canberra area, Australia, which overlie sediments accurately placed as

Table 1. Rb–Sr data of acid volcanics from Stord

Sample No.	$^{87}Sr/^{86}Sr$	Rb/Sr (Wt/Wt)	Rb (ppm Wt)	Sr (ppm Wt)	$^{87}Rb/^{86}Sr$
72 Sto 1	0.7372	1.721	220	128	5.00
72 Sto 2	0.8890	9.683	207	21.3	28.5
72 Sto 3	0.8705	8.754	181	20.6	25.8
72 Sto 4	0.9493	12.85	246	19.1	38.1
72 Sto 5	0.7202	0.6624	156	235	1.92
72 Sto 6	1.081	19.84	260	13.1	59.6
72 Sto 7	1.086	19.86	287	14.4	59.7
72 Sto 8	1.027	17.04	238	13.9	50.9

Lower Ludlovian on fossil evidence and may well be of Lower Ludlovian age themselves. The same authors estimate the age of the Upper Llandovery as 445 ± 7 m.y., fixing the Ordovician/Silurian boundary at around 450 m.y. Concerning the lower boundary of the Ordovician, reference may be made to the Rb–Sr isochron date of 502 ± 5 m.y. recently obtained from volcanics overlain by Tremadoc sediments in the Krivoklat–Rokycany zone in Bohemia (Vidal et al. 1973). The Cambrian/Ordovician boundary can thus be dated at around 500 m.y., leaving some 50 million years for the duration of the Ordovician Period.

It can thus be concluded that the acid volcanics of the overthrust igneous complex on Stord have been extruded close to the Ordovician/Silurian boundary, in Upper Ordovician time (probably Ashgill).

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