

fuller's earths contain rare non-authigenic biotite, hence strengthening the close comparison with the Wyoming bentonites.

As for the source of the volcanic ash, it is well appreciated that this can be carried in large quantities for hundreds of miles and that therefore the likelihood of locating the volcano is very slight. Contrary to what Brown *et al.* maintain, there is in fact direct evidence of late Mesozoic vulcanicity at no great distance from southern England. Since we wrote our paper we have learned of a major series of basaltic and andesitic lavas and tuffs in the Cenomanian of northern Spain (Rat, 1959), and sediments have been found in Northern Ireland with basaltic tuff fragments associated with Maestrichtian foraminifera (J. M. Hancock, personal communication). There is also a possibility that some of the Mull basalts may be late Cretaceous in age (Martin, 1968). More evidence may come from the further exploration of Mesozoic deposits of the continental shelf around the British Isles.

*Department of Geology and Mineralogy
University of Oxford*

A. HALLAM
B. W. SELLWOOD

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Fortran II and Fortran IV programs for petrochemical calculations

TWO FORTRAN II and four FORTRAN IV programs for the calculation of many common petrochemical parameters of igneous rocks have been developed from an extended version of D. B. McIntyre's modified norm programme (Seaver Laboratory, Pomona College, California, Tech. Rep. no. 14, 1963). Output is unselective with the same parameters being produced for both dunite and rhyolite, but modifications to the logic to suit the individual petrologist or metamorphic rocks are easily accomplished. A memory storage capacity of at least 40K decimal (1620) or 8K hexadecimal (1130) is required. Where greater capacity is available combinations of programs may be made. Copies of listings suitable for use with IBM 1620 and 1130 computers may be obtained from the department.

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1620 FORTRAN II. *Program 1.* Raw analysis in wt % oxides; cation %; iron ratio (Wager, 1956); Larsen's parameter (Nockolds and Allen, 1953); $\text{Na}^+/\text{K}^+/\text{Ca}^{2+}$ to 100 %; $(\text{Na}^+ + \text{K}^+)/(\text{Fe}^{2+} + \text{Fe}^{3+})/\text{Mg}^{2+}$ to 100 %; Niggli values (Barth, 1952); SKM values to 100 % (Schmidt, 1957); Osann values with ACF to 100 % (Johannsen, 1931); standard cell (Barth, 1948); molecular norm (McIntyre, 1963); % composition of normative minerals. *Program 2.* Raw analysis in wt % oxides; wt % oxides recalculated to 100 %, water free; differentiation parameters (Poldervaart, 1950); C.I.P.W. weight norm, water free (McIntyre, 1963); von Wolff values; differentiation index (Thornton and Tuttle, 1960); crystallization index (Poldervaart and Parker, 1964); albite ratio (Wager, 1956); % composition of normative minerals. *Data input, programs 1-2.* Single card contains wt % oxide composition in the order: SiO_2 , TiO_2 , Al_2O_3 , Cr_2O_3 , Fe_2O_3 , FeO , MnO , MgO , CaO , Na_2O , K_2O , P_2O_5 , CO_2 , H_2O^+ , H_2O^- , others, where 'others' is S, Cl, F, etc., and is not included in computations, apart from total.

1130 FORTRAN IV. *Program 3.* Analysis identification; wt % oxides; wt % norm, including water; % composition of normative minerals; wt % oxides to 100 %, waterfree; wt % norm, excluding water; % composition of normative minerals; von Wolff values, differentiation and crystallization indices, as for program 2. *Program 4.* Analysis identification; wt % oxides; cation %; molecular % oxides; molecular norm; % composition of normative minerals; Wager's albite ratio, after Carmichael (1964). *Program 5.* Analysis identification; wt % oxides; Niggli, SKM, and Osann values, as for program 1; Wager's iron ratio (Carmichael, 1964); $(\text{FeO} + \text{Fe}_2\text{O}_3)/(\text{FeO} + \text{Fe}_2\text{O}_3 + \text{MgO})$, wt %; $(\text{FeO} + \text{Fe}_2\text{O}_3)/(\text{Na}_2\text{O} + \text{K}_2\text{O})/\text{MgO}$ wt %; $\text{MgO}/(\text{MgO} + \text{FeO} + \text{Fe}_2\text{O}_3) \times 100$ (Green and Ringwood, 1968); $\text{Na}_2\text{O} + \text{K}_2\text{O}$. *Program 6.* Lists header and data cards with totals. *Data input, programs 3-6.* Card 1. Header card with analysis identification number or description or both. Card 2. As for programs 1-2.

Department of Geology
University of Auckland
Auckland 1
New Zealand

K. A. RODGERS
R. H. A. COCHRANE
P. C. LECOUREUR

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