# CANMET

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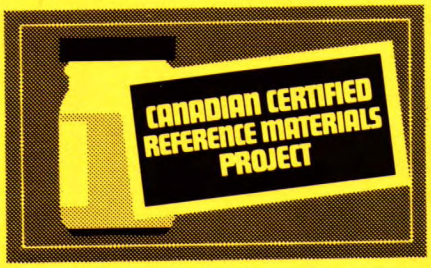
Canada Centre for Mineral and Energy Technology

Centre canadien de la technologie des minéraux et de l'énergie

# REFERENCE MATERIALS – ROCK SAMPLES SY-2, SY-3, MRG-1

SYDNEY ABBEY



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# FOREWORD

The Canadian Certified Reference Materials Project (CCRMP) is a facet of the Utilization Activity (Quality Control Sub-Activity) of CANMET's Minerals Research Program. In this project, compositional reference materials are prepared for use in analytical laboratories associated with mining, metallurgy and the earth sciences.

CCRMP was initiated in the early seventies in response to a demand from industrial, commercial and government laboratories for reference materials that were typical of Canadian deposits and not available elsewhere. Many laboratories, both Canadian and international, voluntarily participate in the inter-laboratory programs for the certification of reference materials. Now that a relatively large number of reference ores and related materials are available and in wide-spread use, they serve as standards by which the analytical methods which are essential for quality-control and research in Canadian enterprises can be critically assessed with respect to accuracy and precision.

W.A. Gow
Chief
Mineral Sciences Laboratories

## AVANT-PROPOS

Le Projet canadien sur les matériaux de référence certifiés (PCMRC) est l'une des occupations de l'Activité de l'utilisation (Sous-activité du contrôle de la qualité) du Programme de recherche sur les minéraux du CANMET. Ce projet à pour but de préparer des matériaux de référence de composition pour l'usage dans les laboratoires analytiques concernés par les sciences minières, métallurgiques et de la terre.

Le PCMRC a été mis sur pied au début des années soixante-dix suite à une demande des laboratoires industriels, commerciaux et gouvernementaux pour des matériaux de référence sur des gisements typiquement canadiens et qui ne sont pas disponibles ailleurs. Plusieurs laboratoires, canadiens et internationaux, participent volontairement aux programmes entre laboratoires d'homologation de matériaux de référence. Maintenant, un grand nombre de minerais de référence et autres matériaux apparentés sont disponibles et d'usage répendu. Ils agissent en tant que normes selon lesquelles les méthodes analytiques essentielles au contrôle de la qualité et à la recherche effectuée dans les entreprises canadiennes peuvent être évaluées adéquatement en fonction de l'exactitude et de la précision.

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# REFERENCE MATERIALS - ROCK SAMPLES
# SY-2, SY-3, MRG-1

by

Sydney Abbey*

## ABSTRACT

Two samples of syenite and one of gabbro were prepared for use as reference material. Analytical data on the composition of the three samples known as SY-2, SY-3 and MRG-1 were reported for more than 100 laboratories from around the world. The analytical methods are described systematically for purposes of comparison, and procedures for deriving assigned values are detailed for both major and minor elements as well as for some of the more common trace elements. Values that are less certain are suggested for less common constituents.

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*Geological Survey of Canada, Energy, Mines and Resources Canada, Ottawa.

# MATERIAUX DE REFERENCE - ECHANTILLONS DE ROCHES SY-2, SY-3, MRG-1

par

Sydney Abbey*

## RESUME

Deux échantillons de syénite et un échantillon de gabbro ont été préparés pour en faire usage comme matériaux de référence. Plus de 100 laboratoires ont collaboré pour fournir les données analytiques sur la composition de trois échantillons connus respectivement sous les symboles SY-2, SY-3 et MRG-1. Les méthodes analytiques ont été décrites systématiquement pour des fins de comparaison. Les procédés utilisés pour dériver les valeurs désignées ont été détaillés pour la détermination des éléments majeurs et mineurs ainsi que pour les éléments-traces plus communs. Les valeurs moins certaines ont été attribuées aux composantes moins communes.

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*Commission géologique du Canada, Energie, Mines et Ressources Canada, Ottawa.

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TABLES

## INTRODUCTION

The geologist generally requires a complete analysis of his rock samples that normally includes the determination of $SiO_2$, $Al_2O_3$, $Fe_2O_3$, FeO, MgO, CaO, $Na_2O$, $K_2O$, $H_2O$, $CO_2$, $TiO_2$, $P_2O_5$ and MnO, and frequently of F and S. More recently, requirements have also included such common trace elements as Ba, Co, Cr, Cu, La, Li, Ni, Pb, Rb, Sr, V, Y, Zn and Zr, with less frequent demands for additional elements. Collaborative analytical programs on reference samples of rocks originating in the U.S.A. (1,2), France (3,4), Japan (5) and South Africa (6) have revealed certain special characteristics of such programs:

(1) Because of the many constituents which must be determined and the limited facilities available in individual laboratories, many such establishments must be enlisted. Laboratories qualified to participate in such programs are generally those in governmental and geological institutions and in geology departments of universities.

(2) Results for individual constituents show the relatively wide and erratic dispersion usually observed for rocks.

Many uncontrolled variables in the collaborative analysis of rock samples make it difficult to treat the data statistically as done for ores - e.g., by Sutarno and Faye (7). Various semi-empirical methods have been proposed for the difficult problem of choosing suitable values. The logic behind the choice of method used here has been described elsewhere (8-11).

## HISTORY OF THE SAMPLES

The first reference sample of a rock prepared by the predecessors of the Canadian Certified Reference Materials Project was SY-1, a syenite from the Bancroft area of eastern Ontario, containing unusually high concentrations of uranium, thorium, rare earths and several additional trace elements. Sine et al. listed the most recent analytical data on SY-1 (12). That sample was never subjected to a systematic collaborative analysis, and because it was prepared in a limited quantity the supply became exhausted in a short time.

SY-2 was collected in the same area as a replacement for SY-1 but was found to have lower contents of uranium, thorium and rare earths. To provide a new material closer in composition to SY-1, another batch of syenite from the same source was subjected to autogenous grinding with fist-sized lumps of material containing uraninite, allanite and betafite. Autogenous grinding was performed to minimize the well-known heterogeneity problems encountered in mixing finely-ground solids. Spectrographic checks on the distribution of individual rare-earth elements indicated that the mixing process had been successful. The product was designated SY-3. Preliminary descriptions of SY-2 and SY-3 were given by Gillieson (13).

MRG-1 is a gabbro sample from Mount Royal, Montreal, described in detail by Perrault et al. (14).

The three samples were originally offered for sale as "uncertified" materials, purchasers being invited to report analytical data to the originators, as had been done with SY-1. In an effort at more systematic treatment, a group known as the Task Force on Rock Samples was organized late in 1973 for obtaining and correlating as much compositional data as possible on the three samples. This paper lists all available data and recommends some compositional values.

## COLLABORATIVE ANALYSIS

A number of laboratories which had shown competence in the collaborative analysis of other reference rocks were invited to analyze SY-2, SY-3 and MRG-1 (2-5). Because of the many trace elements which had not been reported by those laboratories, additional laboratories were required. Laboratories which had reported limited results before the task force was organized were asked to provide further data, and invitations were also extended to a number of Canadian provincial

institutions. In all, over 100 laboratories were approached and many agreed to participate. Additional results were also taken from the literature.

Two earlier reports have been issued on these samples. Report MRP/MSL 75-132(TR) gave all relevant information as of 1975. A supplement, CANMET Report 76-36, brought matters up to date as of 1976. The current report includes all the material in the earlier reports, updated where necessary, as well as data received since 1976. The recommended values in this report supersede those in the two earlier reports.

## SUMMARY OF RESULTS RECEIVED

Table 1 lists all data on the major and minor components and Table 2 those on trace elements. Some trace elements are present at sufficiently high levels that they must be taken into account in deriving the summation for the complete analysis. Major and minor components are tabulated in the order proposed by Maxwell (15), with some modifications. Trace elements are listed in alphabetical order of their chemical symbols.

In Tables 1 and 2 the following notes should be observed:

(1) where replicate results were reported, apparently produced by the same analyst using the same method at about the same time, only the arithmetic average is tabulated, the figure in parentheses indicating the number of replicates. Actual individual results are available on request.

(2) $Fe_2O_3T$ refers to total iron content expressed as ferric oxide.

(3) $RE_2O_3T$ refers to total rare earth oxide content.

(4) Readers are requested to inform the author of any error they may observe.

## ANALYTICAL METHODS

The methods used in obtaining individual results in compilations were often listed with such cryptic notations as "spectro", "AAS", "grav", etc. However, the reliability of a result can depend on steps other than the final measurements. Analysts were therefore requested to provide either details of their methods or to cite pertinent literature.

To conserve space a three-letter code based on the three essential analytical unit operations has been adopted. Literature references to the methods are given in the tables when available.

(1) Sample pretreatment

- B pelletization
- F fusion, sintering
- H acid decomposition
- 0 none used or specified

(2) Separations (if any)

- C chromatography, ion exchange
- D fractional distillation
- P precipitation, leaching
- V bulk volatilization
- Y solvent extraction
- Z electrodeposition
- 0 none used or specified

(3) Final measurement

- A atomic absorption or fluorescence
- E flame emission
- G gravimetric
- J absorptimetric, fluorimetric
- K gas volumetric
- L electrometric, ion-selective electrode, polarographic, coulometric
- M mass spectrometric
- R radiometric, neutron activation
- S spectrographic
- T titrimetric
- X X-ray fluorescence
- Dif by difference
- 0 not specified

Table 1 - Reported values of major and minor components, per cent (dry basis)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| $SiO_2$ | | | 39.37 (2) | FPG | (157) |
| | | | 39.25 | FPG | (141) |
| | 59.86 | | | FPG | (20,21) |
| | 60.05 | 59.45 | 39.18 | FPG | (22) |
| | 59.78 (3) | 59.33 (3) | | FPG | (24,25) |
| | 60.8 | 60.26 | | FPG | (13) |
| | | 60.50 (2) | | FPG | (26) |
| | 59.69 (6) | 59.48 (6) | 38.90 (6) | FPG | (27) |
| | 59.34 (3) | 59.49 (3) | 39.24 (3) | FOJ | (28) |
| | 59.90 | 59.40 | 39.40 | OOO | (29) |
| | 59.42 | 58.69 | 37.46 | FPG | (30,31) |
| | 60.45 | 60.05 | 39.55 | FOJ | (32) |
| | 60.06 | 59.36 | 39.06 | FPG | (32) |
| | 60.19 (5) | 59.48 (5) | 39.16 (5) | FPG | (33,34) |
| | 60.33 (3) | 59.92 (3) | 39.53 (3) | FOA | (33,34) |
| | 60.25 | 60.02 | 39.58 | FPG | (35) |
| | 60.26 | 59.55 | 39.43 | FPG | (36) |
| | 60.84 (3) | 59.80 (3) | | FOJ | (37) |
| | 60.8 | | | FOX | (38) |
| | 60.4 | 60.3 | 39.5 | OOX | (39) |
| | 59.78 (4) | 59.65 (4) | 40.45 (2) | FOX | (66,67) |
| | 60.13 (3) | 59.78 (3) | 38.97 (3) | FPG | (82) |
| | 59.98 (2) | 59.23 (2) | 38.88 | FPG | (82,83) |
| | 60.24 (5) | 59.77 (5) | 39.24 (5) | FOA | (86) |
| | | | 39.52 (5) | FOA | (86) |
| | 59.61 | 59.31 | 39.58 | FPG | (87) |
| | 59.69 | 59.44 | 39.60 | FPG | (87,90) |
| | 60.9 | 60.3 | 39.5 | FOX | (91) |
| | 60.27 | 60.09 | 39.02 | FOA | (92) |
| | 59.4 | 59.7 | 39.4 | FOX | (93) |
| | 58.4 | 58.5 | 38.5 | FPG | (93) |
| | 59.7 | 60.15 | 38.3 | FOL | (93) |
| | 59.54 (3) | 59.46 (4) | 39.20 (2) | FPG | (101) |
| | 59.8 (3) | 59.6 (3) | 38.7 (3) | FOA | (101) |
| | 59.74 (2) | 59.24 (2) | 39.12 (2) | FPG | (102) |
| | 59.73 | 59.02 | 39.16 | FPG | (102) |
| | 60.00 | 59.44 | 39.19 | OOO | (112) |
| | 59.78 | 59.28 | 39.21 | OOO | (112) |
| | 59.85 | 59.30 | 38.82 | OOO | (112) |
| | 59.80 (4) | 59.38 (4) | 38.96 (4) | FVS | (113) |
| | 60.16 | 59.92 | 39.26 | FOJ | (113,114) |
| | 60.0 (2) | 59.0 (2) | 37.8 (2) | OOR | (115) |
| | 60.24 | 59.56 | 39.37 | FPG | (116) |
| | 60.0 | 59.0 | 39.0 | FOA | (116) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 60.0 (2) | 59.4 (2) | | FOX | (121) |
| | 60.31 | 59.72 | 39.44 | FPG | (130) |
| | 58.80 (3) | 58.35 (3) | 39.50 (3) | FOJ | (128) |
| | 59.99 | 59.35 | 39.18 | FPG | (131) |
| | 60.13 | 59.73 | 39.35 | FPG | (132,133) |
| | 60.19 | 60.40 | 37.90 | OOX | (132,104) |
| | 59.89 | 59.49 | 39.23 | FPG | (135) |
| | 59.90 | 59.52 | 38.90 | FPG | (135) |
| | 60.92 | 60.02 | | FOX | (136) |
| | 60.84 | 60.52 | 38.20 | FPG | (137,138) |
| | 60.34 | 59.56 | 38.89 | FOA | (137,139) |
| | 60.71 | 60.39 | 38.75 | FOX | (137,140) |
| | 59.80 (2) | 59.34 (2) | 38.78 | FPG | (134) |
| | 60.08 (2) | 59.50 (2) | 39.33 (2) | FPG | (153) |
| | 60.04 (3) | 59.82 (3) | 40.22 (3) | FOX | (115) |
| | 60.7 | 60.2 | | OOA | (166) |
| | 60.07 | 60.04 | | FOX | (169) |
| | 60.21 | 59.91 | | FOX | (169) |
| | 60.3 | 59.9 | 39.5 | FOA | (173) |
| | 60.1 | 59.8 | 39.4 | FOX | (173) |
| | 59.27 | 62.16 | 41.90 | OOR | (178) |
| | 61.0 (4) | 60.1 (4) | 39.4 (4) | HOA | (196) |
| $Al_2O_3$ | | | 8.58 (2) | FPG | (19) |
| | | | 8.00 | FPG | (14) |
| | 12.15 | | | FOJ | (19,20) |
| | 11.90 | 11.21 | 8.48 | FPG | (22) |
| | 12.0 | | | FOX | (38) |
| | 11.86 (3) | 11.46 (3) | | FPT | (24,25) |
| | | 11.5 | | FPG | (13) |
| | | 11.61 (2) | | FPG | (26) |
| | 11.83 (6) | 11.67 (6) | 8.87 (6) | FPT | (27) |
| | 12.06 (3) | 11.55 (3) | 8.55 (3) | HOA | (28) |
| | 12.69 (3) | 12.13 (4) | 8.21 (3) | HOA | (40,41) |
| | 12.40 | 12.25 | 8.65 | OOO | (29) |
| | 12.09 | 11.83 | 7.99 | FPT | (30,31) |
| | 12.16 | 11.78 | 8.48 | FOJ | (32) |
| | 12.1 | 11.4 (2) | 8.45 | FOA | (32) |
| | 12.43 (4) | 12.31 (4) | 8.74 (2) | FOX | (66,67) |
| | 12.68 | 12.29 | 8.09 | FOA | (35) |
| | 11.74 (5) | 11.64 (5) | 8.20 | FPG | (33,34) |
| | 11.87 (3) | 11.63 (3) | 8.38 | FOA | (33,34) |
| | 11.89 | 11.41 | 8.69 | OOO | (36) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 12.31 (3) | 12.42 (3) | | FOJ | (37) |
| | 11.7 | 11.3 | 8.8 | OOX | (39) |
| | 12.05 | 11.82 | 8.79 | FOA | (82,84) |
| | 11.98 (5) | 11.49 (5) | 8.45 (5) | FOA | (86) |
| | | | 8.45 (5) | FOA | (86) |
| | 11.36 | 11.56 | 7.37 | FPG | (87) |
| | 11.53 | 11.59 | 7.54 | HYJ | (87,90) |
| | 12.1 | 11.9 | 8.6 | FOX | (91) |
| | 12.27 | 11.85 | 8.39 | FOA | (92) |
| | 12.0 | 11.7 | 8.6 | FOX | (93) |
| | 12.3 | 12.0 | 8.9 | HOA | (93) |
| | 12.2 (3) | 11.8 (3) | 9.07 (3) | FOA | (101) |
| | 11.76 (5) | 12.08 (4) | 8.43 (3) | FPG | (102) |
| | 11.90 (2) | 12.15 (2) | 8.50 (2) | FPG | (102) |
| | 12.15 (3) | 12.03 (2) | 8.54 (2) | HOA | (40) |
| | 11.72 | 12.02 | 7.69 | OOO | (112) |
| | 12.76 | 12.32 | 8.12 | OOO | (112) |
| | 12.31 | 12.40 | 8.92 | OOO | (112) |
| | 12.12 (4) | 11.58 (4) | 8.69 (4) | FVS | (113) |
| | 12.00 | 11.38 | 8.27 | FOJ | (113,114) |
| | 12.2 (2) | 11.4 (2) | 8.0 (2) | OOR | (115) |
| | 12.0 (2) | 11.6 (2) | 8.60 | FOA | (116) |
| | 12.10 | | 8.42 | FPG | (116) |
| | 12.0 (2) | 12.0 | | FOX | (121) |
| | 11.91 | 11.93 | 8.49 | FPG | (130) |
| | 11.60 (3) | 11.33 (3) | 9.31 (3) | FOJ | (128) |
| | 12.27 | 12.50 | 8.80 | FPG | (131) |
| | 11.99 | 12.06 | 8.52 | OOT | (132,133) |
| | 12.76 | 12.20 | 8.52 | OOX | (132,109) |
| | 12.08 | 12.09 | 8.04 | FPG | (135) |
| | 12.18 | 12.05 | 8.57 | OOA | (135) |
| | 12.03 | 11.58 | | FOX | (136) |
| | 11.86 | 11.43 | | HOA | (136) |
| | 12.20 | 12.10 | 8.46 | OOT | (137,138) |
| | 12.16 | 11.81 | 8.82 | FOA | (137,139) |
| | 12.05 | 11.71 | 8.38 | FOX | (137,140) |
| | 12.12 (2) | 11.62 (2) | 8.52 (2) | FPG | (134) |
| | | | 8.57 (2) | FPT | (153) |
| | 12.10 (2) | 11.88 (2) | 8.50 (2) | HYT | (153) |
| | 12.16 (3) | 11.73 (3) | 8.73 (3) | FOX | (165) |
| | 11.58 | 11.56 | | OOA | (166) |
| | 11.99 | 11.76 | | FOX | (169) |
| | | | 7.6 (15) | OVS | (170) |
| | 12.18 | 11.80 | | FOX | (169) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 12.1 | 11.5 | 8.25 | FOA | (173) |
| | 12.3 | 11.7 | 8.25 | FOX | (173) |
| | 11.16 | 11.76 | 8.84 | OOR | (178) |
| | 11.81 (4) | 11.41 (4) | 8.33 (4) | HOA | (198) |
| $Fe_2O_3$ | | | 8.94 | Dif | (19) |
| | | | 8.02 | Dif | (14) |
| | 2.72 | | | Dif | (20,21) |
| | 2.59 | 2.53 | 8.59 | Dif | (22) |
| | 2.33 (3) | 2.43 (3) | | Dif | (24,25) |
| | | 2.36 (2) | | Dif | (26) |
| | 2.18 (6) | 2.46 (6) | 8.44 (6) | Dif | (27) |
| | 2.25 (3) | 2.38 (3) | 8.52 (3) | Dif | (28) |
| | 2.78 | 2.98 | 8.70 | 000 | (29) |
| | 2.92 | 3.07 | 9.13 | 000 | (30) |
| | 2.22 | 2.44 | 8.05 | Dif | (32) |
| | 2.33 | 2.67 | 8.50 | Dif | (33,34) |
| | 2.27 | 2.42 | 7.42 | Dif | (36) |
| | 2.66 | 2.63 | 8.46 | Dif | (35) |
| | 2.77 (3) | 2.98 (3) | | Dif | (37) |
| | | | 6.9 | 000 | (39) |
| | 2.29 (5) | 2.43 (5) | 8.19 | 000 | (86) |
| | | | 8.28 | 000 | (86) |
| | 3.96 | 3.83 | 9.80 | Dif | (87) |
| | 3.70 | 3.80 | 9.76 | Dif | (87) |
| | 2.53 | 2.52 | 8.53 | Dif | (89) |
| | 3.0 | 3.0 | 9.89 | Dif | (93) |
| | 2.38 | 2.50 | 8.89 | Dif | (101) |
| | 2.63 (2) | 2.64 (2) | 8.29 (2) | Dif | (102) |
| | 2.44 (3) | 2.46 (2) | 8.26 | Dif | (106) |
| | 2.10 | 2.18 | 9.59 | Dif | (40) |
| | 2.58 | 2.59 | 8.88 | 000 | (112) |
| | 3.18 | 3.13 | 9.01 | 000 | (112) |
| | 2.47 | 2.61 | 8.07 | 000 | (112) |
| | 2.44 | 2.58 | 8.49 | Dif | (113,114) |
| | 2.22 | 2.45 | 8.26 | Dif | (116) |
| | 2.54 | 2.75 | 8.54 | Dif | (130) |
| | 2.33 | 2.45 | 8.12 | Dif | (131) |
| | 2.48 | 2.59 | 7.88 | Dif | (132) |
| | 2.40 | 2.48 | 7.74 | Dif | (132) |
| | 2.43 | 2.33 | 8.69 | Dif | (135) |
| | 2.26 | 2.16 | 8.63 | Dif | (135) |
| | 2.20 (2) | 2.30 (2) | 8.00 (2) | Dif | (134) |
| | | | 8.00 | Dif | (134) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 2.03 (2) | 2.39 (2) | 7.70 (2) | Dif | (153) |
| | 2.72 | 2.92 | | Dif | (166) |
| | 2.39 | 2.40 | 8.44 | Dif | (173) |
| FeO | | | 7.94 | HOT | (19) |
| | | | 9.00 | HOT | (14) |
| | 3.52 | | | HOT | (20,21) |
| | 3.70 | 3.70 | 9.17 | HOT | (22) |
| | 3.59 (3) | 3.63 (3) | | HOT | (24,25) |
| | | 3.82 (2) | | HOT | (26) |
| | 3.62 (6) | 3.75 (6) | 8.35 (6) | HOT | (27) |
| | 3.57 (3) | 3.61 (3) | 8.42 (3) | HOT | (28) |
| | 3.10 | 3.10 | 8.10 | 000 | (29) |
| | 3.16 | 3.30 | 8.33 | 000 | (30) |
| | 3.59 | 3.54 | 8.70 | HOT | (32) |
| | 3.64 (3) | 3.61 (3) | 8.71 (3) | HOT | (33,34) |
| | 3.56 | 3.58 | 8.69 | 000 | (36) |
| | 3.21 | 3.26 | 8.36 | HOT | (35) |
| | 2.97 (3) | 2.89 (3) | | HOT | (37) |
| | | | 8.77 | 000 | (39) |
| | 3.63 (5) | 3.66 (5) | 8.76 | 000 | (86) |
| | | | 8.78 | 000 | (86) |
| | 3.68 | 3.74 | 8.75 | HOT | (87) |
| | 3.68 | 3.72 | 8.75 | HOT | (87) |
| | 3.32 | 3.45 | 8.44 | HOT | (89) |
| | 3.1 | 3.0 | 7.75 | HOT | (93,94) |
| | 3.68 (3) | 3.74 (4) | 8.89 (4) | HOT | (107) |
| | 3.62 | 3.48 | 8.92 | HOT | (102) |
| | 3.62 (2) | 3.48 (2) | 8.92 | HOT | (102) |
| | 3.73 (5) | 3.76 (5) | 8.54 (5) | HOT | (106,40) |
| | 3.61 | 3.72 | 8.61 | 000 | (112) |
| | 3.44 | 3.81 | 8.54 | 000 | (112) |
| | 3.49 | 3.66 | 8.76 | 000 | (112) |
| | 3.61 | 3.62 | 8.71 | HOT | (113,114) |
| | 3.66 | 3.66 | 8.90 | HOT | (116) |
| | 3.33 | 3.39 | 8.45 | HOT | (130) |
| | 3.53 | 3.56 | 8.66 | HOT | (131) |
| | 3.45 | 3.54 | 8.71 | HOT | (132,133) |
| | 3.69 | 3.98 | 8.62 | HOT | (135) |
| | 3.68 | 4.06 | 8.65 | HOT | (135) |
| | 3.58 (2) | 3.64 (2) | 8.72 (2) | HOT | (134) |
| | 3.59 (5) | | | HOT | (149) |
| | 3.66 (2) | 3.56 (2) | 9.02 (2) | OOT | (153) |
| | | 3.40 (5) | 7.88 (5) | HOT | (151) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 3.41 | 3.41 | | OOT | (166) |
| | 3.65 | 3.65 | 8.41 | OOT | (173) |
| MgO | | | 13.48 (2) | FPG | (19) |
| | | | 13.34 (2) | FOA | (19) |
| | | | 13.95 | FPG | (14) |
| | 3.06 | | | HOT | (20,21) |
| | 2.98 | 3.05 | 13.64 | HOT | (22) |
| | 2.5 | | | FOX | (38) |
| | 2.76 (3) | 2.84 (3) | | FYT | (24,25) |
| | 2.65 | 2.60 | | OOT | (42) |
| | | 2.63 | | OOA | (42) |
| | | 2.66 (2) | | FPG | (26) |
| | 2.84 (6) | 3.84 (6) | 13.65 (6) | FPT | (27) |
| | 2.74 (3) | 2.69 (3) | 13.91 | HOA | (28) |
| | 2.70 (3) | 2.63 (4) | 13.40 (3) | HOA | (40,41) |
| | 3.06 | 3.00 | 13.95 | OOO | (29) |
| | 2.82 | 3.52 | 14.41 | HOT | (30,31) |
| | 2.68 | 2.70 | 13.75 (2) | FOA | (32) |
| | 2.69 | 2.75 | 13.53 | FPG | (32) |
| | 2.76 | 2.70 | 13.31 | FOA | (35) |
| | 2.61 (5) | 2.56 (5) | 13.77 | FPG | (33,34) |
| | 2.73 (3) | 2.67 (3) | 13.73 | FOA | (33,34) |
| | 2.54 | 2.50 | 13.16 | OOO | (36) |
| | 2.45 (3) | 2.32 (3) | | HOA | (37) |
| | 2.60 | 2.64 | 13.9 | OOA | (39) |
| | | 2.52 (2) | | OVS | (43) |
| | 2.66 (4) | 2.63 (4) | 13.08 (2) | FOX | (66,67) |
| | 2.67 (3) | 2.64 | 13.79 (3) | FOA | (82) |
| | 2.68 | 2.58 | 13.48 | FOA | (82,84) |
| | 2.64 (5) | 2.64 (5) | 13.46 (5) | FOA | (86) |
| | | | 13.43 (5) | FOA | (86) |
| | 2.57 | 2.58 | 13.00 | FPT | (87) |
| | 2.81 | 2.92 | 13.26 | HOA | (87) |
| | 2.58 | 2.42 | 13.18 | FOA | (92) |
| | 2.6 | 2.6 | 14.3 | FOX | (93) |
| | 2.6 | 2.6 | 13.9 | HOA | (93) |
| | 2.58 (3) | 2.56 (2) | 13.33 (3) | FPG | (101) |
| | 2.72 (3) | 2.73 (3) | 13.5 (3) | FOA | (101) |
| | 3.02 (2) | 3.00 (2) | 13.32 (2) | FPG | (102) |
| | 2.92 (2) | 2.90 (2) | 13.18 (2) | FPG | (102) |
| | 2.86 (5) | 2.83 (5) | 13.00 (5) | OVS | (40,105) |
| | 2.51 | 2.47 | 13.34 | OOO | (112) |
| | 2.69 | 2.81 | 13.30 | OOO | (112) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 2.58 | 2.52 | 13.09 | OOO | (112) |
| | 2.60 (4) | 2.55 (4) | 13.55 (4) | FVS | (113) |
| | 2.18 | 2.19 | 13.86 | HOT | (113,114) |
| | | | 12.4 (2) | OOR | (115) |
| | 2.68 | 2.68 | 13.51 | FPG | (116) |
| | 2.72 | 2.67 | 13.5 | FOA | (116) |
| | 2.70 (2) | 2.60 | | FOX | (121) |
| | 2.74 | 2.72 | 13.52 | FPG | (130) |
| | 2.54 (3) | 2.56 (3) | 13.77 (3) | FOA | (128) |
| | 2.67 | 2.61 | 13.54 | FPG | (131) |
| | 2.69 | 2.68 | 13.91 | OOA | (132,133) |
| | 2.64 | 2.59 | 13.41 | FPG | (135) |
| | 2.60 | 2.55 | 13.30 | OOA | (135) |
| | 1.83 | 2.53 | | HOA | (136) |
| | 2.71 | 2.79 | 14.07 | OOT | (137,138) |
| | 2.85 | 2.83 | 13.32 | FOA | (137,139) |
| | 3.50 | 3.55 | 13.23 | FOX | (137,140) |
| | 2.76 (2) | 2.72 (2) | 13.17 (2) | FPT | (134) |
| | 2.82 (2) | 2.79 (2) | | FOT | (153) |
| | 2.77 (2) | 2.73 (2) | 13.61 (2) | FCT | (153) |
| | 2.86 (3) | 2.84 (3) | 12.23 (3) | FOX | (165) |
| | 2.54 | 2.54 | | OOA | (166) |
| | 2.65 | 2.73 | | FOX | (169) |
| | 2.7 (2) | 2.8 (2) | | OVS | (170) |
| | 2.8 (15) | 2.8 (15) | | OVS | (170) |
| | 2.75 | 2.79 | | FOX | (169) |
| | 2.61 | 2.60 | 13.5 | FOA | (173) |
| | 2.64 | 2.64 | 13.5 | FOX | (173) |
| | 2.60(4) | 2.69(4) | 12.50 (4) | HOA | (196) |
| CaO | | | 14.90 (2) | FPG | (157) |
| | | | 14.30 | FPG | (14) |
| | | | 15.39 (2) | FOA | (19) |
| | 7.95 | | | HOT | (20,21) |
| | 7.71 | 8.04 | 14.10 | HOT | (22) |
| | 7.70 | | | FOX | (38) |
| | 8.05 (3) | 7.89 (3) | | FYT | (24,25) |
| | 7.91 | 8.00 | | OOO | (42) |
| | | 8.45 | | OOA | (42) |
| | | 8.84 (2) | | FPG | (26) |
| | 7.88 (6) | 8.27 (6) | 14.19 (6) | FPT | (27) |
| | 7.96 (3) | 8.28 (3) | 14.72 (3) | HOA | (28) |
| | 8.02 (3) | 8.60 (4) | 14.93 (3) | HOA | (30,41) |
| | 7.85 | 8.30 | 14.40 | OOO | (29) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 8.13 | 8.13 | 14.09 | HOT | (30,31) |
| | 8.17 | 8.1 | 15.2 (2) | FOA | (32) |
| | 8.22 | 8.50 | 14.9 | FPG | (32) |
| | 8.20 (5) | 8.54 (5) | 14.46 (5) | FPG | (33,34) |
| | 8.13 (3) | 8.33 (3) | 14.70 (3) | FOA | (33,34) |
| | 7.89 | 8.13 | 14.81 | FOA | (35) |
| | 7.80 | 8.14 | 14.51 | OOO | (36) |
| | 7.85 (3) | 8.63 (3) | | HOA | (37) |
| | 8.05 | 8.20 | 15.6 | OOX | (39) |
| | 8.06 (4) | 8.33 (4) | 14.57 (2) | FOX | (66,67) |
| | 7.81 (3) | 8.14 (3) | 14.54 | FOA | (82) |
| | 7.85 | 8.18 | 14.44 | FOA | (82,84) |
| | 8.05 (5) | 8.28 (5) | 14.86 (5) | FOA | (86) |
| | | | 14.79 (5) | FOA | (86) |
| | 7.90 | 8.15 | 15.10 | FPT | (87) |
| | 7.98 | 8.08 | 14.67 | HOA | (87) |
| | 8.05 | 8.15 | 15.1 | FOX | (91) |
| | 8.19 | 8.43 | 14.81 | FOA | (92) |
| | 8.2 | 8.5 | 15.2 | FOX | (93) |
| | 8.3 | 8.5 | 14.9 | HOA | (93) |
| | 7.98 (3) | 8.17 (3) | 14.76 (2) | FPG | (101) |
| | 8.17 (3) | 8.43 (3) | 14.8 (3) | FOA | (101) |
| | 7.85 (2) | 8.20 (2) | 14.52 (2) | FPT | (102) |
| | 7.97 (2) | 8.26 (2) | 14.60 (2) | FPT | (102) |
| | 7.67 (3) | 7.71 (3) | 15.39 (2) | BOX | (40,104) |
| | 7.96 | 8.37 | 14.73 | OOO | (112) |
| | 7.65 | 8.26 | 14.51 | OOO | (162) |
| | 7.90 | 8.16 | 14.45 | OOO | (162) |
| | 8.38 (4) | 8.55 (4) | 14.53 | FVS | (113) |
| | 8.42 (4) | 8.84 | 14.23 | HOT | (113,116) |
| | | | 17.0 (2) | OOR | (115) |
| | 7.98 | 8.34 | 14.78 | FPG | (116) |
| | 7.98 | 8.29 | 14.7 | FOA | (116) |
| | 7.84 (2) | 8.16 | | FOX | (121) |
| | 7.91 | 8.13 | 14.59 | FPG | (130) |
| | 8.05 (3) | 8.20 (3) | 14.08 (3) | FOA | (128) |
| | 7.99 | 8.33 | 14.70 | FPG | (131) |
| | 7.82 | 8.09 | 14.70 | OOA | (132,133) |
| | 7.47 | 7.89 | 16.38 | OOX | (132,104) |
| | 7.91 | 8.19 | 14.46 | FPT | (135) |
| | 7.87 | 8.15 | 14.52 | OOA | (135) |
| | 7.93 | 8.15 | | FOX | (136) |
| | 7.96 | 8.09 | | HOA | (136) |
| | 8.00 | 8.10 | 14.64 | OOT | (137,138) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 8.24 | 8.35 | 15.06 | FOA | (137,139) |
| | 8.22 | 8.44 | 14.49 | FOX | (137,140) |
| | 8.08 (2) | 8.42 (2) | 14.82 (2) | FPG | (134) |
| | 7.86 (2) | 8.10 (2) | 14.36 (2) | FOT | (153) |
| | 7.87 (2) | 8.10 (2) | 14.36 (2) | FCT | (153) |
| | 8.03 (3) | 8.30 (3) | 14.85 (3) | FOX | (165) |
| | 8.05 | 8.08 | | OOA | (166) |
| | 8.01 | 8.32 | | FOX | (169) |
| | 7.98 | 8.23 | | FOX | (169) |
| | 7.93 | 8.25 | 14.6 | FOA | (173) |
| | 7.92 | 8.13 | 14.3 | FOX | (173) |
| | 7.15 (4) | 7.11 (4) | 13.98 (4) | HOA | (196) |
| | 8.82 (10) | 8.62 (10) | 16.0 (10) | OOS | (197) |
| $Na_2O$ | | | 0.74 | HOA | (157) |
| | | | 0.73 | FOA | (19) |
| | | | 0.66 (2) | FOA | (19) |
| | | | 0.85 | HOE | (14) |
| | 4.54 | | | HOE | (20,21) |
| | 4.45 | 4.31 | 0.81 | HOE | (22) |
| | 4.38 (3) | 4.15 (3) | | HCE | (24,25) |
| | 4.22 | 3.88 | | OOO | (13) |
| | | 3.64 | | OOR | (42) |
| | | 4.17 (13) | | OOA | (26) |
| | 4.04 (6) | 3.86 (6) | 0.67 (6) | HPE | (27) |
| | 4.36 (4) | 4.11 (3) | 0.77 (3) | HOA | (28) |
| | 4.70 (4) | 4.45 (4) | 0.84 (3) | HOE | (40,41) |
| | 4.40 | 4.20 | 0.75 | OOO | (29) |
| | 4.26 | 3.76 | 1.24 | HOE | (30,31) |
| | 4.33 | 4.20 | 0.70 | FOA | (32) |
| | 4.30 | 4.12 | 0.68 | FOA | (32) |
| | 4.25 | 4.15 | | FOA | (32) |
| | 4.37 | 4.16 | 0.72 | FOA | (35) |
| | 4.08 (5) | 3.92 (5) | 0.69 (5) | HOA | (33,34) |
| | 4.11 (3) | 3.93 (3) | 0.65 (3) | FOA | (33,34) |
| | 4.39 | 4.17 | 0.77 | OOO | (36) |
| | 4.37 (3) | 4.27 (3) | | HOA,E | (37) |
| | 4.29 | 4.14 | 0.78 | OOA | (39) |
| | 4.67 (4) | 4.40 (4) | 0.70 (2) | BOX | (66,68) |
| | 4.25 | 4.02 | 0.63 | FOA | (82,84) |
| | 4.35 (5) | 4.13 (5) | 0.73 (5) | FOA | (86) |
| | | | 0.72 (5) | FOA | (86) |
| | 3.90 | 3.80 | 0.77 | HPE | (87) |
| | 3.90 | 3.80 | 0.77 | HPE | (87) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 4.17 | 3.95 | 0.68 | FOA | (92) |
| | 4.48 | 4.17 | 0.71 | HPE | (93) |
| | 4.34 (3) | 4.20 (3) | 0.77 (3) | HOE | (101) |
| | 4.48 (3) | 4.22 (3) | | FPE | (102) |
| | | | 0.72 (3) | FCE | (102) |
| | 4.48 (2) | 4.38 (2) | | FPE | (102) |
| | | | 0.72 (2) | FCE | (102) |
| | 4.14 | 3.91 | 0.70 | OOR | (102) |
| | 4.12 | 4.05 | 0.71 | OOR | (102) |
| | 4.41 (3) | 4.24 (2) | 0.80 (2) | HOE | (40) |
| | 4.04 (2) | 3.92 (2) | 0.76 (3) | HOE | (40,107) |
| | 4.39 | 4.17 | 0.93 | OOO | (112) |
| | 4.22 | 4.19 | 1.33 | OOO | (112) |
| | 4.49 | 4.29 | 1.02 | OOO | (112) |
| | 4.38 (4) | 4.16 (4) | 0.69 (4) | FVS | (113) |
| | 4.57 | 4.34 | 0.75 | HOE | (113,114) |
| | 4.27 (2) | 3.86 (2) | 0.70 (2) | OOR | (115) |
| | 4.17 | 3.95 | 0.72 | FOA | (116) |
| | 4.3 (2) | 4.1 | | FOX | (121) |
| | 4.40 | 4.17 | 0.74 | HOE | (130) |
| | 4.53 (3) | 4.34 (3) | 0.74 (3) | FOE | (128) |
| | 4.30 | 4.08 | 0.73 | FPG | (131) |
| | 4.31 | 4.07 | 0.73 | OOA | (132,133) |
| | 4.28 | 4.22 | 0.95 | OOA | (135) |
| | 4.33 | 4.24 | 0.92 | OOA | (135) |
| | 4.38 | 4.12 | | HOA | (136) |
| | 4.02 | 4.02 | 0.94 | OOE | (137,138) |
| | 4.36 | 4.05 | 0.84 | FOE | (137,139) |
| | 4.36 (2) | 4.18 (2) | 0.67 (2) | HPE | (134) |
| | 4.38 (2) | 4.17 (2) | 0.64 (2) | HOE | (153) |
| | 4.32 (2) | 4.14 (2) | 0.67 (2) | HOE | (153) |
| | 4.30 | 3.87 | 0.98 | OOR | (163) |
| | 4.16 | 4.03 | | OOA | (166) |
| | 4.33 | 4.20 | | FOX | (169) |
| | | | 0.70 (15) | OVS | (170) |
| | 4.34 | 4.18 | | FOX | (169) |
| | 4.37 | 4.11 | 0.71 | HOA | (173) |
| | 4.33 | 4.18 | 0.73 | OOR | (178) |
| | 4.12 | 4.05 | 0.71 | HCR | (178) |
| | 4.54 (4) | 4.29 (4) | 0.74 (4) | HOA | (196) |
| $K_2O$ | | | 0.17 | HOA | (19) |
| | | | 0.17 | FOA | (19) |
| | | | 0.16 (2) | FOA | (19) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | | | 0.18 | HOE | (14) |
| | 4.76 | | | HOE | (20,21) |
| | 4.67 | 4.26 | 0.24 | HOE | (22) |
| | 4.45 | | | FOX | (38) |
| | 4.70 (3) | 4.37 (3) | | HCE | (24,25) |
| | 4.15 | 3.85 | | 000 | (113) |
| | | 4.28 | | 00A | (26) |
| | 4.37 (6) | 4.23 (6) | 0.18 (6) | HPE | (27) |
| | 4.51 (4) | 4.30 (3) | 0.18 (3) | HOA | (28) |
| | 4.54 (3) | 4.20 (4) | 0.19 (3) | HOE | (40,41) |
| | 4.80 | 4.35 | 0.20 | 000 | (29) |
| | 4.76 | 4.32 | 0.23 | HOE | (30,31) |
| | 4.46 | 4.10 | 0.20 | FOA | (32) |
| | 4.40 | 4.08 | 0.20 | FOA | (32) |
| | 4.42 | 4.12 | 0.18 | FOA | (32) |
| | 3.79 (5) | 3.62 (5) | 0.14 | HOA | (33,34) |
| | 3.79 (3) | 3.61 (3) | 0.14 | FOA | (33,34) |
| | 4.29 | 4.09 | 0.20 | FOA | (35) |
| | 4.50 | 4.18 | 0.21 | 000 | (36) |
| | 4.41 (3) | 4.26 (3) | | HOA,E | (37) |
| | 4.30 | 4.03 | 0.18 | 00X | (39) |
| | 4.46 (4) | 4.11 (4) | 0.20 (2) | FOX | (66,67), |
| | 4.40 | 4.08 | 0.18 | FOA | (82,84) |
| | 4.57 (5) | 4.32 (5) | 0.18 (5) | FOA | (86) |
| | | | 0.18 | FOA | (86) |
| | 4.30 | 4.40 | 0.17 | HPE | (87) |
| | 4.40 | 4.35 | 0.17 | HPE | (87) |
| | 4.54 | 4.31 | 0.20 | FOX | (91) |
| | 4.51 | 4.32 | 0.16 | FOA | (92) |
| | 4.5 | 4.3 | 0.20 | FOX | (93) |
| | 4.27 | 4.00 | 0.22 | HPE | (93) |
| | 4.64 (3) | 4.20 (3) | 0.17 (3) | HOE | (101) |
| | 4.32 (2) | 4.29 (2) | | FPE | (102) |
| | | | 0.18 (2) | FCE | (102) |
| | 4.32 (2) | 4.37 (2) | | FPE | (102) |
| | | | 0.18 (2) | FCE | (102) |
| | 4.38 (3) | 4.14 (2) | 0.18 (2) | HOE | (40) |
| | 4.50 (3) | 4.41 (2) | 0.19 (2) | BOX | (40,104) |
| | 4.16 (2) | 4.02 (2) | 0.20 (2) | HOE | (40,107) |
| | 4.38 | 4.12 | 0.22 | 000 | (112) |
| | 4.46 | 4.27 | 0.34 | 000 | (112) |
| | 4.54 | 4.24 | 0.21 | 000 | (112) |
| | 4.56 (4) | 4.31 (4) | 0.12 (4) | FVS | (113) |
| | 4.78 | 4.49 | 0.18 | HOE | (113,114) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 4.48 | 4.20 | 0.17 | FOA | (116) |
| | 4.45 | 4.29 | | FPG | (116) |
| | 4.59 (2) | 4.28 | | FOX | (121) |
| | 4.53 | 4.32 | 0.16 | HOE | (130) |
| | 5.25 (3) | 4.96 (3) | 0.12 (3) | FOE | (128) |
| | 4.52 | 4.21 | 0.17 | FPG | (131) |
| | 4.52 | 4.25 | 0.18 | OOA | (132,133) |
| | 4.50 | 4.44 | 0.19 | OOX | (104,132) |
| | 4.42 | 4.25 | 0.23 | OOA | (135) |
| | 4.40 | 4.22 | 0.18 | OOA | (135) |
| | 4.32 | 4.02 | | FOX | (136) |
| | 4.47 | 4.04 | | HOA | (136) |
| | 3.94 | 3.84 | 0.24 | OOE | (137,138) |
| | 4.35 | 4.18 | 0.24 | FOE | (137,139) |
| | 3.99 | 3.68 | 0.09 | FOX | (137,140) |
| | 4.30 (2) | 4.08 (2) | 0.20 (2) | HPE | (134) |
| | 4.51 (2) | 4.25 (2) | 0.15 (2) | HOE | (153) |
| | 4.46 (2) | 4.20 (2) | 0.09 (2) | HOE | (153) |
| | 4.5 | 4.1 | 0.5 | OOR | (163) |
| | 4.46 (3) | 4.17 (3) | 0.19 (3) | FOX | (165) |
| | 4.36 | 4.11 | | OOA | (166) |
| | 4.48 | 4.23 | | FOX | (169) |
| | 4.51 | 4.27 | | FOX | (169) |
| | 4.46 | 4.17 | 0.18 | FOA | (173) |
| | 4.62 | 4.31 | 0.18 | FOX | (173) |
| | 4.44 | 3.89 | 0.18 | OOR | (178) |
| | | | 0.18 | OOR | (195) |
| | 4.26 (4) | 4.10 (4) | 0.18 (4) | HOA | (196) |
| $H_2O^+$ | | | 1.13 | FVG | (19) |
| | | | 1.22 | FVG | (14) |
| | 0.28 | | | FVG | (20,21) |
| | 0.37 | 0.63 | 0.84 | FVG | (22) |
| | 0.37 (3) | 0.78 (3) | | FVG | (24,25) |
| | 0.21 | 0.76 | | OOO | (13) |
| | | 0.48 (2) | | FVG | (26) |
| | 0.93 (2) | 1.14 (2) | 1.30 (2) | OVG | (28) |
| | 0.56 | 0.70 | 1.00 | OOO | (29) |
| | 0.22 | 0.26 | 0.79 | FVG | (32) |
| | 0.74 (3) | 0.68 (3) | 0.89 (3) | OOO | (33) |
| | 0.43 | 0.43 | 0.96 | FVG | (35) |
| | 0.23 | 0.32 | 0.79 | OOO | (36) |
| | 0.28 (3) | 0.44 (3) | | OVG | (37) |
| | 0.28 | 0.70 | 1.3 | OVG | (39) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.53 (5) | 1.03 (5) | 1.03 (5) | FVG | (86) |
| | | | 1.05 (5) | FVG | (86) |
| | 0.61 (3) | 0.69 (3) | 1.01 (3) | FVG | (101) |
| | 1.00 | 0.99 | 1.26 | Dif | (102) |
| | 0.90 | 0.94 | 1.24 | Dif | (102) |
| | 1.30 | 1.40 | 2.10 | OOO | (112) |
| | 0.63 | 0.65 | 1.04 | OOO | (112) |
| | 1.42 | 1.49 | 2.16 | OOO | (112) |
| | 0.48 | 0.48 | 1.15 | OVG | (113,114) |
| | 0.38 | 0.41 | 0.82 | FVG | (116) |
| | 0.58 | 0.59 | 1.07 | FVG | (130) |
| | 0.94 | 1.02 | 1.08 | OOO | (128) |
| | 0.25 | 0.27 | 0.94 | FVG | (131) |
| | 1.53 | 1.18 | 1.98 | OVG | (135) |
| | 1.47 | 1.33 | 2.12 | OVG | (135) |
| | 0.38 (2) | 0.38 (2) | 0.96 (2) | OVG | (134) |
| | 0.62 (5) | | | FVG | (149) |
| | 0.48 (2) | 0.38 (2) | 0.91 (2) | OOG | (153) |
| | | 0.63 (5) | 0.99 (4) | FVG | (151) |
| | 0.65 | 0.65 | 1.12 | OVG | (173) |
| | 0.46 (3) | 0.49 (3) | 0.99 (3) | FVG | (203) |
| $H_2O^-$ | | | 0.09 | OVG | (19) |
| | | | 0.11 | OVG | (14) |
| | 0.18 | | | OVG | (20,21) |
| | 0.18 | 0.17 | 0.12 | OVG | (22) |
| | 0.33 (5) | 0.36 (5) | 0.05 | OVG | (27) |
| | | 0.22 (2) | | OVG | (26) |
| | 0.08 (2) | 0.06 (2) | <0.02 (2) | OVG | (28) |
| | 0.16 | 0.17 | 0.10 | OOO | (29) |
| | 0.17 | 0.21 | 0.14 | OVG | (32) |
| | 0.16 (3) | 0.17 (3) | 0.13 (3) | OVG | (33) |
| | 0.27 | 0.27 | 0.24 | OVG | (36) |
| | 0.23 (5) | 0.27 (5) | 0.23 (5) | OVG | (86) |
| | | | 0.24 (5) | OVG | (86) |
| | 0.10 (3) | 0.10 (3) | 0.06 (3) | OVG | (101) |
| | 0.23 (2) | 0.28 (2) | 0.21 (2) | OVG | (102) |
| | 0.25 (2) | 0.31 | 0.22 | OVG | (102) |
| | 0.25 | 0.26 | 0.10 | OOO | (112) |
| | 0.28 | 0.25 | 0.27 | OOO | (112) |
| | 0.18 | 0.20 | 0.13 | OOO | (112) |
| | 0.18 | 0.19 | 0.13 | OVG | (113,119) |
| | 0.19 | 0.16 | 0.14 | OVG | (116) |
| | 0.16 | 0.19 | 0.13 | OVG | (130) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.13 | 0.18 | 0.07 | OVG | (128) |
| | 0.15 | 0.16 | 0.05 | OVG | (131) |
| | 0.13 | 0.15 | 0.06 | OVG | (132) |
| | 0.11 | 0.29 | 0.09 | OVG | (135) |
| | 0.28 | 0.28 | 0.10 | OVG | (135) |
| | 0.20 (2) | 0.20 (2) | 0.17 (2) | OVG | (134) |
| | 0.13 (10) | | | OVG | (149) |
| | 0.19 (2) | 0.21 (2) | 0.20 (2) | OOG | (153) |
| | | 0.16 (5) | 0.08 (5) | OVG | (151) |
| | 0.18 | 0.18 | 0.15 | OVG | (173) |
| L.O.I. | 1.48 (5) | 1.44 (5) | 2.26 (5) | OVG | (27) |
| | 1.22 | 1.39 | 1.97 | OVG | (30,31) |
| | 1.09 | 1.04 | 1.17 | OVG | (87) |
| | 1.09 | 1.04 | 1.17 | OVG | (87) |
| | 0.99 | 0.89 | 1.09 | OVG | (93) |
| | 1.14 (4) | 1.25 (4) | 1.38 (4) | OVG | (113) |
| | 1.27 | 1.26 | 1.92 | OVG | (132) |
| | 0.99 | 1.16 | 1.32 | OVG | (137,138) |
| | 1.08 | | | OVG | (137,138) |
| | 0.90 | 0.85 | | OVG | (169) |
| $CO_2$ | | | 1.00 | HVG | (19) |
| | | | 0.99 | OVG | (14) |
| | <0.10 | <0.10 | | OOO | (42) |
| | 0.50 | 0.41 | 1.10 | OOO | (29) |
| | 0.59 | 0.50 | 1.14 | FVK | (32) |
| | 0.59 (2) | 0.50 (2) | | FVK | (32) |
| | 0.55 (4) | 0.55 (4) | 1.13 (4) | FVJ | (33) |
| | 0.44 | 0.34 | 1.03 | OOO | (36) |
| | 0.46 | 0.35 | 0.98 | HVT | (44) |
| | 0.32 (3) | 0.26 (3) | | HVK | (37) |
| | | | 1.00 | OOO | (39) |
| | 0.53 (5) | 0.41 (5) | 1.06 (5) | FVK | (86) |
| | | | 1.05 (5) | FVK | (86) |
| | 0.60 | 0.54 | 1.21 | FVL | (93,95) |
| | 0.46 (3) | 0.34 (3) | 1.03 (3) | HVK | (101) |
| | 0.44 (2) | 0.41 (2) | 0.88 (2) | HVG | (102) |
| | 0.46 | 0.40 | 0.90 | HVG | (102) |
| | 0.47 | 0.37 | 1.03 | OVK | (113,114) |
| | 0.42 | 0.18 | 0.90 | HVG | (116) |
| | 0.55 | 0.33 | 1.14 | FVK | (116) |
| | 0.66 | 0.60 | 1.22 (2) | FVT | (111) |
| | 0.42 | 0.38 | 1.05 | OOG | (130) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.48 | 0.42 | 1.03 | HVG | (131) |
| | 0.46 (2) | 0.40 (2) | 1.02 (2) | HVG | (134) |
| | 0.47 | 0.41 | 1.08 | HVK | (147,148) |
| | 0.43 (5) | | | HVK | (149) |
| | 0.50 (2) | 0.46 (2) | 1.14 (2) | OOT | (153) |
| | | 0.47 (5) | 1.22 (5) | HVK | (151) |
| | 0.57 | 0.46 | 1.11 | FVL | (159) |
| | 0.63 | 0.55 | 1.15 | FVG | (173) |
| | 0.48 (8) | | | FVT | (202) |
| | 0.52 (4) | 0.44 (4) | 1.10 (4) | FVJ | (204) |
| | 0.49 (4) | 0.40 (4) | 1.06 (4) | HOO | (206) |
| | 0.53 (4) | 0.43 (4) | 1.11 (4) | FOO | (206) |
| $TiO_2$ | | | 3.85 | FPJ | (19) |
| | | | 3.79 | FPT | (14) |
| | 0.14 | 0.13 | | OVS | (45) |
| | 0.16 | | | HOJ | (20,21) |
| | 0.16 | 0.21 | 3.88 | HOJ | (22) |
| | 0.12 | 0.12 | | OOX | (46) |
| | 0.12 | | | FOX | (38) |
| | 0.18 (3) | 0.17 (3) | | FOJ | (24,25) |
| | | | 3.5 | OVS | (47) |
| | | 0.14 (2) | | OOO | (26) |
| | 0.16 (6) | 0.16 (6) | 3.92 (6) | FPJ | (27) |
| | 0.15 (3) | 0.15 (3) | 3.72 (3) | HOJ | (28) |
| | 0.14 (3) | 0.16 (3) | 3.84 (6) | HOJ | (48) |
| | 0.16 | 0.18 | 3.65 | OOO | (29) |
| | 0.18 | 0.26 | 3.87 | FPJ | (30,31) |
| | 0.14 | 0.16 | 3.90 | HOJ | (32) |
| | 0.15 | | 3.65 | FOA | (32) |
| | | | 3.27 (2) | FOA | (32) |
| | 0.16 | 0.13 | | OVS | (49) |
| | 0.13 (3) | 0.13 (3) | 3.67 (3) | FPJ | (33,34) |
| | 0.12 (3) | 0.12 (3) | 3.62 (3) | FOA | (33,34) |
| | 0.12 | 0.12 | 3.33 | FOA | (35) |
| | 0.11 | 0.11 | 3.34 | OVS | (50) |
| | 0.14 | 0.16 | 4.00 | OOO | (36) |
| | 0.15 (3) | 0.25 (3) | | HOJ | (37) |
| | 0.14 | 0.15 | 3.63 | OOX | (39) |
| | 0.16 (2) | 0.16 (2) | | OVS | (43) |
| | 0.14 (4) | 0.15 (4) | 3.60 | FOX | (66,67) |
| | 0.16 (5) | 0.14 (5) | 3.82 (5) | FOA | (86) |
| | | | 3.83 (5) | FOA | (86) |
| | | | 3.60 | FOA | (35) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.15 | 0.15 | 3.75 | FOJ | (87) |
| | 0.15 | 0.15 | 3.80 | HOJ | (87,90) |
| | $0.13_2$ | $0.13_7$ | 3.9 | FOX | (91) |
| | 0.14 | 0.14 | 3.68 | FOA | (92) |
| | 0.2 | 0.2 | 3.90 | FOX | (93) |
| | 0.12 | 0.15 | | BVS | (93) |
| | 0.12 | 0.12 | 3.4 | HOL | (93) |
| | 0.15 (3) | 0.15 (3) | 3.86 (3) | HOJ | (101) |
| | 0.18 | 0.18 | 4.00 | OOJ | (102) |
| | 0.18 | 0.19 | 4.01 | OOJ | (102) |
| | $0.14_4$ (5) | $0.16_5$ (5) | | OVS | (40,103) |
| | 0.14 (2) | 0.14 (2) | 4.03 (3) | BOX | (40,104) |
| | 0.22 | 0.25 | 3.88 | OOO | (112) |
| | 0.18 | 0.22 | 3.95 | OOO | (112) |
| | 0.22 | 0.27 | 3.85 | OOO | (112) |
| | 0.16 (4) | 0.13 (4) | 3.72 (4) | FVS | (113) |
| | 0.15 | 0.14 | 3.69 | HOJ | (113,114) |
| | | | 3.50 (2) | OOR | (115) |
| | 0.156 | 0.159 | | FPJ | (116) |
| | 0.19 | 0.20 | 3.71 | FOA | (116) |
| | 0.14 (2) | 0.15 | | FOX | (121) |
| | 0.15 | 0.16 | 3.61 | OOJ | (130) |
| | 0.18 | 0.20 | 2.50 | OOS | (130) |
| | 0.15 (3) | 0.16 (3) | 4.28 (3) | FOJ | (128) |
| | 0.15 | 0.16 | 3.77 | FPJ | (131) |
| | 0.18 | 0.17 | 3.74 | OOJ | (132,133) |
| | 0.12 | 0.12 | 3.75 | OOX | (104,132) |
| | 0.21 | 0.23 | 3.91 | OOJ | (135) |
| | 0.19 | | 3.86 | OOJ | (135) |
| | | 0.22 | | OOA | (135) |
| | 0.15 | 0.16 | | FOX | (136) |
| | 0.26 | 0.18 | 4.08 | OOJ | (137,138) |
| | 0.33 | 0.29 | 3.81 | FOA | (137,139) |
| | 0.13 | 0.14 | 3.56 | FOX | (137,140) |
| | 0.14 (2) | 0.14 (2) | 3.63 (3) | FPJ | (134) |
| | 0.16 | 0.16 | 3.41 | HCM | (125,126) |
| | | 0.15 | | HCM | (125,126) |
| | | | 3.86 (3) | HOJ | (40) |
| | $0.14_7$ (2) | $0.16_8$ (2) | | FPJ | (153) |
| | $0.14_8$ (2) | $0.16_6$ (2) | 3.82 (2) | HOJ | (153) |
| | 0.13 (3) | 0.14 (3) | 3.56 (3) | FOX | (165) |
| | | 0.15 | | FOX | (166) |
| | 0.14 | 0.14 | | FOX | (169) |
| | 0.15 (2) | 0.15 (2) | 3.8 (2) | OVS | (170) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.15 (15) | 0.16 (15) | 3.3 (15) | OVS | (170) |
| | 0.14 | 0.14 | | FOX | (169) |
| | 0.14 | 0.14 | 3.79 | FOA | (173) |
| | 0.14 | 0.14 | 3.74 | FOX | (173) |
| | 0.14 | 0.15 | | OOX | (179) |
| | 0.13 | 0.13 | | OOS | (197) |
| $P_2O_5$ | | | <0.02 | FOJ | (19) |
| | | | 0.05 | OOJ | (14) |
| | 0.42 | | | HOJ | (20,21) |
| | 0.43 | 0.53 | 0.13 | HOJ | (22) |
| | 0.46 (3) | 0.55 (3) | | HOJ | (24,25) |
| | 0.43 | 0.55 | | HOJ | (51) |
| | 0.59 | 0.59 | | OOO | (42) |
| | | 0.60 (2) | | HOJ | (26) |
| | 0.45 (6) | 0.55 (6) | 0.06 (6) | HOJ | (27) |
| | 0.47 (3) | 0.60 (3) | 0.08 (3) | HOJ | (28) |
| | 0.43 | 0.53 | | HOJ | (40,48) |
| | 0.39 | 0.50 | 0.10 | OOO | (29) |
| | 0.52 | 0.62 | 0.31 | OOO | (30) |
| | 0.44 | 0.56 | 0.09 | HOJ | (32) |
| | 0.44 (4) | 0.56 (4) | 0.05 (4) | HOJ | (33) |
| | 0.43 | 0.550 | 0.05 | FOJ | (35) |
| | 0.44 | 0.56 | 0.08 | OOO | (36) |
| | 0.42 (3) | 0.53 (3) | | HOJ | (37) |
| | 0.40 | 0.52 | 0.05 | OOX | (39) |
| | 0.43 (4) | 0.52 (4) | 0.08 (2) | FOX | (66,67) |
| | 0.49 | 0.49 | 0.005 | FPJ | (87) |
| | 0.49 | 0.50 | 0.005 | HOJ | (87,90) |
| | 0.43 | 0.48 | | FOX | (91) |
| | 0.35 | 0.44 | 0.03 | HOJ | (93) |
| | 0.43 | 0.53 | 0.06 | HOJ | (101) |
| | 0.38 | 0.52 | 0.07 | HPT | (102) |
| | 0.42 | 0.53 | 0.07 | HPT | (102) |
| | 0.53 (3) | 0.60 (2) | 0.08 (2) | HOJ | (40) |
| | $0.49_5$ (3) | $0.52_6$ (3) | $0.12_1$ (3) | BOX | (40,104) |
| | 0.43 | 0.52 | 0.06 | OOO | (112) |
| | 0.36 | 0.43 | 0.12 | OOO | (112) |
| | 0.51 | 0.57 | 0.06 | OOO | (112) |
| | 0.44 | 0.54 | 0.10 | HOJ | (113,114) |
| | 0.44 | 0.56 | $0.05_4$ | FOJ | (116) |
| | 0.44 (2) | 0.56 | | FOX | (121) |
| | 0.43 | 0.52 | 0.18 | OOJ | (130) |
| | 0.43 (3) | 0.48 (3) | 0.06 | FOJ | (128) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.41 | 0.53 | 0.06 | FPJ | (131) |
| | 0.50 | 0.58 | 0.08 | OOJ | (132,133) |
| | 0.45 | 0.45 | 0.14 | OOT | (135) |
| | 0.42 | 0.44 | 0.13 | OOJ | (135) |
| | 0.42 (2) | 0.51 (2) | | HOJ | (134) |
| | | | 0.05 (2) | FOJ | (134) |
| | 0.45 | 0.50 | 0.074 | HCM | (125,126) |
| | | 0.55 | | HCM | (125,126) |
| | $0.40_8$ (2) | $0.52_9$ (2) | $0.05_9$ (2) | FPJ | (153) |
| | $0.41_1$ (2) | $0.53_4$ (2) | | HOJ | (153) |
| | 0.39 (3) | 0.50 (3) | <0.20 (6) | OVS | (155) |
| | 0.41 | 0.22 | | OOJ | (166) |
| | 0.44 | 0.54 | | FOX | (169) |
| | 0.44 | 0.55 | | FOX | (169) |
| | 0.43 | 0.56 | 0.06 | FOX | (173) |
| F | 0.51 | $0.73_5$ | | FVL | (52) |
| | 0.46 (2) | 0.65 (2) | 0.02 | FPL | (53) |
| | 0.48 | 0.64 | $0.02_5$ | FPL | (27,54) |
| | | | $0.02_7$ | FOL | (14) |
| | 0.49 (4) | 0.67 (4) | 0.10 (4) | FPL | (33) |
| | 0.51 (3) | 0.76 (3) | | FPL | (37) |
| | 0.72 (3) | 0.60 (4) | 0.10 (4) | FPL | (82,85) |
| | 0.47 | 0.72 | $0.06_5$ | FVL | (93) |
| | 0.50 | 0.75 | $0.02_5$ | FVL | (93) |
| | 0.37 | 0.45 | <0.01 | FVJ | (102) |
| | 0.37 | 0.45 | <0.01 | FVJ | (102) |
| | 0.48 | 0.65 | 0.019 | FVL | (116) |
| | 0.50 (3) | $0.72_8$ (3) | $0.02_8$ (3) | FVJ | (123) |
| | 0.54 | 0.76 | 0.03 | FVJ | (131) |
| | 0.52 (2) | 0.66 (2) | 0.02 (2) | FVL | (134) |
| | 0.49 | 0.70 | 0.015 | HCM | (125) |
| | | 0.72 | | HCM | (126) |
| | 0.54 (2) | 0.76 (2) | 0.03 (2) | FVJ | (153) |
| | 0.47 | 0.82 | $0.06_4$ | FVL | (164) |
| | 0.51 | 0.67 | <0.1 | OOL | (173) |
| | 0.49 | 0.74 | 0.02 | FVT | (167) |
| S | | | $0.04_7$ (3) | FVT | (19) |
| | | | 0.05 | FPG | (14) |
| | 0.04 | 0.04 | | OOO | (42) |
| | $0.01_6$ | $0.04_6$ | $0.06_4$ | OOO | (29) |
| | 0.01 | 0.06 | 0.06 | FVT | (32) |
| | 0.02 (3) | 0.07 (3) | $0.07_2$ (3) | FVJ | (33) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.03 (3) | 0.07 (3) | | OPG | (37) |
| | 0.011 (5) | 0.41 (5) | 0.062 (5) | OOO | (86) |
| | | | 0.066 (5) | OOO | (86) |
| | 0.052 | 0.074 | 0.08 | FVL | (93,96) |
| | 0.01 (3) | 0.05 (3) | 0.07 (3) | FVT | (101) |
| | 0.03 | 0.02 | 0.02 | FPJ | (102) |
| | 0.03 | 0.02 | 0.02 | FPJ | (102) |
| | $0.01_5$ | 0.06 | 0.06 | FVT | (111) |
| | 0.02 | 0.05 | | FOX | (121) |
| | 0.01 | 0.05 | 0.06 | FPG | (131) |
| | $0.01_2$ (2) | 0.046 (2) | 0.062 (2) | FVT | (134) |
| | 0.056 | 0.064 | 0.076 | FVL | (167) |
| | 0.02 | 0.04 | 0.06 | FVO | (173) |
| | 0.011 | 0.035 | 0.054 | BOX | (176) |
| | 0.013 (4) | 0.053 | 0.064 (4) | FVJ | (204) |
| MnO | | | 0.16 (2) | FPJ | (19) |
| | | | 0.17 | OOT | (14) |
| | 0.33 | 0.32 | | OVS | (45) |
| | 0.32 | | | HOJ | (20,21) |
| | 0.34 | 0.32 | 0.15 | HOJ | (22) |
| | 0.31 | | | FOX | (38) |
| | 0.34 (3) | 0.34 (3) | | HOJ | (24,25) |
| | | | 0.18 | OVS | (47) |
| | | 0.33 (2) | | OOA | (42) |
| | | 0.29 (2) | | HOJ | (26) |
| | 0.29 (6) | 0.31 (6) | 0.14 (6) | FPJ | (27) |
| | 0.31 (3) | 0.32 (3) | 0.17 (3) | HOA | (28) |
| | 0.30 (2) | 0.31 (3) | 0.17 (3) | HOA | (40,41) |
| | | 0.35 | | OVS | (55) |
| | 0.33 | 0.36 | 0.21 | OOO | (29) |
| | 0.31 | 0.32 | 0.15 | HOA | (30) |
| | 0.31 | 0.30 | 0.17 | HOA | (30) |
| | 0.30 | 0.30 | 0.17 | OOX | (30,56) |
| | 0.32 | 0.32 | 0.17 | FOA | (32) |
| | 0.32 | 0.35 | | OVS | (49) |
| | 0.32 | 0.32 | 0.17 | FOA | (35) |
| | 0.31 (5) | 0.31 (5) | 0.17 (5) | HOA | (33) |
| | 0.32 (3) | 0.31 (3) | 0.17 (3) | FOA | (33) |
| | 0.28 | 0.28 | 0.14 | OVS | (50) |
| | 0.32 | 0.33 | 0.17 | OOO | (36) |
| | 0.36 (3) | 0.33 (3) | | HOA | (37) |
| | 0.33 | 0.35 | 0.16 | OOX | (39) |
| | 0.34 (2) | | 0.17 (2) | OVS | (43) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.32 (4) | 0.33 (4) | 0.16 (2) | FOX | (66,67) |
| | 0.33 (5) | 0.34 (5) | 0.18 (5) | FOA | (86) |
| | | | 0.18 (5) | FOA | (86) |
| | 0.32 | 0.32 | 0.19 | FOJ | (87) |
| | 0.32 | 0.31 | 0.22 | HOJ | (87,90) |
| | 0.32 | 0.33 | 0.17 | FOX | (91) |
| | 0.31 | 0.32 | 0.17 | FOA | (92) |
| | 0.3 | 0.3 | 0.20 | FOX | (93) |
| | 0.30 | 0.31 | 0.17 | HOA | (93) |
| | 0.38 | 0.38 | 0.20 | BVS | (93) |
| | 0.32 | 0.32 | 0.17 | HOL | (93) |
| | 0.31 (5) | 0.32 (5) | 0.17 (5) | HOA | (101) |
| | 0.38 | 0.36 | 0.22 | OOJ | (102) |
| | 0.38 | 0.36 | 0.22 | OOJ | (102) |
| | $0.30_7$ | $0.31_1$ | $0.17_2$ | OOR | (102) |
| | $0.29_7$ | $0.30_1$ | $0.16_6$ | HOA | (40) |
| | $0.31_5$ (5) | $0.31_2$ (5) | $0.18_9$ (5) | OVS | (40,101) |
| | 0.32 | 0.33 | 0.18 | OOO | (112) |
| | 0.33 | 0.36 | 0.23 | OOO | (112) |
| | 0.32 | 0.33 | 0.17 | OOO | (112) |
| | 0.33 (4) | 0.34 (4) | 0.18 (4) | FVS | (113) |
| | 0.31 | 0.32 | 0.16 | HOJ | (113) |
| | $0.31_3$ | $0.31_8$ | $0.16_6$ | OOR | (115) |
| | 0.33 | 0.34 | 0.18 | FOA | (116) |
| | 0.31 (2) | 0.30 | | FOX | (121) |
| | 0.31 | 0.32 | 0.17 | OOJ | (130) |
| | 0.31 | 0.33 | 0.18 | OOX | (130) |
| | 0.31 | 0.31 | $0.11_6$ | OOS | (130) |
| | 0.31 (3) | 0.33 (3) | 0.17 (3) | FOA | (128) |
| | 0.31 | 0.32 | 0.17 | FPJ | (131) |
| | 0.33 | 0.34 | 0.17 | OOA | (132,133) |
| | 0.34 | 0.34 | 0.17 | OOX | (104,132) |
| | 0.31 | 0.34 | 0.19 | OOJ | (135) |
| | 0.32 | 0.33 | 0.17 | OOA | (135) |
| | 0.33 | 0.33 | | FOX | (136) |
| | 0.33 | 0.34 | | HOA | (136) |
| | 0.34 | 0.35 | 0.19 | OOA | (137,139) |
| | 0.32 (2) | 0.33 (2) | 0.14 (2) | HOJ | (134) |
| | 0.37 (6) | 0.37 (6) | 0.16 (6) | OVS | (142) |
| | $0.33_8$ | 0.37 | 0.19 | HCM | (125,126) |
| | | 0.365 | | | (125,126) |
| | $0.33_0$ (2) | $0.33_2$ (2) | $0.16_1$ (2) | FPJ | (153) |
| | $0.33_5$ (2) | $0.33_2$ (2) | | HOJ | (153) |
| | $0.32_8$ (4) | $0.31_9$ (4) | $0.16_2$ (4) | OOX | (153) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 0.30 (4) | 0.29 (4) | | OVS | (162) |
| | 0.30 | 0.28 | 0.23 | OOR | (163) |
| | 0.29 (3) | 0.30 (3) | 0.15 (3) | FOX | (165) |
| | 0.33 | 0.31 | | OOA | (166) |
| | 0.32 | 0.33 | | FOX | (169) |
| | 0.30 (2) | 0.35 (2) | 0.17 (2) | OVS | (170) |
| | 0.36 (15) | 0.40 (15) | 0.17 (15) | OVS | (170) |
| | 0.31 | 0.32 | | FOX | (169) |
| | 0.32 | 0.33 | 0.17 | FOA | (173) |
| | 0.31 | 0.31 | 0.18 | FOX | (173) |
| | 0.32 | 0.30 | 0.17 | OOR | (178) |
| | 0.337 | 0.312 | | OOR | (192) |
| | 0.32 (4) | 0.34 (4) | 0.18 (4) | HOA | (196) |
| $Fe_2O_3T$ | | | 17.76 | HOT | (19) |
| | | | 17.48 (2) | FOA | (19) |
| | | | 18.02 | HOT | (14) |
| | 6.63 | | | HOT | (20,21) |
| | 6.70 | 6.64 | 18.78 | HOT | (22) |
| | 6.20 | | | FOX | (38) |
| | 6.31 (3) | 6.47 (3) | | FOJ | (24,25) |
| | | 6.60 (2) | | HOT | (26) |
| | 6.21 (6) | 6.63 (6) | 17.71 (6) | FPT | (27) |
| | 6.21 (3) | 6.39 (3) | 17.89 (3) | HOA | (28) |
| | 6.22 | 6.42 | 17.70 | OOO | (29) |
| | 6.43 | 6.74 | 18.39 | FPJ | (30,31) |
| | 6.21 | 6.37 | 17.72 | HOJ | (32) |
| | 6.37 (5) | 6.68 (5) | 18.18 (5) | FPT | (33,34) |
| | 6.35 (3) | 6.60 (3) | 18.17 (3) | FOA | (33,34) |
| | 6.17 | 6.34 | 16.92 | FOA | (35) |
| | 6.23 | 6.40 | 17.90 | OOO | (36) |
| | 6.23 | 6.25 | 17.75 | HOT | (35) |
| | 6.07 (3) | 6.19 (3) | | HOJ | (37) |
| | 6.32 | 6.52 | 16.64 | OOX | (39) |
| | 6.83 | 6.33 | 17.8 | HYA | (57,58) |
| | | | 17.60 | FOA | (35) |
| | 6.36 (4) | 6.56 (4) | 17.28 (2) | FOX | (66,67) |
| | 6.22 | 6.35 | 17.60 | FOA | (82,84) |
| | 6.33 (5) | 6.50 (5) | 17.92 (5) | FOA | (86) |
| | | | 18.03 (5) | FOA | (86) |
| | 8.05 | 7.99 | 19.52 | HOT | (87) |
| | 7.79 | 7.93 | 19.48 | HOJ | (87) |
| | 6.22 | 6.35 | 17.91 | HOT | (89) |
| | 6.30 | 6.56 | 17.3 | FOX | (91) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 6.62 | 6.89 | 17.89 | FOA | (92) |
| | 6.2 | 6.3 | 18.0 | FOX | (93) |
| | 6.4 | 6.3 | 18.5 | FOT | (93,97) |
| | 6.3 | 6.4 | 18.1 | HOA | (93) |
| | 6.37 (2) | 6.76 (2) | 18.19 (2) | HOT | (101) |
| | 6.54 (3) | 6.61 (3) | 18.01 (3) | FOA | (101) |
| | 6.65 | 6.51 | 18.20 | FPT | (102) |
| | 6.46 | 6.33 | 18.19 | FPT | (102) |
| | 6.36 (3) | 6.68 | 18.55 | HOA | (40) |
| | 6.32 (5) | 6.51 (5) | 19.4 (5) | OVS | (40,105) |
| | 6.17 (2) | 6.20 (2) | 18.76 (2) | BOX | (40,104) |
| | 6.59 | 6.72 | 18.45 | OOO | (112) |
| | 7.00 | 7.36 | 18.50 | OOO | (112) |
| | 6.35 | 6.68 | 17.80 | OOO | (112) |
| | 6.42 | 6.50 (4) | 18.03 (4) | FVS | (113) |
| | 6.45 | 6.60 | 18.17 | HOT | (14,113) |
| | 6.2 | 6.3 | 18.4 | OOR | (115) |
| | 6.29 | 6.52 | 18.15 | FPT | (116) |
| | 6.46 | 6.68 | 18.06 | FOA | (116) |
| | 6.19 (2) | 6.28 | | FOX | (121) |
| | 6.24 | 6.52 | 17.93 | OOJ | (130) |
| | 6.26 (3) | 6.47 (3) | 17.79 | FOJ | (128) |
| | 6.15 | 6.31 | 17.78 | HOT | (131) |
| | 6.31 | 6.52 | 17.56 | OOJ | (132,133) |
| | 6.23 | 6.41 | 17.42 | OOX | (104,132) |
| | 6.53 | 6.75 | 18.27 | HOT | (135) |
| | 6.35 | 6.67 | 18.24 | OOA | (135) |
| | 6.36 | 6.50 | | FOX | (136) |
| | 6.48 | 6.75 | 17.92 | OOJ | (137,138) |
| | 6.37 | 6.52 | 17.57 | FOA | (137,139) |
| | 6.07 | 6.29 | 17.30 | FOX | (137,140) |
| | 6.18 (2) | 6.34 (2) | 17.68 (2) | FPJ | (134) |
| | | | 17.68 | FOJ | (134) |
| | 6.09 (2) | 6.36 (2) | 17.75 (2) | FPT | (153) |
| | 6.11 (2) | 6.35 (2) | 17.71 (2) | HYT | (153) |
| | 7.0 (2) | 5.3 (2) | 15.7 (2) | OOR | (163) |
| | 6.17 (3) | 6.30 (3) | 18.22 (3) | FOX | (165) |
| | 6.55 | 6.71 | | OOA | (166) |
| | 6.26 | 6.55 | | FOX | (169) |
| | 5.6 (2) | 6.4 (2) | | OVS | (170) |
| | 6.3 (15) | 6.9 (15) | | OVS | (170) |
| | 6.31 | 6.55 | | FOX | (169) |
| | 6.46 | 6.49 | 18.03 | FOA | (173) |
| | 6.42 | 6.43 | 17.97 | FOX | (173) |

Table 1 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 6.64 | 6.79 | 18.96 | OOR | (178) |
| | 6.36 | 5.86 | | OOR | (192) |
| | 6.00 (4) | 6.29 (4) | 18.01 (4) | HOA | (196) |
| $RE_2O_3T$ | 0.09 (2) | 0.60 (2) | 0.15 (2) | HPG | (33,34) |
| | 0.09 | 0.75 | 0.01 | Calc'd | (From Table 5) |
| | 0.06 | | | HPJ | (110) |
| | | 0.48 (2) | 0.007 (2) | HPJ | (151) |
| Oxygen | $43.2_6$ | | | OOR | (42) |
| | 45.74 (2) | 45.26 (2) | 41.89 (2) | OOR | (59) |
| | 45.54 | 45.12 | 43.09 | Calc'd | (From Table 12) |
| | 45.6 (2) | 44.5 (2) | 41.0 (2) | OOR | (115) |

Table 2 - Reported values of "trace" elements

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Ag | <0.05 | 0.054 | | ODS | (45) |
| ppm | 2 | 3 | | HOA | (51) |
| | | | 0.10 | ODS | (47) |
| | <1 | <1 | <1 | OOO | (29) |
| | 0.4 (5) | 0.2 (4) | 1.2 (5) | HOA | (33) |
| | <3 | <3 | <3 | BVS | (93) |
| | 2 | 2 | 3 | HOA | (93) |
| | 1.9 (4) | 2.0 (5) | 3.5 (5) | HOA | (101) |
| | <10 | <10 | <10 | OOO | (127) |
| | <0.5 | <0.5 | <0.5 | OVS | (142) |
| | <0.25 (3) | <0.25 (3) | <0.25 (6) | OVS | (155) |
| | 0.022 (5) | 0.026 (5) | 0.14 (5) | HYA | (174) |
| | 0.029 | 0.019 | 0.120 | OOA | (183) |
| | | | 0.100 | HYA | (207) |
| As | <30 | <30 | | ODS | (45) |
| ppm | <300 | <300 | | HOA | (51) |
| | | | <50 | ODS | (47) |
| | 82 | 94 | 106 | OOO | (29) |
| | 16.3 | 16.1 | 0.65 | HVA | (60) |
| | 12 (5) | 14 (5) | 2 (10) | FVJ | (86) |
| | 22 | 24 | 12 | HYL | (93,98) |
| | 14 (3) | 13 (3) | 4 (3) | FOJ | (101) |
| | 21 | 23 | 1.7 | HVJ | (117,118) |
| | 20 | 21 | 1.2 | HVJ | (117,118) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 16 | 21 | <7 | OOX | (123) |
| | <68 | <68 | <68 | OVS | (142) |
| | 17.8 (7) | 19.7 (7) | 0.46 (7) | HVA | (154) |
| | 18.0 (7) | 19.8 (7) | 0.50 (7) | HVA | (154) |
| | 16.0 (3) | 16.7 (3) | 0.69 (3) | HVA | (175) |
| | 19.4 | 16.3 | | FVA | (186) |
| | 17.8 (2) | 19.6 (2) | 0.6 (2) | FVJ | (191) |
| | 19 (6) | 21 (4) | | HYJ | (198) |
| | 18 | | | HVA | (208) |
| Au | <1 | < 1 | | OOS | (45) |
| ppm | <10 | <10 | <10 | OVS | (142) |
| B | 33 (2) | 45 | | ODS | (45) |
| ppm | | | <5 | ODS | (47) |
| | 77 | 98 | | OOS | (61) |
| | 178 | 246 | 71 | OOO | (29) |
| | 110 | 130 | | OVS | (50) |
| | 95 | 110 | 5 | FYJ | (62) |
| | 83 | 108 | 13 | BVS | (93) |
| | 84 | 108 | <9 | OVS | (123) |
| | 61 | 77 | <15 | OOS | (130) |
| | 98 (6) | 119 (6) | <15 | OVS | (142) |
| | 105 | 100 | 4 | HCM | (125,126) |
| | | 98 | | HCM | (125,126) |
| | 82 (4) | 104 (4) | | OVS | (162) |
| | 68 | 70 | 22 | FOX | (165) |
| | <100 | 120 (2) | <100 | OVS | (170) |
| | 90 (15) | 110 (15) | <50 | OVS | (170) |
| | | 91 | | OOS | (209) |
| | | 82 | | OOJ | (209) |
| Ba | 430 | 410 | | OVS | (45) |
| ppm | 650 | 730 | | OOX | (46) |
| | 740 | 800 | | OOS | (46) |
| | 460 | 460 | | OCA | (52) |
| | | | 37 | OVS | (47) |
| | 452.5 | 437 | | OOM | (63) |
| | 450 | 410 | | OOO | (61) |
| | 530 | 526 | | OOO | (46) |
| | 455 (2) | 445 (2) | ca 50 (2) | HOA | (28) |
| | | 600 | | OVS | (55) |
| | 367 | 491 | 106 | OOO | (28) |
| | 550 | 540 | | OOX | (56,64) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 470 | 370 | | OVS | (49) |
| | 410 (2) | 285 | 168 (2) | OOX | (33) |
| | 530 | 530 | 59 | OVS | (50) |
| | 412 | 528 | 99 | OOA | (36) |
| | 450 | 1175 | 190 | OOX | (39) |
| | 460 (2) | 435 (2) | 47 (2) | OVS | (43) |
| | 400 (3) | 200 (3) | | OPG | (37) |
| | 530 | 510 | 130 | FOX | (91) |
| | 394 | 381 | 45 | BVS | (93) |
| | 174 (5) | 137 (5) | 43 (5) | HOA | (101) |
| | 482 (5) | 531 (5) | 39 (5) | OVS | (40,108) |
| | 470 (3) | 465 (3) | 100 (3) | BOX | (40,104) |
| | 465 (2) | 430 | | FOX | (121) |
| | 460 | 460 | 110 | OCA | (123) |
| | 275 | 300 | 65 | HCM | (125,126) |
| | | 285 | | HCM | (125,126) |
| | 490 | 460 | 55 | FCS | (113,127) |
| | 500 | 400 | | OOX | (130) |
| | 430 | 420 | | HOA | (136) |
| | 527 (6) | 523 (6) | | OVS | (142) |
| | 480 | 410 | 66 | HCM | (125,126) |
| | | 420 | | HCM | (125,126) |
| | 420 (4) | | <40 (4) | OOX | (153) |
| | 450 (3) | 425 (3) | 55 (3) | OVS | (155) |
| | | | 55 (3) | OVS | (155) |
| | 510 (3) | 480 (3) | 57 (3) | HOA | (156,157) |
| | 460 (4) | 410 (4) | | OVS | (162) |
| | 500 | 600 | 130 | OOR | (163) |
| | 700 | 700 | 30 | OVS | (165) |
| | 475 | 445 | | OOA | (166) |
| | 380 (20 | 400 (2) | 44 (2) | OVS | (170) |
| | 530 (15) | 520 (15) | 57 (15) | OVS | (170) |
| | 470 | 415 | 100 | BOX | (175) |
| | 524 (3) | 534 (3) | 67 (3) | FCR | (177) |
| | 510 | 510 | 83.52 | FCR | (178) |
| | | | 47 (2) | HCM | (184) |
| | 455 | 445 | | OOA | (189) |
| | | 415 | 55 | HOA | (207) |
| Be | 16 | 16 | | OVS | (45) |
| ppm | 20 | 21 | | OVS | (65) |
| | 20 | 20 | | OOO | (60) |
| | 14 | 16 | <5 | OOO | (29) |
| | 29 | 21 | | OVS | (50) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | | | <2 | OVS | (47) |
| | 29 | | | OVS | (43) |
| | 22 | 31 | <10 | BVS | (98) |
| | 24 | 23 | <5 | HOA | (93) |
| | 28 | 28 | 2 | OVS | (123) |
| | 27 (3) | 26 (3) | | OCJ | (123) |
| | 21 | 20 | <5 | OOS | (130) |
| | <30 | <30 | <30 | OOO | (129) |
| | 30 (6) | 32 (6) | <1 | OVS | (142) |
| | 10.25 | 10.20 | 0.38 | HOA | (143) |
| | 10.70 | 11.60 | 0.50 | HCA | (143) |
| | 10.45 | 11.85 | 0.55 | HCA | (143) |
| | 18 | 17 | 0.5 | HCM | (125,126) |
| | | 18 | | HCM | (125,126) |
| | 22.0 | 21.5 | 0.97 | HOA | (156,157) |
| | 24 (4) | 22 (4) | | OVS | (162) |
| | 13 | 13 | <5 | OVS | (165) |
| | 18 | 18 | | OOA | (166) |
| | 23 (2) | 28 (2) | <2 | OVS | (170) |
| | 23 (15) | 25 (15) | 3.3 (15) | OVS | (170) |
| Bi | <0.5 | 0.58 | | ODS | (45) |
| ppm | | | <0.5 | ODS | (47) |
| | 1 | | | OOO | (69) |
| | <10 | <10 | <10 | OOO | (29) |
| | 2 | 2 | 2 | HOA | (33,34) |
| | <5 | | <5 | BVS | (93) |
| | <10 | <10 | <10 | OOO | (129) |
| | 8.2 (6) | 13 (6) | <5 | OVS | (142) |
| Cd | <2 | <2 | | ODS | (45) |
| ppm | | | <2 | ODS | (47) |
| | 0.158 | | | HCM | (70) |
| | <5 | <5 | <5 | OOO | (29) |
| | 2 | 3 | 4 | HOA | (33,34) |
| | <10 | <10 | <10 | OVS | (142) |
| | | 0.176 | 0.123 | HCM | (145) |
| Ce | <500 | 1900 | | OVS | (45) |
| ppm | 300 | 2550 | 36 | OOR | (27) |
| | | 3500 | | OVS | (50) |
| | | | <500 | OVS | (47) |
| | | 2100 (2) | | OVS | (43) |
| | 160 | 2400 | | OOX | (33) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 237 (3) | 2309 (3) | 25 (4) | HPR | (102) |
| | 290 | 2600 | | FOX | (121) |
| | 130 | 1080 | 26 | HCM | (125,126) |
| | | 1200 | | HCM | (125,126) |
| | 214 (6) | 2640 (6) | <63 | OVS | (142) |
| | 150 | 950 | 24.6 | HCM | (125,126) |
| | | 980 | | HCM | (125,126) |
| | 215 (2) | 2250 (2) | 25 (2) | OOR | (163) |
| | nd | >500 | nd | OVS | (165) |
| | <500 | 2500 (2) | <500 | OVS | (170) |
| | <200 | 2200 (15) | <200 | OVS | (170) |
| | | 3000 | | FOX | (171) |
| | 164 | 1620 | 40 | OOR | (178) |
| | 237.3 | 2274 | 24.5 | FCR | (178) |
| | | | 21.8 | HP,CR | (180,181) |
| Cl | 40 | 120 | 80 | FPJ | (53) |
| ppm | 1000 (3) | 1000 (3) | | OPG | (37) |
| | 140 | 140 | 130 | FVL | (93) |
| | 30 | 180 | 30 | FVL | (116) |
| | 200 | 200 | 200 | FPJ | (131) |
| | 150 | 120 | 170 | HCM | (125,126) |
| | | 130 | | HCM | (125,126) |
| | 98 (2) | 125 (2) | 150 | OOX | (150) |
| | 120 | 140 | 180 | FVL | (164) |
| | 128 | 134 | 158 | BOX | (176) |
| Co | <20 | <20 | | OVS | (45) |
| ppm | 25 | 27 | | HOA | (51) |
| | 9 | 12 | 78 | OVS | (65) |
| | | | 73 | OVS | (47) |
| | 9 | 10 | | OVS | (61) |
| | 1 | | | OOO | (69) |
| | 17 | 32 | | OOX | (71) |
| | 13 (2) | 12 (2) | 86 (2) | HOA | (28) |
| | ca 19 | ca 12 | 96 (3) | HOA | (40,72) |
| | | 4.5 | | OVS | (55) |
| | 12 | 18 | 125 | OOO | (29) |
| | 8.8 | 7.2 | 89 | OOR | (27) |
| | 13 | 14 | 72 | OOX | (56,64) |
| | | 4.5 | | OVS | (49) |
| | 26 (2) | 26 (2) | 88 (2) | HOA | (33,34) |
| | 17 (2) | 28 (2) | 68 (2) | OOX | (33) |
| | <10 | <10 | 60 | OVS | (50) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 8 | 11 | 91 | OOX | (39) |
| | 9.2 (5) | 9.6 (5) | 94 (5) | HYA | (57,58) |
| | | | 77 (2) | OVS | (43) |
| | <10 | <10 | 103 | BVS | (93) |
| | 5 | 8 | 80 | HOA | (93) |
| | 7 (5) | 8 (5) | 75 (5) | HOA | (101) |
| | 8.1 (3) | 7.8 (3) | 86 (5) | HPR | (102) |
| | <20 | <20 | 65 (2) | HYA | (102) |
| | <10 | <10 | 71 | FCS | (113,127) |
| | <17 | <17 | 98 | OOS | (130) |
| | <10 | <10 | 100 (3) | OOO | (129) |
| | 10.5 (6) | 12 (6) | 108 (6) | OVS | (142) |
| | 15 | 13 | 90 | HCM | (125,126) |
| | | 15 | | HCM | (125,126) |
| | 21 (2) | 20 (2) | 102 (2) | HOA | (134) |
| | 10 (3) | 12 (3) | 97 (3) | OVS | (155) |
| | | | 98 (3) | OVS | (155) |
| | 10 (3) | 9 (3) | 89 (3) | HOA | (156,157) |
| | 6.5 (4) | 6.6 (4) | | OVS | (162) |
| | 7.6 (3) | 4.8 (3) | 72 (3) | OOR | (163) |
| | 8 | 8 | 81 | OVS | (165) |
| | <10 | <10 | 81 (2) | OVS | (170) |
| | 11 (15) | 15 (15) | 86 (15) | OVS | (170) |
| | 9 | 10 | 103 | OOR | (178) |
| | 8.2 | 8.0 | 85.9 | FCR | (178) |
| | 11 | 11 | 86.5 | OOA | (189) |
| | 10.8 | 11.6 | | OOR | (192) |
| | 19 (4) | 10 (4) | 91 (4) | HOA | (196) |
| | | 13 | 100 | HOA | (207) |
| Cr | <20 | <20 | | OVS | (45) |
| ppm | 13 | 8 | | HOA | (51) |
| | 7.2 | 4.2 | | HOA | (62) |
| | | | 470 | OVS | (47) |
| | 9 | 6 | | OVS | (61) |
| | 7 | | | OOX | (46) |
| | 13 (2) | 11 (2) | 328 (2) | HOA | (28) |
| | | | 439 (3) | HOA | (40,72) |
| | | 14 | | OVS | (55) |
| | 13 | 15 | 553 | OOO | (29) |
| | 20 | 24 | 484 | FPJ | (27) |
| | 15 | 27 | 690 | OOR | (27) |
| | <8 | <8 | 495 | OOX | (56,64) |
| | 11 | 13 | 475 | HOA | (30) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | | | 340 | 000 | (32) |
| | 9 | 14 | | OVS | (49) |
| | 22 | 24 | 300 | HOA | (33,34) |
| | 6 | <2 | 500 | OOX | (33) |
| | 8 | 4 | 440 | OVS | (50) |
| | <70 | <70 | 335 | 000 | (36) |
| | <20 | <20 | 540 | OOX | (39) |
| | | | 530 (2) | OVS | (43) |
| | | | 650 | FOX | (91) |
| | <5 | <5 | 410 | BVS | (93) |
| | <25 | <25 | 300 | HOA | (93) |
| | 10 | 24 | 385 | FOL | (93) |
| | 14 (5) | 11 (5) | 352 (5) | HOA | (101) |
| | | | 574 (5) | OVS | (40,109) |
| | | | 300 | 000 | (112) |
| | | | 500 | FOA | (116) |
| | 7.2 | 4.2 | 321 (2) | OOA | (123) |
| | 8 | 8 | 410 | OVS | (123) |
| | <10 | <12 | 508 | FCS | (113,127) |
| | 10 (3) | <10 | 800 (3) | 000 | (129) |
| | 32 | 24 | | HOA | (136) |
| | 10 (6) | 6.1 (6) | 466 (6) | OVS | (142) |
| | 10 | 9 | 410 | HCM | (125,126) |
| | | 8 | | HCM | (125,126) |
| | | | 900 (2) | FPJ | (134) |
| | 12 (3) | 10 (3) | 460 (3) | OVS | (155) |
| | | | 465 (3) | OVS | (155) |
| | 7.2 (3) | 6.6 (3) | 317 (3) | HOA | (156,157) |
| | <12 (4) | <12 (4) | | OVS | (162) |
| | 9 | 8 | 510 | OVS | (165) |
| | <10 | <10 | 500 (2) | OVS | (170) |
| | 12 (15) | 15 (15) | 450 (15) | OVS | (170) |
| | 13 | 20 | 360 | OOR | (178) |
| | 6 | 4 | 416 | BOX | (188) |
| | 12.2 | 10.6 | | OOA | (189) |
| | <10 | <10 | 331 (4) | HOA | (196) |
| | <50 | <50 | 850 | OOR | (199) |
| | | <10 | 360 | HOA | (207) |
| Cs | 2.2 | 2.0 | 1.1 | OOR | (25) |
| ppm | 2.28 | 2.54 | 0.48 | FPR | (102) |
| | 2.33 | 3.12 | 0.36 | FPR | (102) |
| | 2.9 (3) | 2.9 (3) | 0.7 (5) | OPE | (123) |
| | 2.6 | 2.3 | 0.4 | HOE | (124) |
| | 3 (3) | 2.5 (3) | <1 (6) | OVS | (155) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 2.0 (3) | 1.6 (3) | 1.0 (3) | OOR | (163) |
| | 1.9 | 2.1 | 0.6 | OOR | (178) |
| | 2.7 | 2.7 | 0.5 | OOR | (178) |
| Cu | <8 | 18 | | OVS | (45) |
| ppm | 7 | 27 | | HOA | (51) |
| | 5.5 | 20 | | HOA | (52) |
| | | | 160 | OVS | (47) |
| | 4.5 | 15 | | OVS | (61) |
| | 2 | | | OOR | (69) |
| | <5 | 16 | | OOX | (71) |
| | 5 (2) | 18 (2) | 128 | HOA | (28) |
| | 10 (2) | 26 (2) | 126 (4) | HOA | (40,72) |
| | | 17 | | OVS | (55) |
| | <5 | 9 | 166 | OOO | (29) |
| | 14 | 16 | 164 | HYJ | (27) |
| | <8 | 10 | 140 | OOX | (56,64) |
| | 4 | 13 | 118 | HOA | (30) |
| | | 13 | | OVS | (49) |
| | 7 | 16 | 130 | HOA | (33,34) |
| | 10 | 12 | 78 | OOX | (33) |
| | 2 | 24 | 120 | OVS | (50) |
| | 3.6 (5) | 24 (5) | 80 (5) | HYA | (57) |
| | | 24 | 122 (2) | OVS | (43) |
| | <5 | 11 | 158 | BVS | (93) |
| | 6 | 24 | 134 | HOA | (93) |
| | 3 (5) | 17 (5) | 135 (5) | HOA | (101) |
| | 40 (2) | 26 (2) | 114 (2) | HYA | (102) |
| | <10 | 16 | 125 | HOA | (117,119) |
| | <10 | 13 | 125 | HOA | (117,119) |
| | 5.5 | 20 | 132 (3) | OOA | (123) |
| | 7 | 13 | 148 | OOX | (123) |
| | <10 | 15 | 122 | FCS | (113,127) |
| | <15 | <15 | 190 | OOS | (130) |
| | <10 | <10 | 100 (3) | OOO | (129) |
| | 2.5 (6) | 22 (6) | 116 (6) | OVS | (142) |
| | <5 | 6 (2) | 127 (2) | BOX | (141) |
| | 5 | 34 | 160 | HCM | (125,126) |
| | | 26 | | HCM | (125,126) |
| | 6 (2) | 12 (2) | 138 (2) | HOA | (134) |
| | 2.0 | 21.4 | 132 | HCA | (152) |
| | 5 (3) | 19 (3) | 131 (3) | OVS | (155) |
| | | | 131 (3) | OVS | (155) |
| | 3.0 (3) | 14.1 (3) | 130 (3) | HOA | (156,157) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 6.1 (4) | 10.9 (4) | | OVS | (162) |
| | 5 | 15 | 150 | OVS | (165) |
| | <5 | 22 (2) | 140 (20) | OVS | (170) |
| | 7.2 (15) | 15 (15) | 150 (15) | OVS | (170) |
| | 5 | 18 | 132 | HOA | (173) |
| | 23 | 23 | 16 | OOR | (178) |
| | 6.1 | 19.0 | 126.3 | OOA | (189) |
| | 9 (4) | 18 (4) | 118 (4) | HOA | (196) |
| | 6.7 (10) | 15.0 (10) | 149 (10) | OOS | (197) |
| | 1.5 (3) | 7.3 (3) | 128.5 (3) | BOX | (200) |
| | 4 | 15 | 135 | HOA | (200) |
| | | 13 | 133 | HOA | (207) |
| Dy | <80 | 110 | | OOS | (73) |
| ppm | 21 | 118 (2) | | HPA | (74) |
| | 17 | 73 | 3.2 | HCM | (125,126) |
| | | 65 | | HCM | (125,126) |
| | 32 (6) | 145 (6) | | OVS | (142) |
| | 16 | 68 | 2.6 | HCM | (125,126) |
| | | 62 | | HCM | (125,126) |
| | 27.31 | 125 | 4.6 | HP,CR | (151) |
| | 10 (2) | 45 (2) | 4 (2) | OOR | (163) |
| | 16 | 92 | 1.4 | OOR | (178) |
| | | | 2.4 | HPA | (185) |
| Er | 13 (2) | 52 (2) | | HPA | (74) |
| ppm | 11 | 45 | 1.1 | HCM | (125,126) |
| | | 38 | | HCM | (125,126) |
| | 24 (6) | 107 (6) | | OVS | (142) |
| | 11 | 40 | 0.95 | HCM | (125,126) |
| | | 38 | | HCM | (125,126) |
| | | | 1.1 | HPA | (185) |
| Eu | 2.2 | 15 | 1.4 | OOR | (27) |
| ppm | 2.2 (2) | 14 (2) | | HPA | (74) |
| | 2.9 (3) | 18.2 (3) | 1.4 (3) | HPR | (102) |
| | 2.0 | 11 | 1.5 | HCM | (125,126) |
| | | 11 | | HCM | (125,126) |
| | 3.1 (6) | 22 (6) | | OVS | (142) |
| | 2.0 | 11 | 1.3 | HCM | (125,126) |
| | | 11 | | HCM | (125,126) |
| | 2.74 | 20 | 2.4 | HP,CR | (151) |
| | 2.4 (4) | 14 (4) | 1.3 (4) | OOR | (163) |
| | 2.3 | 16 | 1.4 | OOR | (178) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 2.6 | 17.4 | 1.4 | FCR | (178) |
| | | | 1.1 | HPA | (185) |
| Ga | 33 | 43 | | ODS | (45) |
| ppm | 24.7 | 25.6 | | HCM | (75) |
| | | | 14 | ODS | (47) |
| | 22 | 20 | | OVS | (61) |
| | 30 | 30 | 18 | OOX | (56,64) |
| | 29 | 19 | | OVS | (49) |
| | 34 (2) | 28 (2) | 25 (2) | OOX | (33) |
| | 25 | 23 | 19 | OVS | (50) |
| | | | 14 | ODS | (45) |
| | 31 | 33 | 28 | BVS | (93) |
| | 15 | 14 | 18 | OVS | (123) |
| | 30 | 36 | 18 | OOS | (130) |
| | 27 (3) | 27 (3) | 20 (2) | OOO | (129) |
| | 40 (6) | 36 (6) | 17 (6) | OVS | (142) |
| | 30 (2) | 27 (2) | 24 (2) | BOX | (143) |
| | 27 (4) | 27 (4) | | OVS | (162) |
| | 35 | 26 | 13 | OVS | (165) |
| | 26 | | | OOR | (178) |
| | 28 | 27 | 16 | BOX | (188) |
| | 30.5 (2) | 27.1 (2) | 19.6 (2) | BOX | (200) |
| | | 26 | 16 | HYA | (207) |
| | 34.2 (3) | 26.9 (3) | 17.4 (3) | HCA | (210) |
| Gd | 11 | 55 | 3.2 | HCM | (125,126) |
| ppm | | 51 | | HCM | (125,126) |
| | 22 (6) | 140 (6) | <15 | OVS | (142) |
| | 11 | 54 | 3.4 | HCM | (125,126) |
| | | 53 | | HCM | (125,126) |
| | | 57 | 5 | OOR | (163) |
| | 12 | | | OOR | (199) |
| Ge | 1.0 | 1.1 | | ODS | (45) |
| ppm | | | <0.7 | ODS | (47) |
| | 6 | 10 | 11 | OOO | (29) |
| | | 1.3 | | ODS | (43) |
| | <10 | <10 | <10 | OOO | (129) |
| | <3 | <3 | <3 | OVS | (142, |
| | 1.56 (2) | 1.55 (2) | | HYS | (162) |
| Hf | 8.6 | 5.1 | 4.1 | OOR | (27) |
| ppm | ∿9 | ∿9 | ∿3 | HPR | (102) |
| | <22 | <22 | <22 | OVS | (142) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 7.7 (4) | 11 (4) | 3.6 (4) | OOR | (163) |
| | 6.4 | 11 | 3.4 | OOR | (178) |
| | 6.8 | 8.4 | | FPR | (178) |
| Hg | 21 (8) | 33 (7) | 181 (8) | HOA | (33) |
| ppb | 4 (5) | 7 (5) | 119 (18) | HVA | (86) |
| Ho | 6.9 (2) | 34 (2) | | HPA | (74) |
| ppm | 3.9 | 16 | 0.49 | HCM | (125,126) |
| | | 14 | | HCM | (125,126) |
| | 2.9 | 12 | 0.48 | HCM | (125,126) |
| | | 14 | | HCM | (125,126) |
| | | | 0.6 | HP,PR | (180,181) |
| | 7 | 22 | 0.5 | HPA | (185) |
| In | <0.2 | <0.2 | | ODS | (45) |
| ppm | | | <0.5 | ODS | (47) |
| | <10 | <10 | <10 | OOO | (29) |
| | <0.5 | <0.5 | <0.5 | ODS | (43) |
| | <5 | <5 | <5 | OVS | (142) |
| Ir | <7 | <7 | <7 | OVS | (142) |
| La | <100 | 1700 | | OVS | (45) |
| ppm | | | 61 | OVS | (47) |
| | 65 | 1600 | | OVS | (61) |
| | 116 | 1160 | <20 | OOO | (29) |
| | 87 | 1370 | 11 | OOR | (27) |
| | 64 (2) | 980 (2) | 10 (2) | OOX | (33) |
| | 88 | 1228 | | HPE | (74) |
| | 140 | 2200 | | OVS | (50) |
| | 97 (2) | 1300 (2) | | OVS | (43) |
| | 79 (3) | 1472 (3) | 10 (3) | HPR | (102) |
| | 100 | 1530 | | FOX | (121) |
| | 53 | 580 | 8.6 | HCM | (125,126) |
| | | 580 | | HCM | (125,126) |
| | 92 (6) | 1530 (6) | <10 | OVS | (142) |
| | 57 | 550 | 8.1 | HCM | (125,126) |
| | | 575 | | HCM | (125,126) |
| | 75 (3) | 1100 (3) | 10.0 (3) | OOR | (163) |
| | <280 | >500 | nd | OVS | (165) |
| | 97 (2) | 1400 (2) | <50 | OVS | (170) |
| | 63 (15) | 1300 (15) | <100 | OVS | (170) |
| | | 1500 | | FOX | (171) |
| | 51 | 1350 | 10 | OOR | (178) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 78.3 | 1472 | 10 | FCR | (178) |
| | | | 10.0 | HP,CR | (180,181) |
| | 88 | 1250 | | HPE | (185) |
| | | | | | |
| Li | 94 | 91 | | HOA | (51) |
| ppm | 88 | 85 | | HOA | (52) |
| | 84 (2) | 80 (2) | 3 (2) | HOA | (28) |
| | 95 (3) | 91 (3) | 4.1 (3) | HOA | (40,41) |
| | 141 | 191 | 137 | OOO | (29) |
| | 88 | 84 | 3 | OOA | (36) |
| | 41 (5) | 39 (5) | 3 (5) | HOA | (33) |
| | 110 | 108 | 84 | HOA | (93) |
| | 55 (5) | 51 (5) | 3 (5) | HOA | (101) |
| | 59 | 86 | 5.5 | OOA | (113) |
| | 89 (2) | 86 (2) | 4.2 (2) | OOA | (123) |
| | 93 | 90 | <4 | HOA | (124) |
| | 100 | 93 | | HOA | (136) |
| | 95 | 96 | 6 | HCM | (125,126) |
| | | 90 | | HCM | (125,126) |
| | 95 (2) | 98 (2) | 7 (2) | HOA | (134) |
| | 106 (3) | 104 (3) | <5 (6) | OVS | (155) |
| | 97 (3) | 94 (3) | 5.2 (3) | HOA | (156,157) |
| | 110 | 105 | | OOA | (166) |
| | 104 | 101 | 4 | HOA | (173) |
| | 88 | 84 | 3 | OOA | (189) |
| | 91 | | | HOA | (193) |
| | 87 | | | HOA | (193) |
| | 93 (4) | 93 (4) | 6 (4) | HOA | (196) |
| | 95.8 (10) | 96.9 (10) | 4.8 (10) | OOS | (197) |
| | | 91 | 4 | HOE | (207) |
| | | | | | |
| Lu | 2.9 | 8.2 | | OOM | (79) |
| ppm | 3.5 | 11 | 0.2 | OOR | (27) |
| | 2.5 | 5.4 | 0.093 | HCM | (125,126) |
| | | 4.8 | | HCM | (125,126) |
| | <3 | 7 (6) | <3 | OVS | (142) |
| | 2.0 | 3.5 | 0.065 | HCM | (125,126) |
| | | 2.9 | | HCM | (125,126) |
| | 3.00 (2) | 8.5 (2) | | HCM | (160) |
| | 2.7 (3) | 6 (3) | 0.31 (3) | OOR | (163) |
| | | | 0.4 | HP,CR | (180,181) |
| | | | | | |
| Mo | 0.99 | 0.90 | | ODS | (45) |
| ppm | | | <1 | ODS | (47) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 5 | 8 | 13 | OOO | (29) |
| | 7 | 2 | 5 | HOA | (33) |
| | <1 | <1 | <1 | ODS | (43) |
| | <4 | <4 | <4 | BVS | (93) |
| | <4 | <4 | <4 | OOX | (123) |
| | 3.2 | 3.2 | 10 | OVS | (123) |
| | <6 | <6 | <6 | OOS | (130) |
| | <10 | <10 | <10 | OOO | (129) |
| | 3 (4) | 3 (4) | | OVS | (162) |
| | 2 | 2 | 8 | OVS | (165) |
| Nb | <50 | 130 | | OVS | (45) |
| ppm | | | <100 | OVS | (47) |
| | 23 | 97 | | OVS | (61) |
| | 27 | 294 | 82 | OOO | (29) |
| | 35 (2) | 156 (2) | 26 (2) | OOX | (33) |
| | 22 | 110 | | OVS | (50) |
| | 33 | 186 | 16 | OOX | (123) |
| | 21 (6) | 195 (6) | 12 (6) | OVS | (142) |
| | 14.9 (4) | 93.8 (4) | | OVS | (162) |
| | <50 | 200 (2) | <50 | OVS | (170) |
| | | | 20 | BOX | (188) |
| | | 155 (2) | | OYJ | (207) |
| Nd | | | <200 | OVS | (45) |
| ppm | <100 | 370 | | OOS | (73) |
| | 75 | 700 | | HPA | (74) |
| | | 1400 | | OVS | (50) |
| | | 970 | | OVS | (43) |
| | 71 | 480 | 23 | HCM | (125,126) |
| | | 470 | | HCM | (125,126) |
| | 70 (6) | 520 (6) | 68 | OVS | (142) |
| | 55 | 420 | 18.0 | HCM | (125,126) |
| | | 430 | | HCM | (125,126) |
| | 110 (2) | 820 (2) | 20 (2) | OOR | (163) |
| | <150 | 930 | <150 | OVS | (170) |
| | | | 2.6 | HP,PR | (180,181) |
| | | | 16 | HPA | (185) |
| Ni | <20 | <20 | | OVS | (45) |
| ppm | 22 | 18 | | HOA | (51) |
| | | | 190 | OVS | (47) |
| | 5.5 | 5.2 | | OVS | (61) |
| | 3.0 | | | OOO | (69) |
| | 19 | 28 | | OOX | (71) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 16 (2) | 17 (2) | 198 (2) | HOA | (28) |
| | | | 203 (3) | HOA | (40,72) |
| | | 14 | | OVS | (55) |
| | 10 | 14 | 251 | OOO | (29) |
| | <8 | <8 | 210 | OOX | (56,64) |
| | 12 | 11 | 203 | HOA | (30) |
| | | | 235 | OOO | (32) |
| | | 14 | | OVS | (49) |
| | 22 | 24 | 195 | HOA | (33,34) |
| | 17 | 34 | 106 | OOX | (33) |
| | ca 8 | Tr | 250 | OVS | (50) |
| | 39 | 125 | 185 | OOX | (39) |
| | 7.8 (5) | 8.0 (5) | 104 (5) | HYA | (57,58) |
| | | | 183 | OVS | (43) |
| | | | 200 | FOX | (91) |
| | 6 | 11 | 193 | BVS | (93) |
| | 8 | 8 | 148 | HOA | (93) |
| | 6 (5) | 8 (5) | 173 (5) | OOO | (101) |
| | <20 | <30 | 160 (2) | HYA | (102) |
| | 10 (2) | 9 | | FOX | (121) |
| | 12 | 7 | 208 | OOX | (123) |
| | | | 194 (2) | OOA | (123) |
| | 6.5 | 7.4 | 245 | OVS | (123) |
| | <10 | 12 | 202 | FCS | (113,127) |
| | <15 | <15 | 240 | OOS | (130) |
| | <10 | <10 | 150 (3) | OOO | (129) |
| | 9.2 (6) | 8.5 (6) | 211 (6) | OVS | (142) |
| | 7 | 8 | 190 | HCM | (125,126) |
| | | 7 | | HCM | (125,126) |
| | 16 (2) | 16 (2) | 205 (2) | HOA | (134) |
| | 9.5 (3) | 10 (3) | 195 (3) | OVS | (155) |
| | | | 195 (3) | OVS | (155) |
| | <5 (3) | <5 (3) | 173 (3) | HOA | (156,157) |
| | 7.5 (4) | 6.9 (4) | | OVS | (162) |
| | 10 | 7 | 310 | OVS | (165) |
| | <10 | <10 | 170 (2) | OVS | (170) |
| | 13 (15) | 17 (15) | 220 (15) | OVS | (170) |
| | 13.0 | 13.7 | 191.4 | OOA | (189) |
| | <10 | <10 | 175 (4) | HOA | (196) |
| | 5.8 (3) | 6.5 (3) | 200.7 (3) | BOX | (200) |
| | 10 | 9 | 200 | HOA | (200) |
| | | 12 | 195 | HOA | (207) |
| Os | <7 | <7 | <7 | OVS | (142) |
| ppb | | | | | |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Pb | 64 | 120 | | ODS | (45) |
| ppm | 58 | 68 | | OOX | (46) |
| | 97 | 161 | | HOA | (51) |
| | | 148 | | HOA | (52) |
| | | | 4.1 | ODS | (47) |
| | | 240 | | OVS | (55) |
| | 176 | 315 | 29 | OOO | (29) |
| | 92 | 145 | <8 | OOX | (56,64) |
| | 95 | 141 | 15 | HOA | (30) |
| | 75 | 105 | | OVS | (49) |
| | 80 | 134 | 12 | HOA | (33,34) |
| | 82 (2) | 121 (2) | 16 (2) | OOX | (33) |
| | 82 | 130 | | OVS | (50) |
| | 70 (5) | 91 (5) | 5.6 (5) | HYA | (57,58) |
| | 78 | 110 | 6.2 | ODS | (43) |
| | 43 | 85 | | FOX | (91) |
| | 85 | 165 | 17 | BVS | (93) |
| | 100 | 180 | 20 | HOA | (93) |
| | 94 (5) | 136 (5) | 10 (4) | HOA | (101) |
| | 69 (2) | 137 (2) | ∿10 | HYA | (102) |
| | 72 | 123 | 5.5 | OOA | (113) |
| | 80 | 140 | <20 | HOA | (117) |
| | 80 | 125 | <20 | HOA | (117) |
| | 91 (2) | 148 | | OOA | (123) |
| | 90 | 130 | <10 | OVS | (123) |
| | 84 | 115 | 15 | OOX | (123) |
| | 95 | 146 | 5 | OOA | (116) |
| | 150 (3) | 110 (3) | 10 (3) | OOO | (129) |
| | 136 (6) | 214 (6) | 14 (6) | OVS | (142) |
| | 118 (2) | 136 (2) | 12 (2) | BOX | (141) |
| | 93 (2) | 148 (2) | 18 (2) | HOA | (134) |
| | 78 (3) | 124 (3) | 10 (3) | OVS | (155) |
| | | | 11 (3) | OVS | (155) |
| | 86 (3) | 135 (3) | <10 (3) | HOA | (156,157) |
| | 71 (4) | 151 (4) | | OVS | (162) |
| | 72 | 120 | <16 | OVS | (165) |
| | | 120 | | FOX | (171) |
| | 100 | 150 | 10 | HOA | (173) |
| | 75 | 126 | 7 | BOX | (188) |
| | 83 | 115 | 12.2 | OOA | (194) |
| | 80.5 | 120 | 11.5 | HOA | (194) |
| | | 130 | <10 | HOA | (207) |
| Pd | 0.7 (6) | <0.7 | <0.7 | OVS | (142) |
| ppm | | | | | |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Pr | 16 | 125 | 3.9 | HCM | (125,126) |
| ppm | | 125 | | HCM | (125,126) |
| | 18 (16) | 346 (6) | 9 (6) | OVS | (142) |
| | 14 | 118 | 3.6 | HCM | (125,126) |
| | | 120 | | HCM | (125,126) |
| | 8 | 22 | | OOR | (178) |
| Pt | <7 | <7 | <7 | OVS | (142) |
| ppm | | | | | |
| Rb | 154 | | | OOX | (46) |
| ppm | 237 | 220 | | HOA | (51) |
| | 192 | 184 | | OOX | (71) |
| | 220 | 208 | | OOM | (79) |
| | 211 (2) | 200 (2) | 6 (2) | HOA | (28) |
| | 204 (3) | 186 (3) | ca 13 (2) | BOX | (40,41) |
| | 200 | 150 | | OOR | (27) |
| | 265 | 250 | 10 | OOX | (56,64) |
| | 207 (2) | 176 (2) | 10 (2) | OOX | (33) |
| | 223 | 208 | 7 | OOA | (36) |
| | 221.8 (2) | 208.4 (2) | 7.17 (4) | HPM | (76) |
| | 171 | 74 | <12 | OOX | (39) |
| | 100 (3) | 100 (3) | | OOX | (37) |
| | 220 | 210 | 20 | FOX | (91) |
| | 240 | 210 | <20 | HOA | (93) |
| | 235 | 254 | 5.4 | FPR | (102) |
| | 237 | 273 | 8.3 | FPR | (102) |
| | 196 (2) | 180 (2) | 12 (2) | BOX | (40) |
| | 312 | 300 | 11.2 | OOA | (113) |
| | 235 (2) | 190 | | FOX | (121) |
| | 199 (2) | 186 (2) | 6.8 (2) | OOA | (123) |
| | 216 | 195 | 9 | OOX | (123) |
| | 213 | 208 | 8 | HOA | (124) |
| | 210 | 210 | <100 | OOX | (130) |
| | 220 | 195 | | HOA | (136) |
| | 236 (2) | 213 (2) | 8 (2) | BOX | (141) |
| | 204 (4) | 196 (4) | 12 (4) | OOX | (153) |
| | 190 (3) | 210 (3) | <10 (6) | OVS | (155) |
| | 194 (3) | 188 (3) | 10 | HOA | (156,157) |
| | 220 | 120 | 30 | OOR | (163) |
| | 225 | 205 | | OOA | (166) |
| | 230 | 200 | 20 | BOX | (173) |
| | 216 | 236 | | OOR | (178) |
| | 228 | 228 | 5.1 | FCR | (178) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 217 | 196 | 9 | BOX | (188) |
| | 221 | 210 | 6 | OOA | (189) |
| | | 226 | 10 | HOE | (207) |
| Re | <10 | <10 | <10 | OVS | (142) |
| ppm | | | | | |
| Rh | <0.7 | <0.7 | <0.7 | OVS | (142) |
| ppm | | | | | |
| Sb | <10 | <10 | | ODS | (45) |
| ppm | | | <5 | ODS | (47) |
| | 143 | 162 | 124 | OOO | (29) |
| | 2 | 2 | 2 | HOA | (33,34) |
| | 0.2 | 0.3 | 0.3 | FYJ | (117,120) |
| | 0.2 | 0.3 | 0.3 | FYJ | (117,120) |
| | 0.9 | 0.9 | 1.3 | H,FYJ | (122) |
| | <68 | <68 | <68 | OVS | (142) |
| | 0.20 (7) | 0.20 (7) | 0.38 (7) | HVA | (154) |
| | 0.20 (7) | 0.20 (7) | 0.39 (7) | HVA | (154) |
| | 1.0 (2) | 3 (2) | 0.9 (2) | OOR | (163) |
| | 0.4 | 0.4 | 1.1 | OOR | (178) |
| | 0.31 (6) | 0.37 (6) | 0.39 (6) | HVA | (201) |
| Sc | <10 | 12 | | OVS | (45) |
| ppm | 8.7 | 11 | 18 | OVS | (65) |
| | | | 57 | OVS | (47) |
| | 6.3 | 11 | | OVS | (61) |
| | <20 | 39 | 29 | OOO | (29) |
| | 6.6 | 4.8 | 47 | OOR | (27) |
| | 9 | 12 | 58 | OVS | (50) |
| | | | 52 (2) | OVS | (43) |
| | 6.8 (3) | 6.6 (2) | 55.4 (3) | HPR | (102) |
| | <5 | <5 | 27 | OVS | (123) |
| | 10.6 (6) | 12 (6) | 42 (6) | OVS | (142) |
| | 6.3 | 3.5 | 41 | HCM | (125,126) |
| | | 4.0 | | HCM | (125,126) |
| | 7.1 (3) | 5.0 (3) | 46 (3) | OOR | (163) |
| | 9.2 (2) | 17 (2) | 50 (2) | OVS | (170) |
| | 7.0 | 6.9 | 61.6 | OOR | (178) |
| | 6.9 | 6.8 | 56.8 | FCR | (178) |
| | 6.3 | 5.6 | | OOR | (192) |
| Se | 0.04 | 0.04 | 0.1 | HPJ | (62) |
| ppm | 0.1 | 0.1 | 0.4 | FPX | (117) |
| | <0.1 | 0.1 | 0.4 | FPX | (117) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Sm | 17 | 130 | 4.1 | OOR | (27) |
| ppm | <20 | 80 | | OOS | (73) |
| | 16 (2) | 108 (2) | | HPA | (74) |
| | 14 | 90 | 5.0 | HCM | (125,126) |
| | | 96 | | HCM | (125,126) |
| | 14 (6) | 221 (6) | <5 | OVS | (142) |
| | 13 | 75 | 4.2 | HCM | (125,126) |
| | | 73 | | HCM | (125,126) |
| | 16 (3) | 80 (3) | 6.4 (3) | OOR | (163) |
| | 0.2 | 174 | 4.8 | OOR | (178) |
| | | | 3.0 | HP,PR | (180,181) |
| | 17 | 108 | 5 | HPA | (185) |
| Sn | 2.5 | 4.8 | | ODS | (45) |
| | | | 3.2 | ODS | (47) |
| | <10 | <10 | 18 | OOO | (29) |
| | 2 | 2 | 2 | HOA | (33,34) |
| | 5.5 | 6.1 | 3.2 | OYA | (60) |
| | 4.1 | 6.4 | 3.5 | ODS | (43) |
| | <10 | <10 | <10 | BVS | (93) |
| | <4 | <4 | 4 | OVS | (123) |
| | <7 | <7 | <7 | OOX | (123) |
| | 3 | 4 | 28 | OOS | (130) |
| | 10 (3) | <10 | <10 | OOO | (129) |
| | <15 | <15 | <15 | OVS | (142) |
| | 5.7 | 6.5 | 3.6 | HCM | (146) |
| | 3.1 (3) | 4.8 (3) | 2.1 (3) | OVS | (155) |
| | | | 2.2 (3) | OVS | (155) |
| | 4 | 6 | | FVA | (158) |
| | 4.4 (4) | 2.9 (4) | | OVS | (162) |
| | <5 | <5 | <5 | OVS | (165) |
| Sr | 270 | 300 | | OVS | (45) |
| ppm | 232 | | | OOX | (46) |
| | 287 | | | OOA | (20) |
| | 288 | 330 | | HOA | (51) |
| | 275 | 310 | | HOA | (52) |
| | | | 280 | OVS | (47) |
| | 270 | 260 | | OVS | (61) |
| | 245 | 280 | | OOX | (71) |
| | 275 | 305 | | OOM | (79) |
| | 271 | 287 | | OOX | (46) |
| | 264 (2) | 298 (2) | 263 (2) | HOA | (28) |
| | 263 (2) | 302 (2) | 267 (2) | HOA | (40,41) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | | 475 | | OVS | (55) |
| | 201 | | | OOA | (180) |
| | 592 | 1033 | 736 | OOO | (29) |
| | 278 | 295 | 285 | OOX | (56,64) |
| | 290 | 250 | | OVS | (49) |
| | 266 (2) | 276 (2) | 242 (2) | OOX | (33) |
| | 370 | 530 | 370 | OVS | (50) |
| | 288 | 338 | 271 | OOA | (36) |
| | 274.6 (2) | 307.0 (2) | 275.9 (2) | HCM | (76) |
| | 260 | 335 | 255 | OOX | (39) |
| | 265 (2) | 300 (2) | 257 (2) | OVS | (43) |
| | 200 (3) | 200 (3) | | OOX | (37) |
| | 280 | 310 | 270 | FOX | (91) |
| | 249 | 282 | 234 | BVS | (93) |
| | 260 | 300 | 280 | HOA | (93) |
| | 295 (5) | 330 (5) | 278 (5) | OVS | (40,108) |
| | 275 | 303 | 265 | HOA | (117,119) |
| | 280 | 302 | 265 | HOA | (117,119) |
| | 270 (2) | 270 | | FOX | (121) |
| | 278 (2) | 305 (2) | 265 (2) | OOA | (123) |
| | 241 | 245 | 245 | OOX | (123) |
| | 300 | 330 | 270 | OVS | (123) |
| | 310 | 329 | 155 | FCS | (113,127) |
| | 220 | 250 | 230 | OOX | (130) |
| | 170 | 310 | | HOA | (136) |
| | 447 (6) | 472 (6) | 322 (6) | OVS | (142) |
| | 285 (2) | 300 (2) | 283 (2) | BOX | (141) |
| | 255 (4) | 273 (4) | 276 (4) | OOX | (153) |
| | | | 255 (3) | OVS | (155) |
| | | | 260 (3) | OVS | (155) |
| | 278 (3) | 322 (30 | 290 (3) | HOA | (156,157) |
| | 370 | 330 | 130 | OVS | (165) |
| | 255 | 295 | | OOA | (166) |
| | 280 (2) | 310 (2) | 270 (2) | OVS | (170) |
| | 280 (15) | 330 (15) | 230 (15) | OVS | (170) |
| | 278 | 300 | 275 | HOA | (173) |
| | 280 | 290 | 260 | BOX | (173) |
| | 256 | 276 | 274 | FCR | (177) |
| | 278 | 303 | 256 | BOX | (188) |
| | 264 | 298 | 263 | OOA | (189) |
| | 268 (4) | 298 (4) | 233 (4) | HOA | (196) |
| | | 303 | 273 | HOA | (207) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Ta | 2.1 | 11 | | OOR | (27) |
| ppm | <500 | <500 | <500 | OVS | (142) |
| | 1.9 (4) | 28 (4) | 0.8 (4) | OOR | (163) |
| | 1.8 | 29 | 2.9 | OOR | (178) |
| Tb | 3.2 (3) | 19.2 (3) | | HPR | (102) |
| ppm | 2.2 | 11 | 0.53 | HCM | (125,126) |
| | | 10 | | HCM | (125,126) |
| | <10 | 15 (6) | <10 | OVS | (142) |
| | 1.85 | 9 | 0.46 | HCM | (125,126) |
| | | 9 | | HCM | (125,126) |
| | 2.7 | 13 | 0.5 | OOR | (163) |
| | 1.4 | 8.5 | | OOR | (178) |
| | 3.4 | 18.8 | | FPR | (178) |
| Te | 0.002 | 0.006 | 0.039 | OOM | (161) |
| ppm | 0.002 (2) | 0.006 | 0.054 (2) | HCM | (182) |
| Th | 246 | | | OOR | (13) |
| ppm | 240 | 780 | | OOX | (71) |
| | 374 | 980 | | FCJ | (77) |
| | 380 | 810 | 0.8 | OOR | (27) |
| | 400 (2) | 970 (2) | <2 (2) | OOX | (33) |
| | 351 (3) | 1007 (3) | 0.88 (3) | HPR | (102) |
| | 437 | 1170 | | FOX | (117) |
| | 300 | 850 | | OOX | (130) |
| | 521 (6) | 1180 (6) | <2 | OVS | (142) |
| | 330 (2) | 900 (2) | 0.7 (2) | OOR | (163) |
| | | 1010 | | FOX | (171) |
| | 570 | 980 | 4 | BOX | (173) |
| | 380 | 1030 | | OOR | (178) |
| | 420 | 1048 | | FCR | (178) |
| | | | 5 | HPJ | (185) |
| | 380 | 1032 | 1.2 | OOR | (195) |
| | 365 | 991 | 1.1 | OOR | (195) |
| | 353 | 964 | <13 | OOR | (205) |
| | 340 | 978 | 0.9 | OOR | (205) |
| Tl | 2.0 | 2.2 | | ODS | (45) |
| ppm | | | <1 | ODS | (47) |
| | <5 | 7 | <5 | OOO | (29) |
| | 1.44 (4) | 1.34 (4) | 0.073 (4) | OOA | (36) |
| | 1.1 | 1.1 | <1 | ODS | (43) |
| | <5 | <5 | <5 | OVS | (142) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Tm | 2.4 (2) | 10.5 (2) | | HPA | (74) |
| ppm | 2.0 | 6.5 | 0.12 | HCM | (125,126) |
| | | 5.6 | | HCM | (125,126) |
| | <3 | 12 (6) | <3 | OVS | (142) |
| | 2.1 | 5.6 | 0.095 | HCM | (125,126) |
| | | 5.2 | | HCM | (125,126) |
| | 2.5 | 10.5 | 0.14 | HPA | (185) |
| | 1.6 | 7.7 | 0.05 | OOR | (199) |
| U | 280 | 619 | | OOR | (13) |
| ppm | 260 | 670 | | OOX | (71) |
| | 281 | 614 | | FYJ | (77) |
| | 280 | 619 | | BOR | (22,78) |
| | 310 | 680 | <1 | OOA | (33) |
| | 400 | 1000 | <2 (2) | OOX | (33) |
| | 250 | 570 | <1 | HYL | (93,99) |
| | 290 | 580 | | HOJ | (101) |
| | 266 (3) | 695 (4) | 0.44 (2) | OOR | (102) |
| | 326 | 853 | 0.2 | OOR | (117) |
| | 323 | 651 | 0.4 | OOR | (117) |
| | 264 | 725 | | FOX | (121) |
| | 243 | 528 | <6 | OOX | (123) |
| | 300 | 540 | | OOX | (130) |
| | 270 | 600 | 1 | OOJ | (130) |
| | 262 (6) | 863 (6) | <150 | OVS | (142) |
| | 246 | 634 | 0.30 | HCJ | (144) |
| | 250 | 630 | 0.25 | HCJ | (144) |
| | 250 | 600 | 0.21 | HCJ | (144) |
| | 255 | 623 | 0.19 | HCJ | (144) |
| | 260 | 560 | <1 | OOR | (163) |
| | | 800 | | FOX | (171) |
| | | 876 | | OOR | (172) |
| | 260 | 570 | <5 | BOX | (173) |
| | 291 | 652 | 0.30 | OOR | (195) |
| | 321 | 719 | 0.3 | OOR | (195) |
| | 254 | 547 | <1 | OOR | (205) |
| | 290 | 670 | 0.28 | OOR | (205) |
| | 300 | 401 | 0.27 | OOR | (205) |
| | 291 | 617 | <1 | OOR | (205) |
| V | | | 400 | OOJ | (137) |
| ppm | <30 | <30 | | OVS | (45) |
| | 56 | 60 | 470 | OVS | (65) |
| | | | 570 | OVS | (47) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 45 | 41 | | OVS | (61) |
| | 20 | | | OOO | (69) |
| | | 79 | | OVS | (55) |
| | 45 | 52 | 566 | OOO | (29) |
| | 55 | 56 | 530 | FYJ | (27) |
| | 53 | 55 | | HOA | (30) |
| | 52 | 55 | | OVS | (49) |
| | 55 | 65 | 550 | HOA | (33,34) |
| | 38 (2) | 33 (2) | 596 (2) | OOX | (33) |
| | 44 | 35 | 540 | OVS | (50) |
| | 36 | 34 | 500 | OOX | (39) |
| | 52 | 47 | 545 | HYJ | (51,80) |
| | 53 | 51 | 510 | OOA | (28) |
| | 43 | 48 | 486 | BVS | (93) |
| | 34 | 34 | 450 | OOL | (93,100) |
| | <50 | <50 | 510 | FOJ | (101) |
| | | | 496 (5) | OVS | (40,109) |
| | 68 | 61 | 540 | OVS | (123) |
| | 52 | 53 | 575 | OOJ | (123) |
| | 18 | 20 | 511 | FCS | (113,127) |
| | <50 | <50 | 460 | OOS | (130) |
| | 20 (3) | 12 (3) | 300 (3) | OOO | (129) |
| | 66 (6) | 68 (6) | 384 (6) | OVS | (142) |
| | 48 | 50 | 520 | HCM | (125,126) |
| | | 50 | | HCM | (125,126) |
| | | | 540 | OOA | (40) |
| | 50 (3) | 48 (3) | 493 (3) | HOA | (156,157) |
| | 55 (4) | 54 (4) | | OVS | (162) |
| | 65 | 52 | 420 | OVS | (165) |
| | 54 (2) | 54 (2) | 530 (2) | OVS | (170) |
| | 39 (15) | 46 (15) | 530 (15) | OVS | (170) |
| | 46 | 50 | | OOX | (179) |
| | 50 | 49 | | HYA | (187) |
| | 52 | | 520 | OOA | (189) |
| | 57 (4) | 50 (4) | 306 (4) | HOA | (196) |
| | | 63 | 555 | HOA | (207) |
| W | | | <100 | OVS | (45) |
| ppm | <10 | <10 | 29 | OOO | (29) |
| | <1 | <1 | <1 | OOA | (33) |
| | <10 | <10 | <50 | OVS | (142) |
| | | 1 | 0.3 | OOR | (178) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| Y | 160 | 870 | | OVS | (45) |
| ppm | | | <20 | OVS | (47) |
| | 113 | 690 | | OVS | (65) |
| | 103 | 650 | | OVS | (61) |
| | 118 | 710 | | OOX | (71) |
| | 241 | 1577 | 106 | OOO | (29) |
| | 145 | 780 | 15 | OOX | (56,64) |
| | 120 (2) | 600 | | HPA | (74) |
| | 220 | 930 | 21 | OVS | (50) |
| | 132 (2) | 840 (2) | | OVS | (43) |
| | 140 | 590 | 19 | OOX | (33) |
| | 170 | 678 | | FOX | (121) |
| | 110 | 658 | 25 | OOX | (123) |
| | 150 | 880 | <12 | OOS | (130) |
| | 100 | 670 | <100 | OOX | (130) |
| | 131 | 610 | | OOA | (136) |
| | 130 (6) | 696 (6) | 16 (6) | OVS | (142) |
| | 116 (2) | 696 (2) | 12 (2) | BOX | (141) |
| | 150 | 800 | 20 | HCM | (125,126) |
| | | 800 | | HCM | (125,126) |
| | <500 | >500 | nd | OVS | (165) |
| | 151 (4) | | nd | OOX | (168) |
| | 130 (2) | 770 (2) | <20 | OVS | (170) |
| | 120 (15) | 760 (15) | 34 (15) | OVS | (170) |
| | 150 | 750 | 10 | BOX | (173) |
| | | | 10 | HPA | (185) |
| | 144 | 740 | 15 | BOX | (188) |
| Yb | 17 | 69 | | OVS | (45) |
| ppm | 8.6 | 30 | 2.9 | OVS | (65) |
| | | | <4 | OVS | (47) |
| | 20 | 90 | 1.6 | OOR | (27) |
| | 12 | 35 | | OOS | (73) |
| | 16 (2) | 54 (2) | | HPA | (74) |
| | 21 | 80 | 3 | OVS | (50) |
| | 18 | 40 | 0.82 | HCM | (125,126) |
| | | 41 | | HCM | (125,126) |
| | 29 | 92 | <7 | OOS | (130) |
| | 19 | 73 | | OOA | (136) |
| | 19 (6) | 80 (6) | 1.9 (6) | OVS | (142) |
| | 17.4 | 62.5 | 0.6 | HCM | (145) |
| | 17 | 41 | 0.44 | HCM | (125,126) |
| | | 41 | | HCM | (125,126) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | 16 (2) | 57 (2) | 0.7 (2) | OOR | (163) |
| | nd | "detected" | nd | OVS | (165) |
| | 21 (2) | 79 (2) | <5 | OVS | (170) |
| | 17 (15) | 70 (15) | <2 | OVS | (170) |
| | 13 | 45 | | OOR | (178) |
| | | | 2.8 | HP,PR | (180,181) |
| | 16 | 55 | 0.61 | HPA | (185) |
| Zn | 200 | 180 | | ODS | (45) |
| ppm | 236 | 214 | | OOX | (46) |
| | 259 | 246 | | HOA | (51) |
| | | | 158 | ODS | (47) |
| | 255 | 256 | | HCM | (81) |
| | 250 | 250 | | OOX | (71) |
| | 254 | 259 | | HCA | (81) |
| | 239 | 221 | | OOX | (46) |
| | 244 (2) | 236 (2) | 188 (2) | HOA | (28) |
| | 171 | 187 | 189 | OOO | (29) |
| | 265 | 245 | 225 | OOX | (56,64) |
| | 230 | 240 | 182 | HOA | (30) |
| | 255 (2) | 250 (2) | 190 (2) | HOA | (33,34) |
| | 220 (2) | 210 (2) | 180 (2) | OOX | (33) |
| | 247 | 253 | 196 | BVS | (93) |
| | 280 | 265 | 225 | HOA | (93) |
| | 280 | 280 | 200 | HOL | (93) |
| | 250 (5) | 246 (5) | 184 (5) | HOA | (101) |
| | 215 (2) | 212 (2) | 170 (2) | HYA | (102) |
| | 262 | 252 | 192 | HOA | (117,119) |
| | 260 | 252 | 189 | HOA | (117,119) |
| | 250 (2) | 260 | | FOX | (121) |
| | 280 | 260 | 180 | OOA | (123) |
| | 284 | 254 | 209 | OOX | (123) |
| | | | >1000 | OOO | (129) |
| | 380 | 320 | | HOA | (136) |
| | 257 (6) | 247 (6) | 193 (6) | OVS | (142) |
| | 256 (2) | 236 (2) | 197 (2) | BOX | (141) |
| | | | 180 | HCM | (145) |
| | 205 | 280 | 190 | HCM | (125,126) |
| | | 260 | | HCM | (125,126) |
| | 274 (2) | 266 (2) | 204 (2) | HOA | (134) |
| | 254 (4) | 238 (4) | 155 (4) | OOX | (153) |
| | 222 (3) | 216 (3) | 177 (3) | OVS | (155) |
| | | | 178 (3) | OVS | (155) |
| | 237 (3) | 232 (3) | 212 (3) | HOA | (156,157) |

Table 2 (cont'd)

| Constituent | SY-2 | SY-3 | MRG-1 | Method | Reference |
|---|---|---|---|---|---|
| | | | 182 (3) | HOA | (156,157) |
| | 237 | 240 | | OOA | (166) |
| | 220 (15) | 250 (15) | <200 | OVS | (170) |
| | 250 | 240 | 190 | HOA | (173) |
| | 230 | 240 | 162 | OOR | (178) |
| | 238 | 224 | 180 | BOX | (188) |
| | 246.5 | 239.3 | 185.2 | OOA | (189) |
| | 258 (4) | 252 (4) | 205 (4) | HOA | (196) |
| | 253.6 | 233.6 | 206.9 | BOX | (200) |
| | 248 | 242 | 187 | HOA | (200) |
| | | 263 | 207 | HOA | (297) |
| Zr | 280 | 260 | | OVS | (45) |
| ppm | | | 130 | OVS | (47) |
| | 260 | 290 | | OOO | (61) |
| | 280 | 370 | | OOX | (71) |
| | 304 | 567 | 198 | OOO | (29) |
| | 278 (2) | 323 (2) | 106 (2) | OOX | (33) |
| | 230 | 250 | 120 | OVS | (50) |
| | 250 | 315 | 110 | OOX | (39) |
| | 240 | 280 | 60 | FOX | (91) |
| | 320 (2) | 420 | | FOX | (121) |
| | 271 | 303 | 87 | OOX | (123) |
| | 250 | 360 | 79 | OOS | (130) |
| | 250 | 300 | 120 | OOX | (130) |
| | <100 | <100 | <100 | OOO | (129) |
| | 293 (6) | 392 (6) | 147 (6) | OVS | (142) |
| | 297 (4) | 373 (4) | 89 (4) | OOX | (153) |
| | 255 (3) | 295 (3) | 99 (3) | OVS | (155) |
| | | | 101 (3) | OVS | (155) |
| | 330 | 380 | 160 | OVS | (165) |
| | | 80 | | FOX | (166) |
| | 270 (8) | 315 (6) | 101 (4) | OOX | (168) |
| | 310 (2) | 370 (2) | 110 (2) | OVS | (170) |
| | 310 (15) | 320 (15) | 110 (15) | OVS | (170) |
| | 280 | 290 | 110 | BOX | (173) |
| | 270 | 340 | 100 | BOX | (188) |

## DISCUSSION

Tables 1 and 2 reveal an erratic pattern in the analytical tasks performed. Although all participants were informed that SY-3 contained unusually high concentrations of uranium, thorium and the rare earths, and that MRG-1 contained somewhat higher concentrations than usual of chromium, copper, nickel and vanadium, some analysts nevertheless provided only a limited amount of data. Moreover some interference in determining the more common components may have been overlooked.

The great spread of values for each component is somewhat offset by the process of selective elimination used in arriving at the recommended values. Nevertheless, reliable values for some components may never be attained, no matter how many additional analyses are reported. In the case of U.S. Geological Survey standard W-1, 20 years after the sample became available, only "magnitude" values were listed for such common trace components as B, Be, Ce, Cl, Ge, Se, and W (16). Only 24 of the 48 other trace element values listed for W-1 in the same compilation are given as "recommended".

Some of the collaborating laboratories used more than one analytical method, thereby providing (in some cases) independent checks on their own results; others depended entirely on one method.

A disappointingly small number of participants reported results for the common components - ferrous iron, water, carbon dioxide and fluorine. Further complications arose in the case of carbon dioxide because of the failure of some contributors to specify whether they determined the carbon dioxide evolved by acid treatment, hence carbonates, or that resulting from the combustion of the sample, hence total carbon. At least two laboratories reported appreciably different results by the two approaches. The difference may represent non-carbonate carbon or contamination. A similar difference has been observed by laboratories of the Geological Survey of Canada with samples having no appreciable non-carbonate carbon.

Because of the availability of additional data it is now possible to make some distinction between carbon dioxide results obtained by acid evolution and by combustion. The following results clearly indicate a significant difference between the two techniques. All of the following values are expressed as per cent carbon dioxide:

| SY-2 | | SY-3 | | MRG-1 | |
|---|---|---|---|---|---|
| Acid | Combust | Acid | Combust | Acid | Combust |
| 0.49 | 0.66 | 0.47 | 0.60 | 1.22 | 1.22 |
| 0.48 | 0.63 | 0.42 | 0.55 | 1.08 | 1.21 |
| 0.48 | 0.60 | 0.41 | 0.55 | 1.06 | 1.15 |
| 0.47 | 0.59 | 0.41 | 0.50 | 1.03 | 1.14 |
| 0.46 | 0.59 | 0.40 | 0.50 | 1.03 | 1.14 |
| 0.46 | 0.57 | 0.40 | 0.46 | 1.02 | 1.13 |
| 0.46 | 0.55 | 0.40 | 0.44 | 1.00 | 1.11 |
| 0.46 | 0.55 | 0.35 | 0.43 | 0.98 | 1.11 |
| 0.44 | 0.53 | 0.34 | 0.41 | 0.90 | 1.10 |
| 0.43 | 0.53 | 0.26 | 0.33 | 0.90 | 1.06 |
| 0.42 | 0.52 | 0.18 | | 0.88 | 1.05 |
| 0.32 | | | | | |

The two sets of results for carbon dioxide in each sample were treated as different determinations. Results for which there was insufficient information on the method used were ignored. The recommended value for "carbon dioxide" is derived from the acid-evolution results. "Carbon" represents the difference between the derived values by both methods, recalculated to the element.

Results received from one reliable source suggested inhomogeneity in sample SY-3, with regard to uranium, thorium, lead, and copper. Because the base material used in preparing SY-3 was very similar to SY-2, and the four listed elements are among those for which there is a marked difference between SY-2 and SY-3, there is reason to suspect that the inhomogeneity, if any, is the result of incomplete mixing in the autogenous grinding step mentioned above. Although the data from earlier spectrographic examination of the variation of individual rare earths in SY-3 showed no noticeable evidence of inhomogeneity, additional tests were undertaken, using X-ray fluorescence. The elements observed were uranium,

thorium, cerium, lanthanum, yttrium, strontium and rubidium. Results obtained were not sufficiently conclusive either to confirm or to contradict the suggestion of inhomogeneity. The issue therefore remains in doubt, although the weight of evidence suggests that the one observed example of inhomogeneity may have been fortuitous.

Some questions could be raised regarding the possibility that inhomogeneity is a major source of the general spread of values, particularly for trace elements. Rocks are essentially heterogeneous, and the artificial "homogenization" processes used in sample preparation are reversible to some extent. However, a perusal of the available data suggests that inter-laboratory bias is a much greater source of deviation than could generally be expected from sample inhomogeneity. For example, some of the participating laboratories showed a persistent bias that affected several different elements in a manner that would be difficult to justify in terms of segregation of individual minerals. In many cases, a particular bias in the results for a given element coming from a given laboratory was observable in all three samples. It is also noteworthy that the spread of values for most of the components of the three rocks is not very different from those observed in similar programs originating in other countries (2-6).

## DERIVATION OF ASSIGNED VALUES

The errors and aberrations from using mere averages or straightforward statistical treatment to arrive at assigned values have been pointed out elsewhere (9,10,17). The empirical method used in this work was first applied in a study of six samples from the U.S. Geological Survey (2,10) and subsequently modified (10,11). It is based on the assumption that the best values must be derived from results reported only by laboratories with the best over-all performance.

The method involved a series of steps:

(1) Based on the $H_2O^-$ percentages reported with each group of data, all results were converted to the "dry basis". Where no $H_2O^-$ was reported, results were assumed to be on the dry basis.

(2) Where fewer than three results were available for a particular constituent of a particular sample, no value was assigned.

(3) Where three or four results were available, a value was assigned equal to the median of the reported results, provided they were based on at least three mutually independent methods and were in reasonable agreement. Such values are shown with question marks, to indicate uncertainty.

(4) Where five to nine results were available, the median was also used as an assigned value, regardless of method, but also shown with a question mark.

(5) Where ten or more results were available, the mean and standard deviation were calculated. All values removed from the mean by more than one standard deviation were categorized as "poor", each being identified with the laboratory that produced it.

(6) The poor results were set aside and the mean and standard deviation of the remaining values calculated. All values removed from that mean by more than its standard deviation were categorized as "fair" and each identifed with the laboratory that produced it.

(7) The fair results were set aside and the remaining "hard core" of values categorized as "good" and identified with the laboratories that produced them.

(8) After operations (5), (6) and (7) had been completed for all eligible values for all constituents of all three samples, each contributing laboratory was given a rating, determined by the following formula:

$$R = \frac{N_g - N_p}{N_g + N_f + N_p} \times 100$$

where

$R$ = rating

$N_g$ = number of good results

$N_f$ = number of fair results

$N_p$ = number of poor results

(9) Results reported by laboratories with ratings of 40 or higher were categorized as "select".

(10) For each constituent of each sample, any outlying select result that differed from its nearest neighbour by as much as or by more than the latter differed from the opposite extreme, was eliminated.

(11) For constituents where fewer than five select values were available, the median of the available select values was assigned, but again with a question mark.

(12) Where five or more select results were available, a subjective decision was made in choosing either the select median or the select mean as an assigned value.

All recommended values have been categorized as "A", "B", or "?". The "A" is for constituents for which at least 20 results were reported, where there is no evidence of bias in the distribution and where there is close agreement between mode, median, mean, select median and select mean. It follows that any further results received are not likely to affect such values beyond one or two units in the last significant figure. The "?" category includes the values mentioned above, and also others where erratic distribution or other factors cast doubt on the derived value. The "B" is intended for values intermediate between the other two.

Because some trace elements are present at sufficiently high levels to affect the complete analysis of the samples, calculations on those elements were done first. Recommended values are given in Table 3. Most of those with question marks are based on the medians, the others on the select medians. In both cases, some rounding of values has been introduced.

An exception was made for rubidium in SY-3, where two isotopic-dilution mass-spectrometry laboratories, one in Canada, the other in Australia, reported 208.4 and 208 ppm respectively. The select median, 208 ppm, was therefore taken as the recommended value and listed to one significant figure more than usual.

Equivalent percentages as oxides are also given in Table 3 only where those values are 0.01 or higher. They were used in the subsequent calculations on the major and minor elements. The equivalent percentages for non-carbonate carbon and chlorine are expressed as the elements, the form in which those constituents are usually reported in a complete rock analysis.

Recommended values for major and minor constituents are listed in Table 4 in which "others" represents the sum of the "equivalent percentages" of the trace elements, adjusted upward to allow for additional rare-earth elements for which reported results were too limited to justify assigning values. $Fe_2O_3TR$ represents the value for total iron, expressed as ferric oxide and derived from reported values for total iron. $Fe_2O_3TC$ represents the value for total iron, expressed as ferric oxide, but calculated from the values derived for $Fe_2O_3$ and FeO from reported values for ferric and ferrous iron. Closeness of agreement between the two values for total iron is a rough measure of the validity of the procedures used in deriving recommended values. Closeness of the total to 100% is another, but less reliable, indicator of that validity. The values of elements for which insufficient data were received to assign "recommended" values are recorded in Table 5.

## CONCLUSIONS

The present collaborative program has placed the quantitative compositional data for the three samples on a much firmer footing than they were originally. There are, however, some negative aspects to the results:

(1) The suspicion of heterogeneity resulting from the autogenous grinding used in preparing SY-3.

(2) The limited quantity of data, and hence the uncertainty in the assigned values, for uranium, thorium, the rare earths and several additional elements which distinguish SY-2 and SY-3 from other available reference samples.

Table 3 - Recommended values - "trace" elements

| | SY-2 | | SY-3 | | MRG-1 | | |
|---|---|---|---|---|---|---|---|
| | ppm | Oxide % | ppm | Oxide % | ppm | Oxide % | |
| Ag | | | | | 0.14? | | |
| As | 18B | | 20B | | 0.7B | | |
| B | 85? | 0.027 | 110B | 0.035 | 13? | | $B_2O_3$ |
| Ba | 460A | .051 | 430A | .048 | 50? | 0.006 | BaO |
| Be | 23A | .006 | 22A | .006 | 0.6? | | BeO |
| C | | .027? | | .025? | | .025? | C |
| Ce | 210? | .026 | 2200B | .27 | 25? | | $CeO_2$ |
| Cl | 130? | .013 | 140? | .014 | 150? | .015 | Cl |
| Co | 11B | | 12A | | 86A | .011 | CoO |
| Cr | 12B | | 10B | | 450A | .066 | $Cr_2O_3$ |
| Cs | 2.3? | | 2.5? | | 0.6? | | |
| Cu | 5A | | 16A | | 135A | .017 | CuO |
| Dy | 20? | | 80? | .009 | 3? | | $Dy_2O_3$ |
| Er | 12? | | 50? | .006 | | | $Er_2O_3$ |
| Eu | 2.4 | | 14? | | 1.4? | | |
| Ga | 28A | | 26A | | 18? | | |
| Gd | | | 55? | .006 | | | $Ga_2O_3$ |
| Hf | 8? | | 9? | | | | |
| Ho | | | 20? | | 0.5? | | |
| La | 88B | .010 | 1350B | .16 | 10? | | $La_2O_3$ |
| Li | 93A | .020 | 92A | .020 | 4B | | $Li_2O$ |
| Lu | 3? | | 8? | | 0.2? | | |
| Mo | 3? | | 2.5? | | | | |
| Nb | 23? | | 130B | .019 | 20? | | $Nb_2O_5$ |
| Nd | 71? | .008 | 800? | .093 | 19? | | $Nd_2O_3$ |
| Ni | 10A | | 11B | | 195A | .025 | NiO |
| Pb | 80A | .009 | 130A | .014 | 10B | | PbO |
| Pr | | | 120? | .014 | | | $Pr_6O_{11}$ |
| Rb | 220A | .024 | 208A | .023 | 8B | | $Rb_2O$ |
| Sb | 0.2B | | 0.3B | | 0.4B | | |
| Sc | 7? | | 7? | | 48? | .007 | $Sc_2O_3$ |
| Sm | 15? | | 100? | .012 | 5? | | $Sm_2O_3$ |
| Sn | 4B | | 6? | | 3.2B | | |
| Sr | 275A | .032 | 306A | .036 | 260A | .031 | SrO |
| Tb | 2? | | 11? | | | | |
| Th | 380? | .043 | 990B | .115 | 1? | | $ThO_2$ |
| Tm | 2? | | 8? | | 0.1? | | |
| U | 290B | .034 | 650A | .077 | 0.3? | | $U_3O_8$ |
| V | 52A | .009 | 51A | .009 | 520A | .093 | $V_2O_5$ |
| Y | 130A | .017 | 740A | .094 | 16? | | $Y_2O_3$ |
| Yb | 17B | | 65B | .007 | 1? | | $Yb_2O_3$ |
| Zn | 250A | .031 | 240A | .030 | 190A | .024 | ZnO |
| Zr | 280A | .038 | 320A | .043 | 105A | .014 | $ZrO_2$ |
| | | .03? | | .08? | | | $ORE_2O_3$ |

Table 4 - Recommended values - "complete analysis" (%, dry basis)

| | SY-2 | SY-3 | MRG-1 |
|---|---|---|---|
| $SiO_2$ | 60.10A | 59.68A | 39.32A |
| $Al_2O_3$ | 12.12A | 11.80A | 8.50A |
| $Fe_2O_3$ | 2.28B | 2.44B | 8.26B |
| FeO | 3.62A | 3.58A | 8.63A |
| MgO | 2.70A | 2.67A | 13.49A |
| CaO | 7.98A | 8.26A | 14.77B |
| $Na_2O$ | 4.34A | 4.15A | 0.71A |
| $K_2O$ | 4.48A | 4.20A | 0.18A |
| $H_2O^+$ | 0.43B | 0.42B | 0.98B |
| $CO_2$ | 0.46B | 0.38B | 1.00B |
| $TiO_2$ | 0.14A | 0.15A | 3.69B |
| $P_2O_5$ | 0.43A | 0.54A | 0.06A |
| F | 0.51B | 0.66B | 0.025B |
| S | 0.011B | 0.05B | 0.06B |
| MnO | 0.32A | 0.32A | 0.17A |
| Others* | 0.43? | 1.18? | 0.33? |
| Σ | 100.35? | 100.48? | 100.18? |
| O/F, etc. | 0.22? | 0.31? | 0.04% |
| Σ (corr.) | 100.13? | 100.17? | 100.14? |
| $Fe_2O_3TR$ | 6.28A | 6.42B | 17.82A |
| $Fe_2O_3TC$ | 6.27B | 6.42B | 17.85B |

*Others represents the sum of the "equivalent percentages" of the trace elements, adjusted upward to allow for additional rare-earth elements for which reported results were too limited to justify assigning values.

Table 5 - Elements for which insufficient data were received

| SY-2 | SY-3 | MRG-1 |
|---|---|---|
| Ag | Ag | |
| Au | Au | Au |
| Bi | Bi | Bi |
| Br* | Br* | Br* |
| Cd | Cd | Cd |
| | | Er |
| Gd | | Gd |
| Ge | Ge | Ge |
| | | Hf |
| Hg | Hg | Hg |
| Ho | | |
| I* | I* | I* |
| In | In | In |
| Ir | Ir | Ir |
| | | Mo |
| N* | N* | N* |
| Os | Os | Os |
| Pd | Pd | Pd |
| Pr | | Pr |
| Pt | Pt | Pt |
| Ra* | Ra* | Ra* |
| Re | Re | Re |
| Rh | Rh | Rh |
| Ru* | Ru* | Ru* |
| Se | Se | Se |
| Ta | Ta | Ta |
| | | Tb |
| Te | Te | Te |
| Tl | Tl | Tl |
| W | W | W |

*No data received

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