The package processes up to 30 analyses in a set with up to 14 elements in an analysis, and these elements can be analysed by up to three different characteristic radiations ($K\alpha$, $L\alpha$, and $M\alpha$); these parameters may be changed if the user wishes. To process data from another probe, one card needs be changed in the program.

The form of input is illustrated in fig. 1. The program defines each request for information by an RQ number, which refers to more detailed notes in the specification of the program. In this example measured concentrations from one analysis are input by the operator at the terminal. The method of calculation selected causes oxygen to be determined by difference. The five elements analysed, Mg, Si, Fe, Mn, and Ca, all determined by their K-radiations (code 1), have been measured with standards named OLIVIN, for both Si and Mg, PUREFE, PUREMN and WOLL2 respectively. The first part of MK7 organizes and then writes this information on to a scratch file. A second identifies the elements and lines used and extracts from another file all the physical constants (e.g. absorption coefficients, line energies, atomic weights, etc.) needed to make corrections with those elements present. The standard names are also recognized and the standard factors extracted. All these data are written on to a second scratch file. Finally the third part of the program reads the data from these scratch files and processes the measured concentrations. Results are output via the terminal in an abbreviated form and full details are written on to a scratch file to be queued to the line printer if so desired.

For the MK2 version each Initial Data Set is prepared by punching the appropriate physical constants on to cards and sorting these cards into the Initial Data Deck for subsequent use. This method was adopted to allow users more flexible selection of absorption coefficients than would be obtained if algorithms that computed coefficients from a particular set were built into the program. For MK7, a separate interactive program has been written, which either allows the user to key in absorption coefficients, or computes them for any element and characteristic radiation using the algorithms of K. Norrish (private comm.). These, together with the other relevant constants, are arranged automatically on the user's Initial Data file.

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Abundance of fluorine in stony meteorites

THE application of pyrohydrolysis to the separation of fluorine from silicate material (Clements and Sergeant, 1971; Berns and van der Zwaan, 1972) has led to consistent and reproducible values for the internationally recognized standard rocks. However, our preliminary results show that the application of this technique to ordinary chondrites results in a low recovery of fluorine.

The pyrohydrolysis procedure (Clements and Sergeant, 1971) used for the separation of fluorine requires the crushed sample (< 100 mesh) to be mixed with a flux of (5g sodium tungstate, 5g bismuth trioxide, and 10g vanadium pentoxide) before being inserted in a quartz tube and heated to about 1000 °C in a stream of moist air. The liberated fluorine is flushed from the tube by the gas flow and absorbed in a dilute solution of sodium hydroxide. The following pretreatment of the sample increased the recovery of fluorine by a factor of up to 8 (Table I). A sample weight of 100 mg of finely crushed (< 100 mesh) meteorite was ground

TABLE I. *Results with and without preliminary treatment (each value obtained on a separate sample)*

Chondrites:	Without	With‡	Aubrites:		Without	With‡
Mocs (L6) { bulk	10	86		⎧bulk	58	
{ fusion crust	nil	–		⎪	59	–
	7	23	Mayo Belwa, BM 1976, M11 ⎨		57	
Barwell (L5) BM 1966, 59		71		⎪portion rich		82*
Ohuma (L) BM 1966, 53	4	32		⎩in fluorichterite	–	
		34		⎧bulk	22	29
	13	56	Khor Temiki, BM 1934, 781 ⎨enstatite crystal a	–	18†
Oakley (stone) (H6) BM 84814	14	61		⎩enstatite crystal b	–	18†
	16	71				

* No fluorine obtained from second pyrohydrolysis
† No fluorine obtained from second and third pyrohydrolyses
‡ Provisional values, since fluorine release may not be complete in all cases

with twice its weight of flux under several ml of acetone in an agate mortar for 3 to 4 min. The acetone was allowed to evaporate and thè mixture transferred to a silica boat. Two ml of water were added to the contents of the boat and evaporated to dryness on a water bath. The addition and evaporation were repeated. The sample was then subject to pyrohydrolysis for 30 min at 950–1000 °C, the inert gas (N_2) flow being saturated with water vapour at about 70 °C. The liberated fluorine was collected in 0·1 M NaOH, the solution buffered and adjusted to volume with water. The fluorine concentration was measured by an ion selective electrode. Standard fluoride solutions were prepared containing sodium sulphate appropriate to the S content of chondrites since sulphate ions slightly depressed the fluorine results. Standard additions were made to solutions containing < 0·125 ppm F in solution to raise the concentration range to 0·1–1·0 ppm F.

From Table I it is evident that our figures for ordinary chondrites (7–16 ppm F), obtained without preliminary treatment, are in close agreement with those of Dreibus *et al.* (1976), who used a similar pyrohydrolytic separation and ion-selective electrode technique for F; indeed their figure for Mocs, 11 ppm, is within experimental error of ours (10 ppm). In contrast, our value obtained after pretreatment is considerably higher, 86 ppm, and closer to, but below, that of Reed (1964), who used an activation technique. In general the values for the abundance of fluorine in ordinary chondrites obtained using the pretreatment described here are close to those summarized by Reed (1971). We conclude therefore that some form of pretreatment of ordinary chondrites is essential for an approach to the complete liberation of fluorine by pyrohydrolysis.

The data for aubrites are inconclusive, but suggest that in these highly reduced stones fluorine is less tightly bound than in the phosphate-bearing ordinary chondrites.

Note added in proof: Determination of fluorine in eight low-iron and five high-iron chondrites

by a neutron activation method has given averages of 41 and 32 ppm respectively; the value obtained for Bishopville, enstatite achondrite, was 90 ppm. (Allen (R. O., *Jr.*) and Clark (P. J.), 1977. *Geochimica Acta*, **41**, 581.)

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