DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

# Geochemistry and preliminary assessment of resource potential for postorogenic granites of the Southwestern Arabian Shield, Kingdom of Saudi Arabia

by

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## TABLE OF CONTENTS


| | Page |
|---|---|
| ABSTRACT | 1 |
| INTRODUCTION | 1 |
| ANALYTICAL PROCEDURES | 3 |
| RESULTS AND DISCUSSION | 4 |
| SUMMARY | 9 |
| DATA STORAGE | 10 |
| Data File | 10 |
| Mineral Occurrence Documentation System | 10 |
| REFERENCES | 54 |


## ILLUSTRATIONS


Figure 1. Location map ........ 11
2. Map showing distribution of Y values....... 12
3. Map showing distribution of Nb values...... 13
4. Map showing average differentiation index.. 14
5. Ternary diagram for normative Q-Or-Ab...... 15
6. Ternary diagram for normative An-Ab-Or..... 16
7. Map showing uranium concentrations......... 17
8. Map showing thorium concentrations......... 18
9. Map showing distribution of Th/U values.... 19
10. Ternary diagram for relative amounts of uranium, thorium, and potassium............ 20
11. Ternary diagram for relative amounts of potassium, rubidium, and strontium......... 21
12. Map showing distribution of K/Rb values.... 22
13. Map showing distribution of Rb/Sr values... 23


## TABLES


Table 1. Chemical and normative data.................. 24
2. Location data and trace-element contents..... 36
3. Means and standard deviations................ 50
4. Comparison of southwestern and anomalous granite.................................. 51
5. Selected correlation coefficients............ 53

# GEOCHEMISTRY AND PRELIMINARY ASSESSMENT OF RESOURCE POTENTIAL FOR POSTOROGENIC GRANITES OF THE SOUTHWESTERN ARABIAN SHIELD, KINGDOM OF SAUDI ARABIA

by

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## ABSTRACT

*Geochemical data for samples from 55 postorogenic plutons of the southwestern Arabian Shield show that these granitoids are generally less evolved than similar granitoids of the eastern Arabian Shield. Radioelement contents are low to normal relative to typical granitic rocks and uranium contents are distinctly low relative to rocks of the eastern Arabian Shield. The data indicate low favorability for ore deposits of elements that are typically enriched in granites at the end stages of magmatism such as tin, tungsten, niobium, tantalum, molybdenum, rare-earth elements, and radioactive elements.*

*Regional geochemical patterns are not consistent with the north-south trending microplate boundary that has been proposed by other workers. Correlation coefficients for trace-element data obtained during the current study also argue against sharp compositional breaks in the protolith for the postorogenic granites. Consideration of the data presented here and similar data for granitoids of the eastern Arabian Shield, suggest the existence of a compositionally gradational protolith of continental affinity to the east and oceanic affinity to the west.*

## INTRODUCTION

The Arabian Shield is composed of metavolcanics, plutonic, and metasedimentary rocks that range in age from 1,100 Ma to 540 Ma and in composition from gabbroic to granitic (Greenwood and others, 1976; Delfour, 1977; Fleck and others, 1980; Stoeser and Elliott, 1980; Fleck and Hadley, 1982; Schmidt and Brown, 1982; Elliott, 1983). Most rock units have been variably, and in some cases, multiply deformed. During evolution of the Arabian Shield, the character of magmatism changed from unevolved mafic rocks to intermediate rocks to evolved silicic (or bimodal gabbroic-granitic) rocks. In the eastern Arabian Shield, the youngest granitic rocks exhibit very highly evolved trace-element signatures (Stuckless and others, 1986). Granitic rocks of the last phase of plutonism have been variously referred to as postorogenic, anorogenic, and posttectonic; the term postorogenic is used in this report. Towards the end of this last magmatic period, the Arabian Shield was cut by the northwest trending Najd Fault system, that has a left-lateral displacement of as much as 240 km (Brown, 1972).

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The southern Arabian Shield has been described as a series of nine north-trending tectonic belts that are dominantly to completely ensimatic in composition (Greenwood and others, 1982). Stoeser and Camp (1985) have described the entire Arabian Shield as a series of five accreted microplates and intervening suture zones. According to Stoeser and Camp's model, most of the study area (fig. 1) lies within the Asir Terrane, but the eastern margin is within or adjacent to the Nabitah Suture Zone. The Asir Terrane has been subdivided into the Taif Province to the northwest and the Abha Province to the southeast (Stoeser, 1985). The Taif Province contains a significantly greater percentage of granitic plutonic rocks and the contained arc-type rocks are somewhat younger.

The postorogenic granitic rocks have received considerable attention because of their association with several elements of economic interest (Elliott, 1980; du Bray and others, 1982; Jackson and Odell, 1984; Drysdale and others, 1984, Moore, 1984; Stuckless and others, 1986). Within the Arabian Shield, occurrences of tungsten (Cole and others, 1981), rare-earth elements and thorium (Harris and Marriner, 1980; Stuckless, Knight, and others, 1982; Drysdall and others, 1984 ; Stuckless, Quick, and VanTrump, 1984), molybdenum (Dodge, 1979), and tin (Elliott, 1980; du Bray, 1984) have been reported, and the potential for niobium and tantalum deposits is high (Ramsay and others, 1982; Elliott, 1983). Within the southwestern Arabian Shield, there are ancient mines in areas of quartz, or quartz and fluorite, and these deposits are about the same age as the postorogenic plutons (Greenwood, 1975a; Schmidt, 1980a,b), although there is no obvious genetic relationship between the granitic magmas and mineralizations (Schmidt, 1980a).

The postorogenic granites have also been studied with regard to the petrogenesis of peralkaline granites (Radain and others, 1981; Harris, 1981; Stuckless, Nkomo, and Wenner, 1982; Jackson, 1984). Chemical and isotopic data yield information about the protoliths for the young granites, and these inferences have been used in the debate concerning the origin of the Arabian Shield (Stacey and others, 1980; Delfour, 1981; Schmidt and Brown, 1984; Fleck and Hadley, 1982; Stacey and Stoeser, 1984; Stuckless, Hedge, and others, 1984; Stuckless and others, 1986).

The postorogenic plutons of the Arabian Shield were intruded from about 660 Ma to 540 Ma (Fleck and others, 1980; Fleck and Hadley, 1982; Calvez and Kemp, 1982; Stuckless, Hedge, and others, 1984; Stuckless and Futa, in press). Only a few ages have been determined within the study area and these are generally older than 610 Ma. Limited K/Ar data (Fleck and others, 1976) suggest that an early Cambrian heating event affected the southern Arabian Shield.

The work on which this report is based was performed in accordance with the cooperative agreement between the Saudi Arabian Ministry of Petroleum and Mineral Resources and the U.S. Geological Survey. The research is part of a program to study the petrogenesis and mineral potential of granitic rocks of the Arabian Shield. In particular this report presents results for the postorogenic granites of the southwestern Arabian Shield (fig. 1[1/]) and compares some of the geochemical characteristics of these granites with other postorogenic granites of Saudi Arabia that are known to be mineralized.

The classification of plutonic rocks used in this report is that recommended by the International Union of Geological Sciences (IUGS) Subcommission on the Systematics of Plutonic Rocks (Streckeisen, 1976). Subdivision of the rocks on the

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1/ All figures are at the end of the report. See page 11.

basis of alumina saturation is based on the definitions of Shand (1951) such that rocks with molar Al/(Na+K)<1 are peralkaline; Al/(Na+K+Ca)>1 are peraluminous; Al/(Na+K+Ca)<1 and Al/(Na+K)>1 are metaluminous.

## ANALYTICAL PROCEDURES

Samples of granitic rock were collected from most of the postorogenic plutons in the southwestern Arabian Shield of Saudi Arabia (fig. 1). The selection of plutons for sampling was based mainly on the compilation of plutonic rocks of the southern Arabian Shield prepared by Stoeser (1984). The classification of postorogenic is interpretive and based on cross-cutting relations with regional tectonic fabric and on the lack of apparent tectonic foliation within the plutons. Each sample was judged to be representative of the freshest material available at the sample locality and was usually collected from a recent spall block. Samples weighed between 2 and 5 kg, were ground to approximately minus-32 mesh and split. Analyses were made on aliquots from a 30-g split that had been ground to minus-200 mesh except as noted below.

Major-element concentrations (table 1[1/]) were determined by high-precision X-ray fluorescence on 0.8-g splits of fused sample powder according to the methods described by Taggart and others (1982). Abundances greater than 1 percent absolute are precise and accurate within ±2 percent of the amount reported (2 sigma). The fourth digit reported for $SiO_2$ and $Al_2O_3$ is not significant for any single sample, but may be significant in a statistical treatment of the entire data set (A. T. Miesch, oral commun., 1980). Elements for which reported values are below the limits of detection (MgO<0.10, $P_2O_5$<0.05, and MnO<0.02) were arbitrarily assigned a value of one-half the limit of detection for purposes of statistical and normative calculations. Iron concentrations were determined as total ferric iron, but for purposes of normative calculations, a ferric-ferrous ratio of 1:2 has been assumed (table 1). Total iron is reported as total ferrous iron (FeO(t)) in table 2.

The concentrations of uranium (U) and thorium (Th) reported in table 2 were determined on 8- to 10-g splits of sample powder by the delayed-neutron technique described by Millard (1976). The precision and accuracy for individual determinations are dependent on counting statistics. These in turn are dependent on total weight of the sample aliquot, and the concentrations and relative proportions of uranium and thorium. Uranium contents obtained for this study are generally accurate to within ±5 percent of the amount reported (2 sigma) for concentrations >1 ppm. Thorium contents greater than 10 ppm are generally accurate to within ±10 percent of the amount reported (2 sigma) but are less accurate for samples with Th/U values <3 or Th contents <10 ppm. Detection limits for normal 10 g aliquots are 1.0 ppm Th and 0.1 ppm U.

Radium-equivalent uranium (RaeU), thorium (eTh), and potassium (eK) contents (table 2) were determined on approximately 600-g samples of coarsely crushed (minus-32 mesh) material by sealed-can gamma-ray spectrometry (Bunker and Bush, 1966, 1967). The prefix "e" is used to distinguish thorium and potassium values determined by this method. RaeU is not a direct measure of uranium, but rather a measure of the amount of uranium needed for secular equilibrium between 238U and 226Ra. Although eTh is not determined directly from thorium,

1/ All tables are at the end of the report. See page 24.

disequilibrium within the thorium decay chain is unlikely. Therefore, eTh is used as a true measure of thorium. Precision for eTh and RaeU is better than ± the quantity (2 percent of the amount reported plus 0.1 ppm absolute). The eK value obtained by gamma-ray spectrometry is a direct measure of potassium, which is precise to within ± the quantity (2 percent of the amount reported plus 0.03 percent absolute). Accuracies for the gamma-ray technique are generally equal to precision except where relative proportions of uranium, thorium and potassium deviate markedly from normal (approximately by more than a factor of 10) in which case accuracy for the element with relatively low abundance is decreased. Because of the large sample, this technique provides measurements that are less susceptible to splitting errors that can produce anomalous results for trace-element contents in coarse-grained rocks, and therefore, eTh and eK are used in preference to Th and K for radioelement ratios and statistical calculations (tables 2, 3, 4, and 5).

Concentrations for rubidium (Rb), strontium (Sr), yttrium (Y), niobium (Nb), and zirconium (Zr) were determined by X-ray fluorescence (XRF) on loose, finely ground (minus-200 mesh) sample powders (table 2). Precision, as determined from replicate analyses, is 10.5 percent for Zr, 25.8 percent for Y, and 42.9 percent for Nb at the concentration levels found for most of the samples used in the current study. Comparison of XRF and isotope-dilution results for Rb and Sr shows that precision and accuracy are equal and that for concentrations >50 ppm results are precise to within 3.2 and 3.4 percent (2 sigma) of the amount reported, respectively. Errors for both elements increase to 100 percent at a concentration of about 5 ppm.

Normative mineralogy was calculated according to the methods described by Stuckless and VanTrump (1979). Statistical methods and formulae used are described by VanTrump and Miesch (1977). Trace-element contents of most geological materials tend to follow log-normal distributions (Ahrens, 1957), and therefore, means and standard deviations for trace-element contents were calculated from the logarithms of the data and are reported as antilog values (tables 3 and 4).

## RESULTS AND DISCUSSION

Major and trace-element data are reported for 179 samples in tables 1 and 2, and a statistical summary of the data and data for an average granite are presented in table 3. One sample (155700) was collected from a young gabbroic intrusion, and results for this sample are not included in the statistical analyses or in the data plots. The general locations of plutons sampled is shown on figure 1; the latitude and longitude for individual samples is given in table 2. Not all of the postorogenic granitic plutons within the study area were sampled owing to restrictions imposed by time and logistical considerations. In two cases, suitable material could not be found. These granites exhibited only low relief and were partially covered by Cenozoic basalts. Nonetheless, all of the major plutons were sampled, and coverage of the area is excellent for a reconnaissance survey.

The postorogenic rocks of the eastern Arabian Shield exhibit a wide range in degree of alumina saturation (Stuckless and others, 1982; 1983; 1985), and a similar range in alumina saturation is present for granitic rocks of the southwestern Arabian Shield (table 2). Four of the sampled plutons (Jabal An, Jabal Kor, Jabal Taweel, and Jabal Amoudah) contain peralkaline rocks. In addition, Schmidt (1980a) notes that the central part of Jabal Khashmadheeb and small plug about 20 km southeast of Al Mu'taridah (fig. 1) are also peralkaline, but these areas were not sampled as part of the current study. Only seven samples are truly peralkaline, and thus they were not treated statistically as a separate subset of the data.

All of the known peralkaline rocks within the study area, except Jabal An, lie along a north-south trend of peralkaline plutonism which was originally described by Stoeser and Elliott (1980). Samples from all of the postorogenic plutons along this trend are hypersolvus alkali feldspar granites. Within the eastern part of the study area, Schmidt (1980a and b) suggests that all of the alkali feldspar granites are the youngest plutonic rocks. The pluton at Jabal An is spatially separated from the main trend of peralkaline rocks within the Arabian Shield, and its trachytic texture is also unique. Gonzalez (1973) reports a whole-rock K-Ar age for Jabal An of 21.6±3.5 Ma, but the sample locality is not documented, and the technique and sample medium provide data of questionable validity given the proximity to the Tertiary basalt field.

Experimental and theoretical studies (Watson and Harrison, 1983) have shown that the saturation limit of zirconium is much higher in peralkaline rocks than in rocks that are saturated or over-saturated with respect to alumina. Peralkaline rocks from the study area show contents of zirconium that are high relative to most of the non-peralkaline samples (table 2), but in contrast to peralkaline rocks outside of the study area (Stuckless and others, 1984; 1985) the peralkaline samples from the study area (except for Jabal An) are not noticeably enriched in uranium, thorium, niobium, or rare-earth elements.

The lack of enrichment in rare-earth elements is indicated by low to normal levels of yttrium that is geochemically similar to the middle rare-earth elements (Felsche and Hermann, 1978). Samples from Jabal An are somewhat enriched in both yttrium and niobium, but are strongly depleted in uranium and thorium relative to average granite (tables 2 and 3). Figures 2 and 3 compare yttrium and niobium contents for plutons of the southwestern Arabian Shield with the mean and standard deviation of these elements in postorogenic granites of the eastern Arabian Shield. The results show that none of the plutons have average yttrium contents that exceed the mean by more than one standard deviation, although the silicic phase at Jabal Qunnah, which is represented by only one sample (155642, table 2), is nearly that enriched in yttrium. This same sample is the only sample that has an anomalous abundance of niobium (fig. 3). Between one-half and one-third of the plutons have anomalously low average contents of yttrium or niobium or both.

In contrast to rocks of the eastern Arabian Shield, the postorogenic plutons of the southwestern Arabian Shield exhibit a wide range in degree of silica saturation. Most samples contain from 25 to 35 percent normative quartz, but two samples contain normative nepheline and a total of 29 samples contain less than 20 percent normative quartz. Seven of the sampled plutons contain rocks of syenitic affinity (Al Ajarda, Hawil, Jabal Asbah, Jabal Qunnah, Jabal An, Jabal Burgatinah, and Jazirah). The first five of these plutons lie along a nearly north-south trend that can be extended through three more syenitic plutons south of the study area (Overstreet and others, 1984) and through five mafic syenites in the southernmost part of Saudi Arabia (Sable, 1986).

Several of the syenitic plutons vary from mafic to silicic in composition: Al Ajarda (Stoeser, 1985), Hawil (Green and Gonzalez, 1980), Jizarah (Greenwood, 1979), and Jabal Qunnah (samples 642 through 644, table 1). Samples collected during the current study show that only Jabal An is peralkaline as well as silica undersaturated, but Stoeser (1985) reports that the rim phase of Al Ajarda is aegirine-bearing which would indicate a peralkaline composition. Several of the syenitic samples show elevated contents of zirconium (Hawil, Jabal An, Jabal Asbah, Jazirah, and Jabal Burgatinah) which would be consistent with a peralkaline affinity. All of the syenitic plutons are markedly depleted in radioelements relative to average granite, and only Jabal An and Jabal Burgatinah show any enrichment in yttrium or niobium (table 3), but average values for these plutons are not anomalous when compared to values obtained in the eastern Arabian Shield (figs. 2 and 3).

Reported ages for the syenitic rocks are all Late Precambrian to Early Cambrian (Greenwood, 1975b; Fleck and others, 1976; Green and Gonzalez, 1980); however, the data provide only minimum ages because only K-Ar and Rb-Sr mineral ages are available, and these probably have been at least partially reset by an Early Cambrian heating event (Fleck and others, 1976). Geologic relationships generally support a late, postorogenic time for intrusion; however, the syenite at Jazirah is mapped as older cone sheets (Greenwood, 1979), but without reference to orogenic timing.

The postorogenic plutons of the eastern Arabian Shield exhibit a very high degree of petrologic evolution as indicated by generally high differentiation indices, low contents of compatible trace elements, and high contents of incompatible trace elements (Stuckless and others, 1982; 1983; 1985). Highly evolved igneous rocks can be derived by 1) a low degree of partial melting, 2) a large amount of fractional crystallization, 3) melting of an evolved source material, or 4) any combination of these mechanisms. Stuckless and others (1986) have argued, on the basis of trace-element data, that the postorogenic plutons reflect, in large part, the degree of evolution of the protolith for the intrusive rocks, and that the degree of evolution of the protolith beneath the eastern Arabian Shield increases from west to east.

Current interpretations for the genesis of the southwestern Arabian Shield indicate that the study area is underlain by primitive island-arc materials (Greenwood and others, 1982; Stoeser and Camp, 1985) that, for moderate to large degrees of partial melting, would give rise to unevolved granitic rocks. Differentiation indices for samples from the southwestern Arabian Shield are generally lower than those for samples from the eastern Arabian Shield. Only 54 percent of the differentiation indices for samples used in the current study are greater than 90 as opposed to 73 percent greater than 90 for the east-central shield (Stuckless and others, 1985) or 86 percent greater than 90 for the southeastern Arabian Shield (Stuckless and others, 1983). There is a tendency for differentiation indices to increase from west to east across the study area, but the dividing line between more and less evolved samples seems to be oriented along a northwesterly trend (fig. 4). This trend contrasts sharply with the northerly trend of belts noted by Greenwood and others (1982) and with northerly and northeasterly trends proposed by Stoeser and Camp (1985).

Stuckless and others (1985) compiled chemical data for postorogenic pluton of the Arabian Shield that were known to be anomalously metalliferous (table 4a).

Relative to data for plutons of the southwestern Arabian Shield, the anomalous plutons are much more evolved as indicated by their higher contents of incompatible elements (U, Th, Rb, Y, and Nb) and their lower contents of compatible elements (Fe, Mg, Ca, Ti, and Sr). Data for the anomalously metalliferous plutons tend to cluster along the water-saturated polybaric miminum of the haplogranite system (fig. 5), whereas data for the southwestern plutons plot over a wide area and commonly below the polybaric minimum in as area typified by water undersaturation (Luth, 1969). In the normative feldspar system, the data for the anomalous plutons plot along the 2kb water-saturated eutectic (fig. 6), whereas data for samples from the southwestern Arabian Shield plot throughout the diagram, which would be consistent with either high pressure or water undersaturation (Whitney, 1975).

Overstreet and others (1984) concluded that syenitic samples collected south of the study area had very little economic potential. Separating the syenitic samples from the rest of those collected for the current study shows that they are the least evolved postorogenic rocks in the southwestern Shield (table 4b). The syenitic samples have higher contents of compatible elements, lower contents of incompatible elements, and are markedly depleted in radioelements.

Uranium is generally enriched in postorogenic samples from the eastern Arabian Shield (Stuckless and others, Stuckless, VanTrump, and others, 1982; 1983; and 1985) relative to a world-average granite (Stuckless and VanTrump, 1982). Figure 7 shows that only five of the plutons sampled for the current study have average uranium contents that exceed the world-average value by more than one standard deviation, and that eleven plutons have average uranium contents that is more than one standard deviation below the world-average value. Thus the uranium concentration data give no indication of favorable conditions for the development of igneous-related uranium deposits.

Stuckless and Ferreira (1976) have shown that low uranium contents in granites can be due to loss of uranium and subsequent reconcentration of leached uranium in low-temperature deposits. If the loss of uranium was recent (within the last 100,000 years), uranium (U) and radium equivalent uranium (RaeU) values should be markedly different such that the average RaeU/U deviates from unity by more than 10 percent. The average RaeU/U for samples from the southwestern Arabian Shield is $0.94 \pm 0.27$. The relatively large error for the ratio might be attributed to the large errors in both measurements at low concentrations. Elimination of the 22 samples that contain less than 1 ppm uranium does decrease the error. The value for 156 samples is $0.91 \pm 0.19$, which is further from equilibrium, and the error is still large.

Uranium and radium equivalent uranium are well correlated for both the entire data set and for subsets of syenitic and non-syenitic samples (table 5). This fact plus the fact that the average ratio is close to unity suggests that most samples have not lost uranium recently. However, the moderately low average RaeU/U and large error suggest that some samples may have recently experienced mobility of uranium of its daughter products. Inspection of table 2 shows several plutons for which the average RaeU/U is less than 0.9 (Jabal Balas, Al Mu'taridah, Jabal Rafa, Wadi Shumas, Jabal Khashmadheed, Jabal al Jafar, and an unnamed pluton north of Jabal Harub). All of these plutons have lost radium equivalent uranium relative to uranium and are therefore potential candidates for providing uranium to the surrounding sediments.

Most of the thorium contents for postorogenic samples of the eastern Arabian Shield are within one standard deviation of the world average for granitic rocks (Stuckless and others, 1982; 1983; and 1985). The average thorium value for samples from the study area is more than one standard deviation below the world-average value (table 3), and most postorogenic plutons in the southwestern Arabian Shield have average values that are anomalously low (fig. 8). Thus as with uranium, there is little favorability indicated for as igneous-type thorium deposit.

Thorium is not as readily leached from granites as is uranium (Zielinski and others, 1981). Therefore, if low uranium values or disequilibrium between uranium and radium equivalent uranium in granite are due to loss of uranium, the Th/U values should be anomalously large, and uranium and thorium should be poorly correlated. However, the uranium and thorium are well correlated for both the entire data set and for subsets of syenitic and non-syenitic samples (table 5), the Th/U values are generally low (fig. 9) and do not suggest any loss of uranium since the time of intrusion. Therefore, the seven plutons that show disequilibrium within the uranium decay chain are best interpreted as having recently lost daughter products with little or no uranium mobility.

Th/U values in the eastern Arabian Shield, like those in the study area, are generally normal to low relative to world-average granite, and thus these granites probably were enriched in uranium relative to thorium at the time of crystallization and have not lost uranium since that time (Stuckless and others, 1982; 1983; and 1985). The data suggest that all the protolith for the postorogenic granites had a common feature of thorium enrichment relative to uranium regardless of the absolute amounts of radioelements; however, isotopic data indicate a slightly more complex interpretation (Stacey and Stoeser, 1984).

Values for both uranogenic and thorogenic lead in rocks from most of the Arabian Shield are unradiogenic relative to values along an average orogene growth curve (Stacey and Stoeser, 1984). Data for samples from along the eastern edge of the Arabian Shield reflect an elevated Th/U value in the protolith that must have existed for a significant period of geologic time. The uranium enrichment in the rest of the protolith for the postorogenic granites is a feature that developed shortly before intrusion of the plutons.

The relative proportions of radioelements in the anomalously metalliferous plutons (Stuckless and others, 1985) forms a fairly restricted field on a ternary diagram (fig. 10). Relative to average granite, the data show a general enrichment of uranium and thorium relative to potassium, and a preferential enrichment of uranium relative to thorium. Few data from the southwestern Arabian Shield plot within this same field, and in fact, most samples are depleted in uranium and thorium relative to potassium. Thus the radioelement data do not indicate either favorability for radioactive element deposits or favorability for tin or tungsten mineralization (which were present in the samples used to define the anomalous granites).

The difference in degree of petrologic evolution between the postorogenic plutons of the southwestern Arabian Shield and that of the metalliferous plutons (Stuckless and others, 1985) is clearly evident in the K-Rb-Sr data (fig. 11). Compared to the plutons of the southwestern Arabian Shield, the metalliferous plutons are strongly depleted in strontium and enriched in rubidium relative to potassium. The relationship of these three elements in the metalliferous granites is evidence of an extreme degree of magmatic evolution. Conversely, about half of the data for the granites of the southwestern Arabian Shield plot in an area of very low degree of magmatic evolution (the right half of the triangle).

The generally low degree of magmatic evolution for the postorogenic plutons of the southwestern Arabian Shield continues a trend of westward decrease in degree of magmatic evolution noted by Stuckless and others (1984). The easternmost exposures of postorogenic granite have very high Rb/Sr values and extremely low K/Rb values (figs. 12 and 13). The data for the plutons of the southwestern Arabian Shield alone are consistent with derivation from an unevolved source material such as an accreted island-arc terrane as proposed by Stoeser and Camp (1985). However, the degree of evolution does not change as a function of derivation from the Asir Terrane or the Nabitah orogenic belt. Furthermore, north of the study area, values seem to grade from high to low rather than changing abruptly along plate boundaries (Stuckless and others, 1984). Thus a gradational protolith of evolved continental affinity to the east and of oceanic affinity to the west seems to provide a better explanation for the observed geochemical patterns.

The postorogenic plutons of the southwestern Arabian Shield seem to form a geochemically coherent group as indicated by good positive correlations between pairs of compatible elements (for example, calcium and strontium) or pairs of incompatible elements (for example, potassium and rubidium) and a good negative correlations between compatible and incompatible elements (for example, silica and iron, magnesium, calcium, or titanium, table 5). Major-element correlations for samples from plutons that for reasons of areal extent cannot be comagmatic, can be explained by derivation and differentiation under similar physical conditions, and thus such correlations do not require a geochemically coherent source region. Trace-element concentrations in the starting magmas reflect protolith mineralogy and degree of partial melting. A coherent behavior of trace elements over a large area is most consistent with a fairly uniform (or at least gradational between two end-members) source region as opposed to a source region composed of unrelated blocks.

## SUMMARY

The postorogenic rocks of the southwestern Arabian Shield are very primitive by comparison with the metalliferous plutons of the eastern Arabian Shield. This is true for syenitic, peralkaline, and peraluminous through metaluminous samples. There is no indication of favorability for ore deposits that form from end-stage magmatic processes such as the deposits of tin or tungsten that are reported in the eastern Arabian Shield (Cole and others, 1981; du Bray, 1984). There is also no indication of favorability for igneous deposits of rare-earths or radioelements, because elsewhere in the Arabian Shield, these have formed at the end stage of magmatic activity (Harris and Marriner, 1980; Stuckless, Quick, and VanTrump, 1984; Drysdall and others, 1984). The close correspondence of uranium and radium equivalent uranium and of uranium and thorium argue against secondary accumulations of uranium leached from granite. The lower than normal concentrations of radioelements, relative to the eastern Arabian Shield seems to be a primary feature that is related to a less evolved protolith.

Areal distributions of average values of chemical data within the study area and for the southwestern and eastern Arabian Shield do not show sharp boundaries as might be expected if the Arabian Shield were made up of discrete and unrelated plates. In fact, there are no changes in values near the some of the boundaries proposed by Stoeser and Camp (1985), and some chemical patterns run at angles to proposed boundaries. There are some features, such as a protolith that is generally enriched in uranium relative to thorium, that seem to persist throughout the Shield. Thus, the chemical data seem to fit best with a gradational protolith that is of continental affinity to the east and of oceanic affinity to the west as proposed by Stuckless, Hedge, and others (1984).

## DATA STORAGE

### *DATA FILE*

All data acquired during this study are presented in this paper, and no base data files were established.

### *MINERAL OCCURRENCE DOCUMENTATION SYSTEM (MODS)*

No MODS entries were made as a result of the work described in this report since the results and conclusions are regional in scope and have no bearing on specific localities.

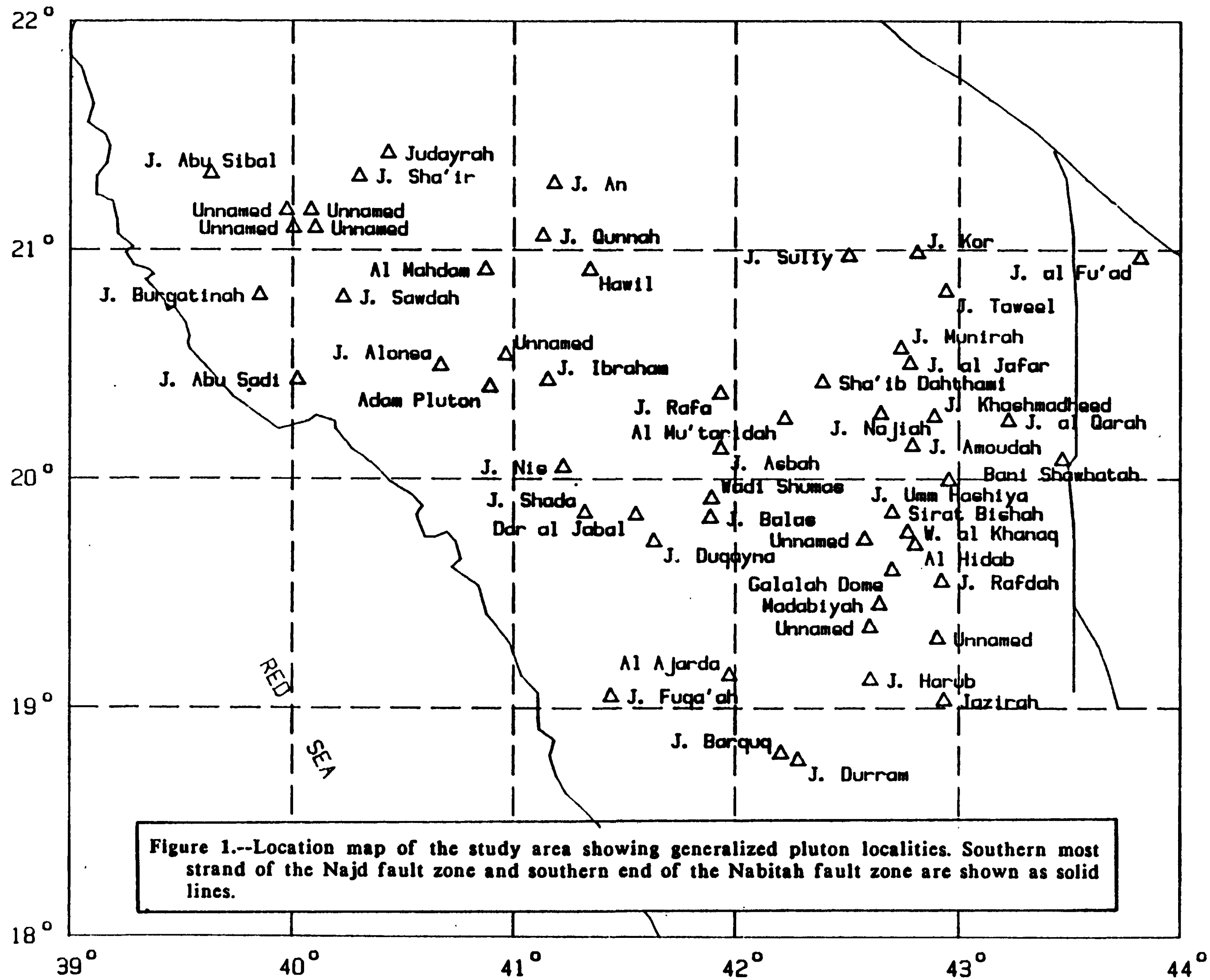



Figure 1.--Location map of the study area showing generalized pluton localities. Southern most strand of the Najd fault zone and southern end of the Nabitah fault zone are shown as solid lines.

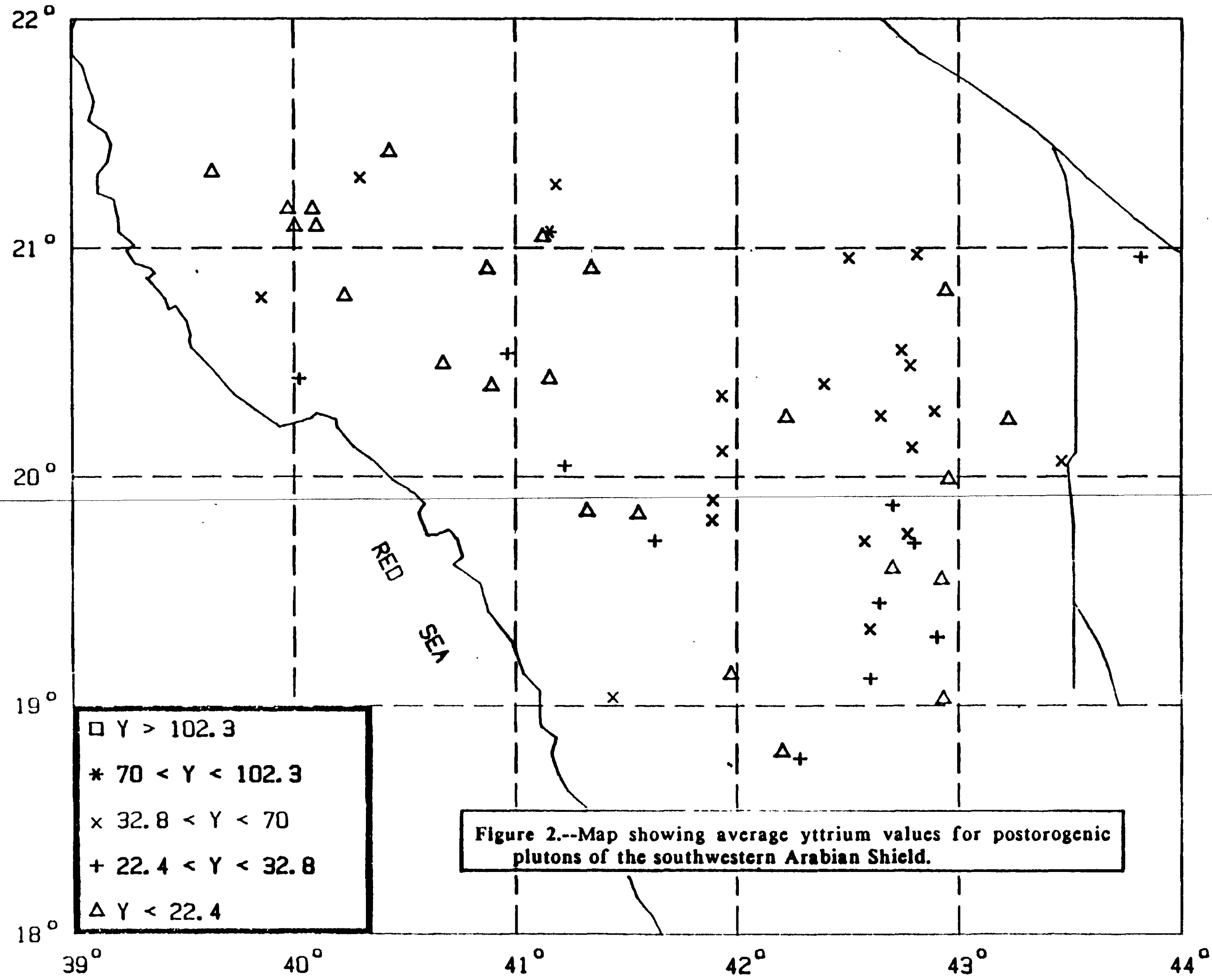



Figure 2.--Map showing average yttrium values for postorogenic plutons of the southwestern Arabian Shield.

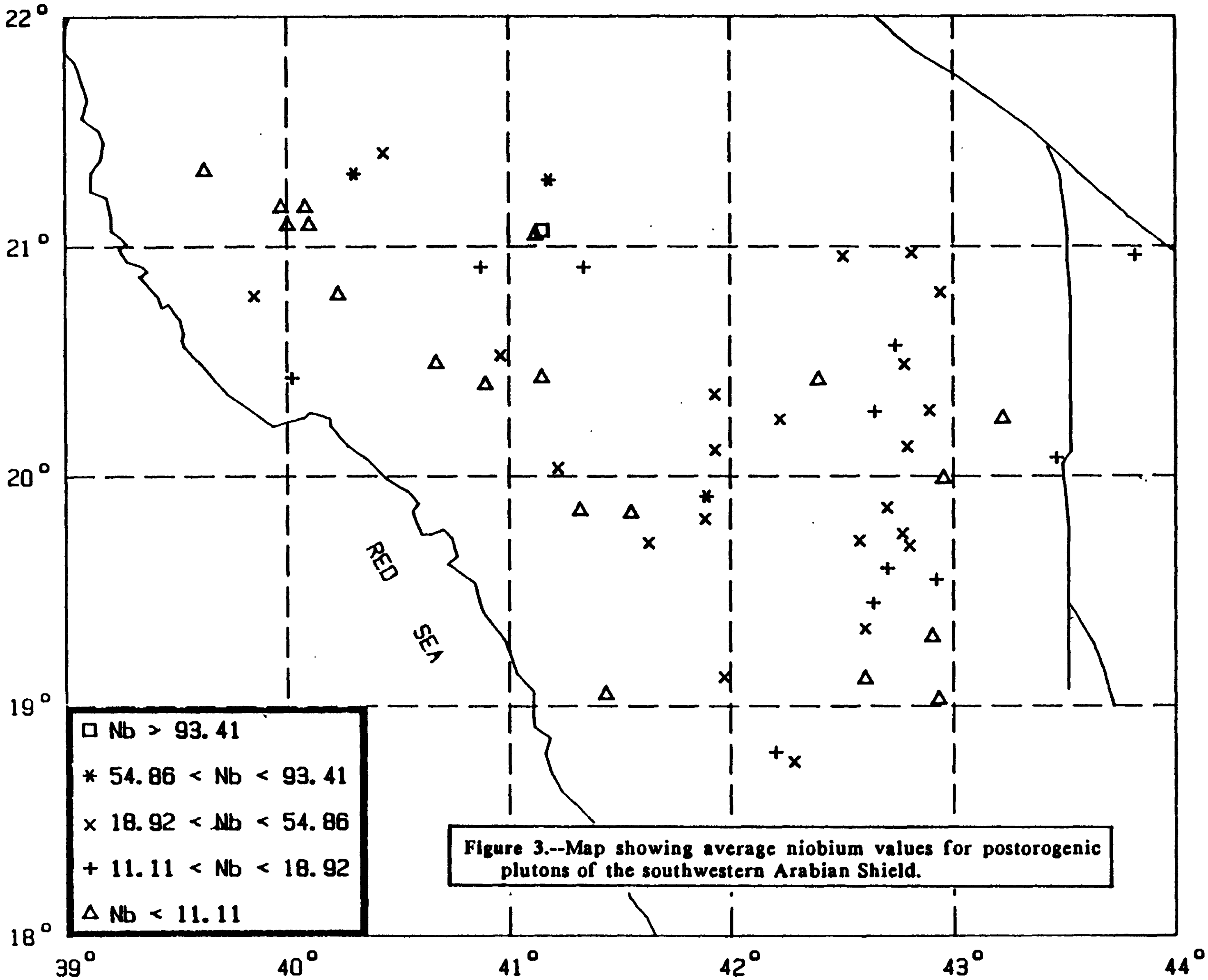



**Figure 3.--Map showing average niobium values for postorogenic plutons of the southwestern Arabian Shield.**

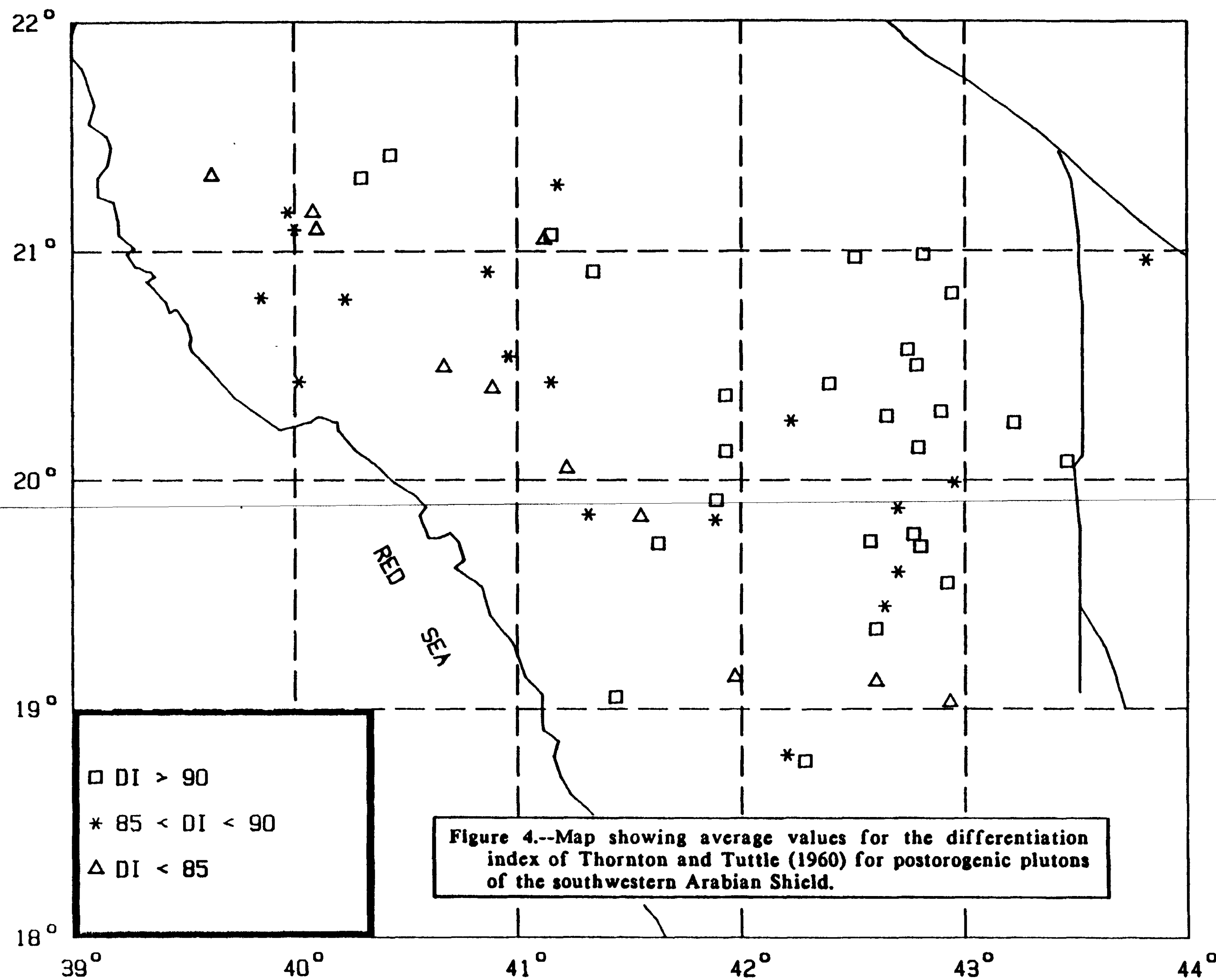



Figure 4.--Map showing average values for the differentiation index of Thornton and Tuttle (1960) for postorogenic plutons of the southwestern Arabian Shield.

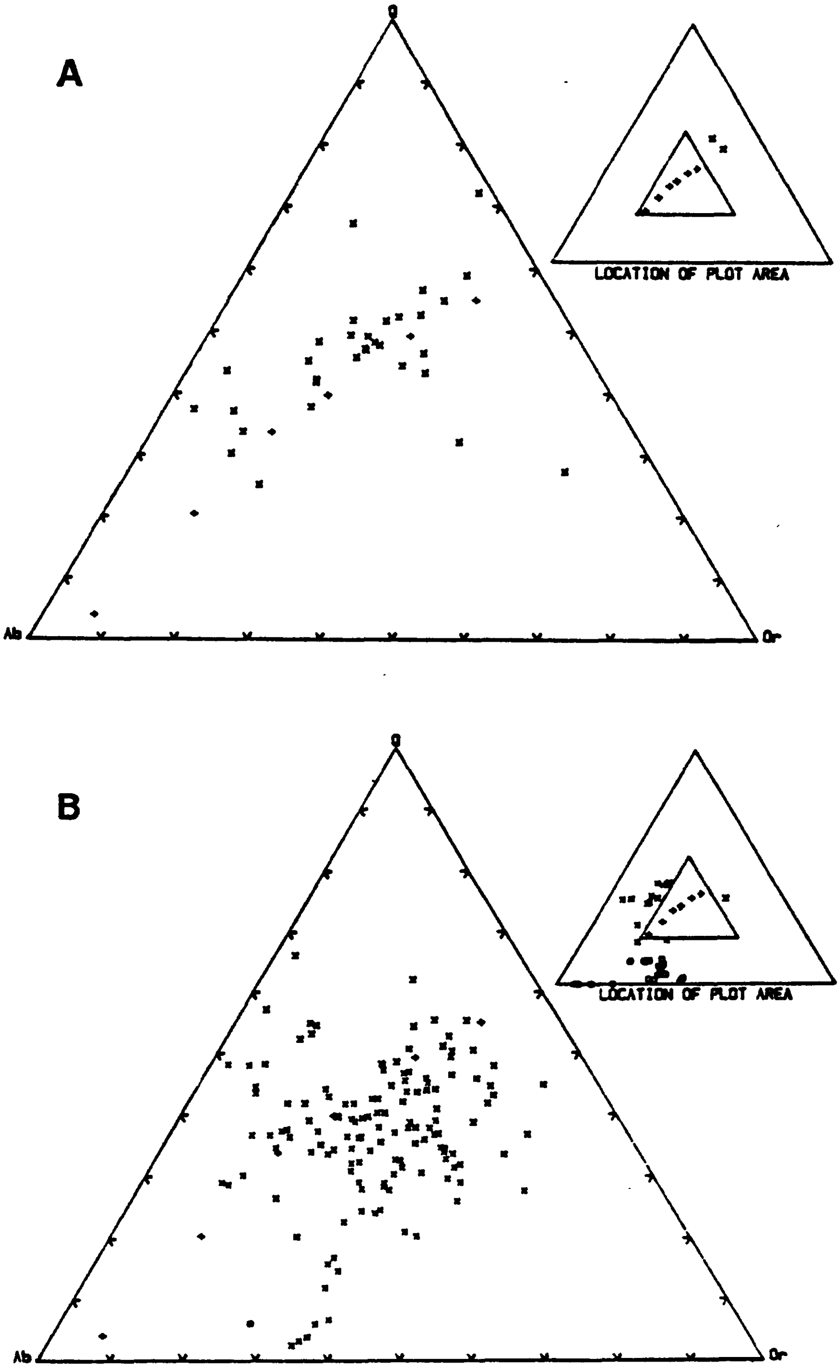
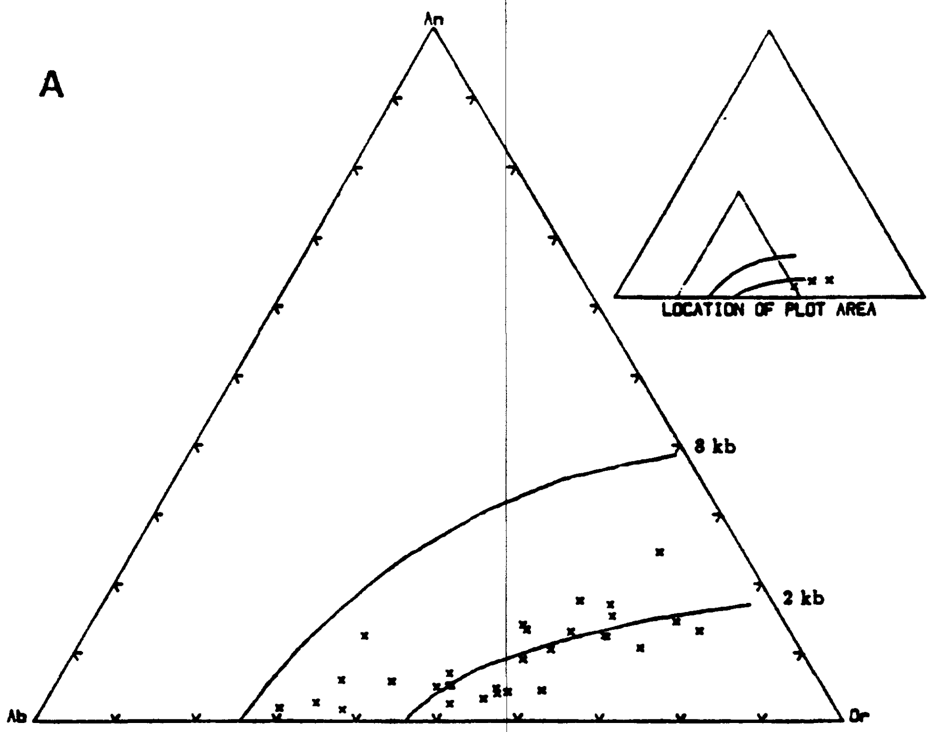



**Figure** 5.--Ternary diagram showing the normative composition of anomalously metalliferous samples (A) and postorogenic samples from the southwestern Arabian Shield (B) and the polybaric ternary minimum (delineated by pluses) in the system Q-Ab-Or (Tuttle and Bowen, 1958; Luth and others, 1964). Insets show the expanded portion of the diagram as well as data points that plot outside the expanded portion. Syenitic samples are shown by squares, all others by x's.



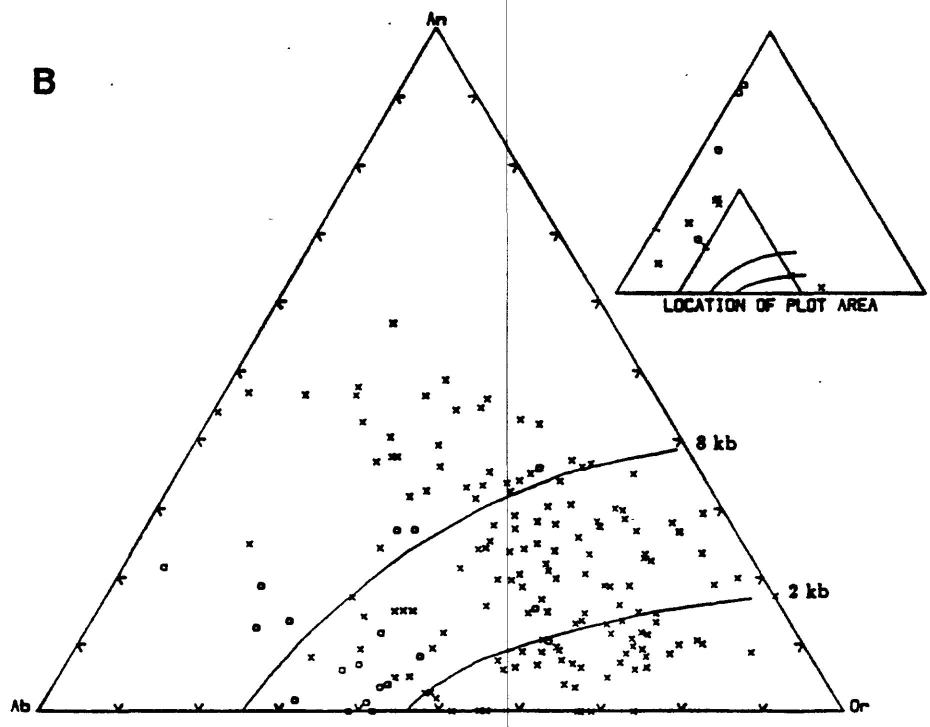




**Figure 6.**--Ternary diagram showing the normative composition of anomalously metalliferous samples (A) and postorogenic samples from the southwestern Arabian Shield (B) and the water-saturated eutectic compositions at 2 and 8 kb (Whitney, 1975). Insets show the expanded portion of the diagram as well as data points that plot outside the expanded portion. Syenitic samples are shown by squares, others by x's.

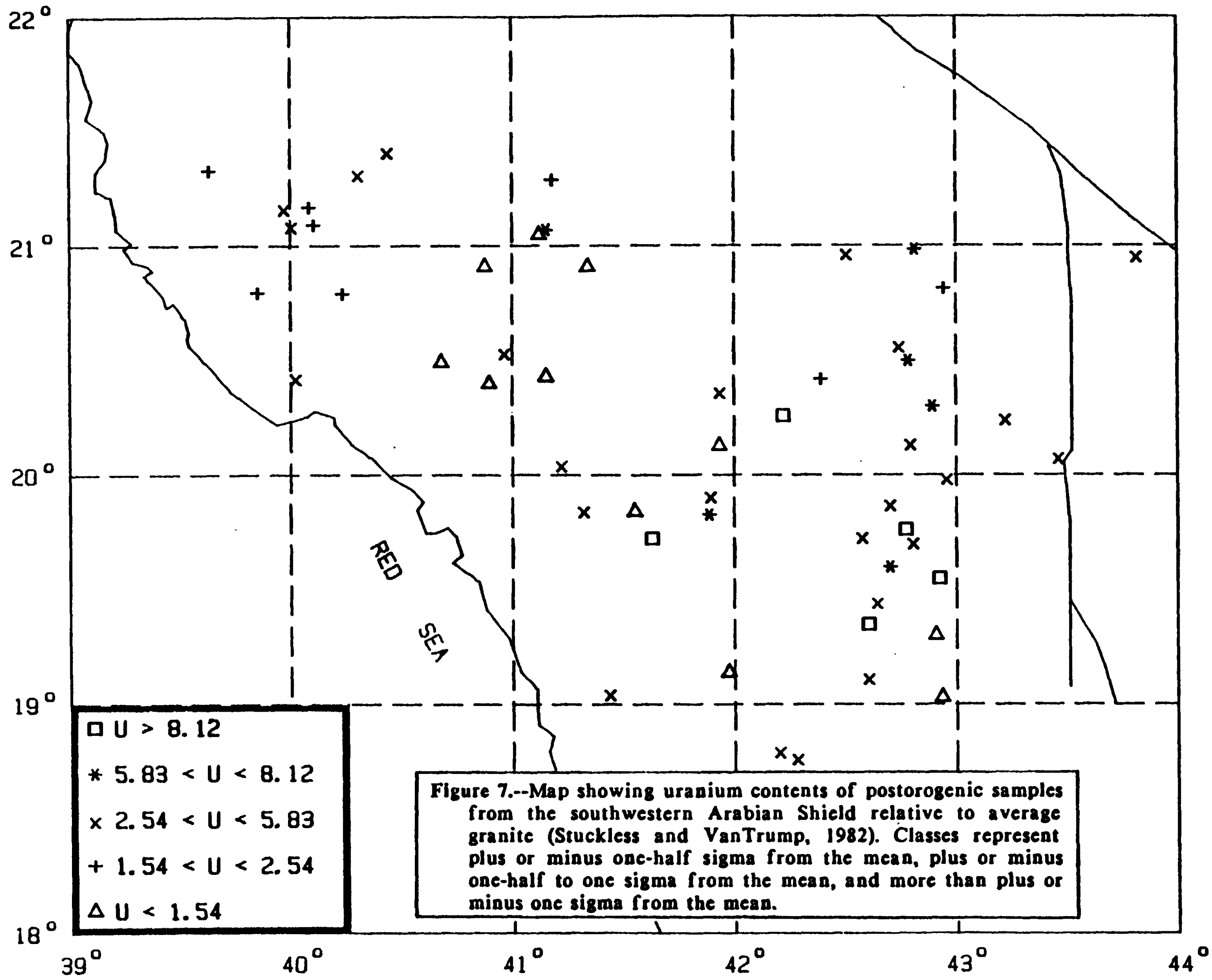



**Figure 7.**--Map showing uranium contents of postorogenic samples from the southwestern Arabian Shield relative to average granite (Stuckless and VanTrump, 1982). Classes represent plus or minus one-half sigma from the mean, plus or minus one-half to one sigma from the mean, and more than plus or minus one sigma from the mean.

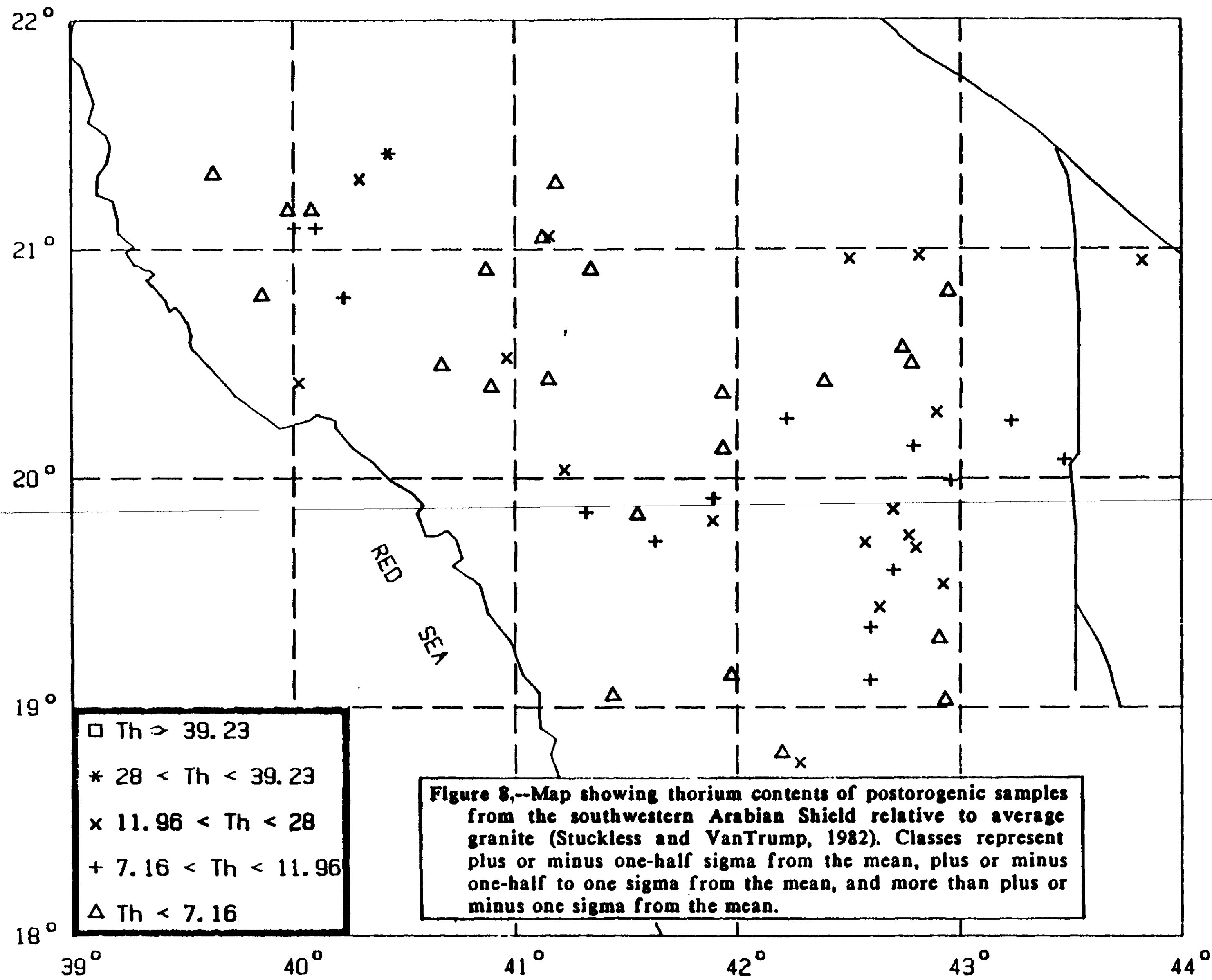



**Figure 8**.--Map showing thorium contents of postorogenic samples from the southwestern Arabian Shield relative to average granite (Stuckless and VanTrump, 1982). Classes represent plus or minus one-half sigma from the mean, plus or minus one-half to one sigma from the mean, and more than plus or minus one sigma from the mean.

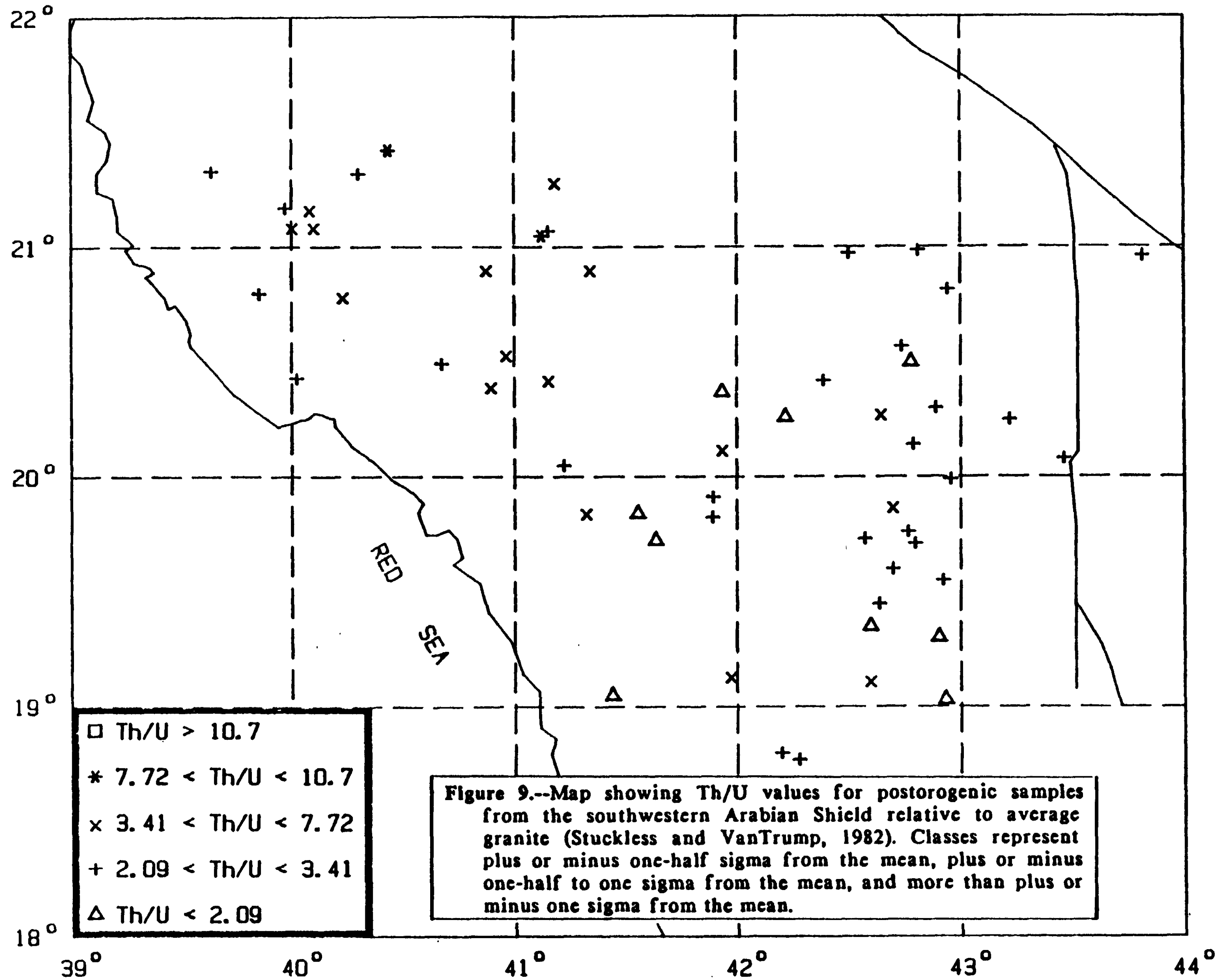



**Figure 9.**--Map showing Th/U values for postorogenic samples from the southwestern Arabian Shield relative to average granite (Stuckless and VanTrump, 1982). Classes represent plus or minus one-half sigma from the mean, plus or minus one-half to one sigma from the mean, and more than plus or minus one sigma from the mean.

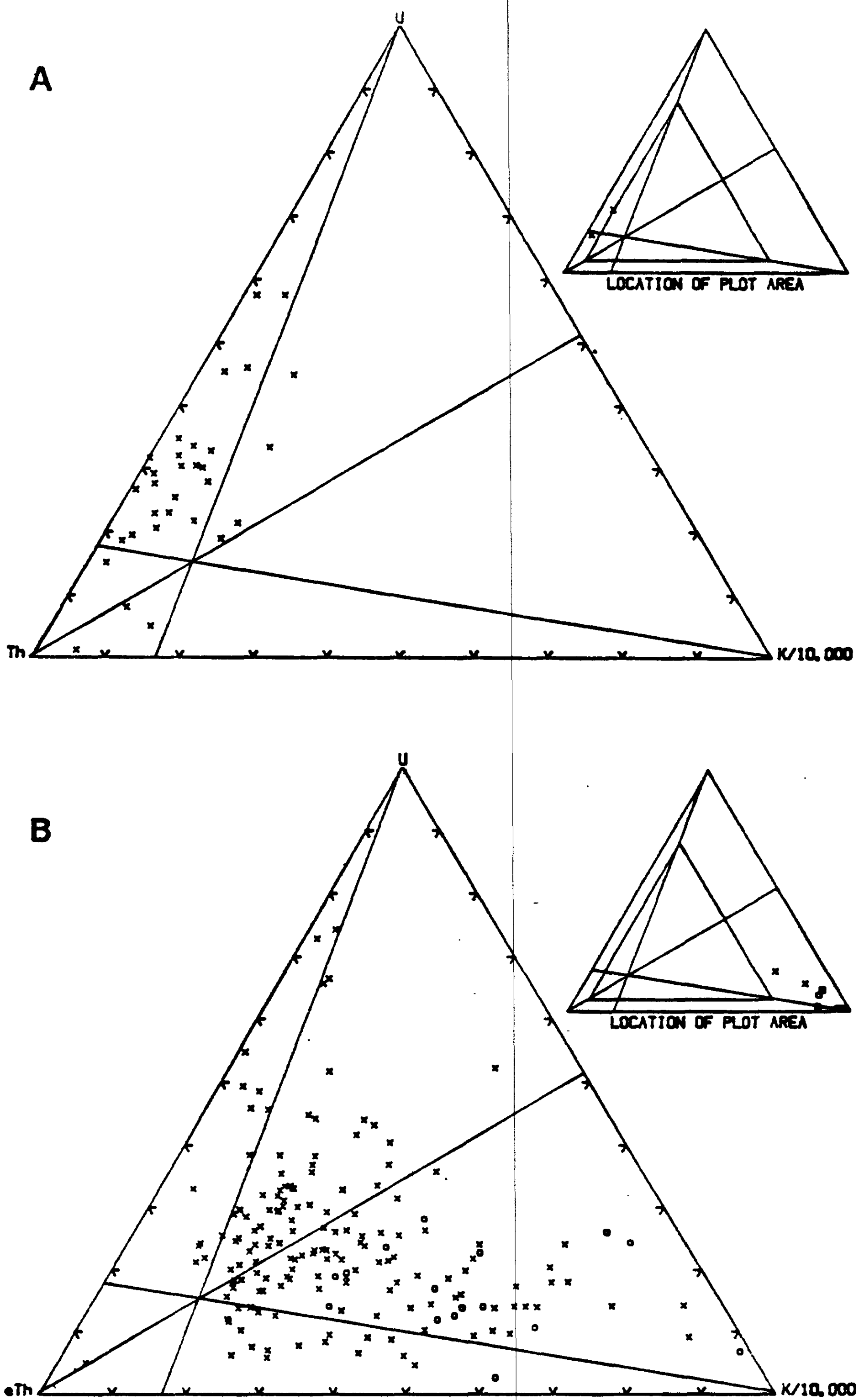



**Figure 10.**--Ternary diagram showing relative proportions of uranium, thorium, and potassium relative to average granite (Stuckless and VanTrump, 1982) for anomalously metalliferous granites (A) and postorogenic samples from the southwestern Arabian Shield (B). Insets show the expanded portion of the diagram as well as data points that plot outside the expanded portion. Syenitic samples are indicated by squares.

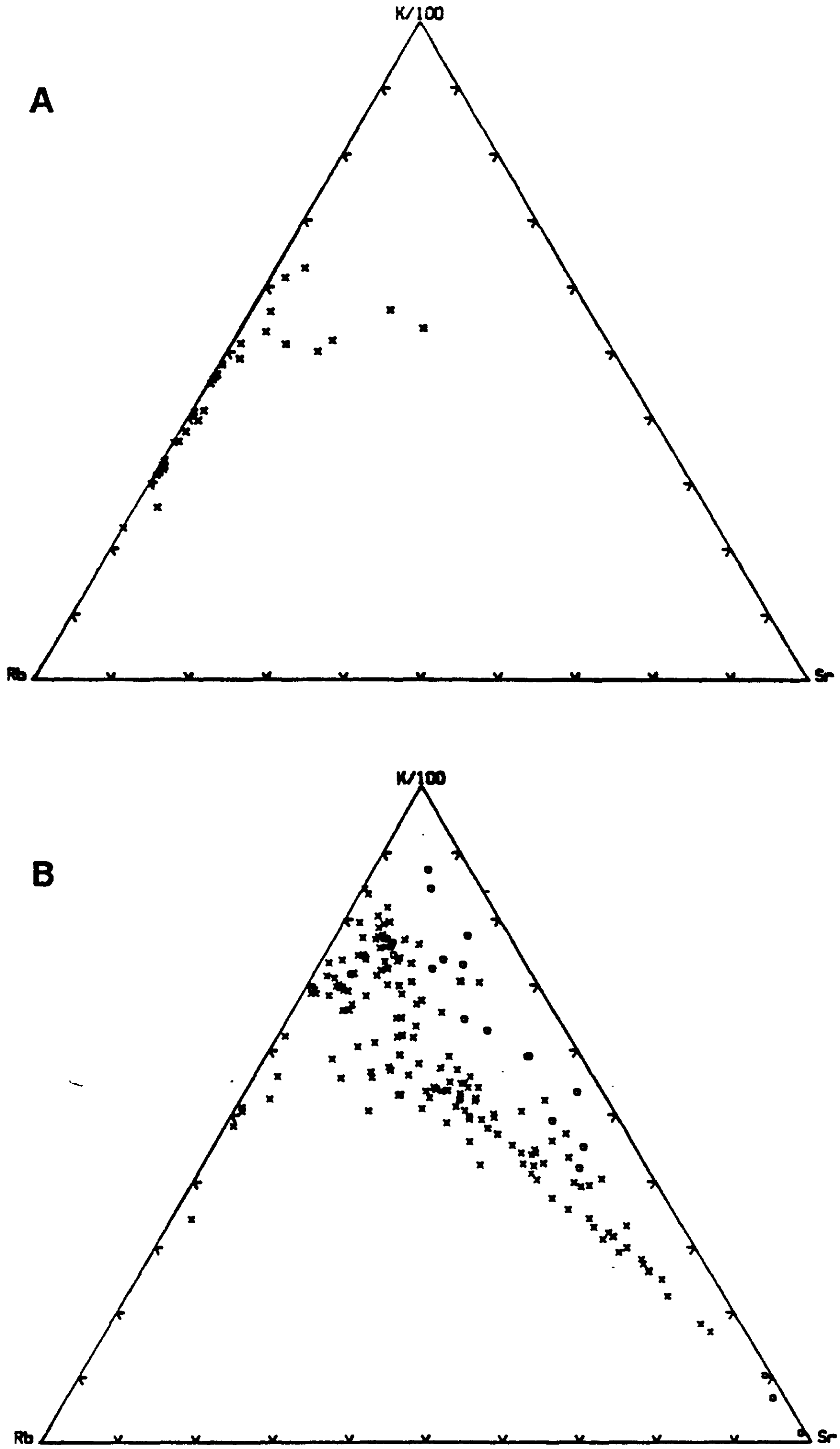



Figure 11.--Ternary diagram showing relative proportions of potassium, rubidium, and strontium for anomalously metalliferous samples (A) and postorogenic samples from the southwestern Arabian Shield (B). Syenitic samples are indicated by squares.

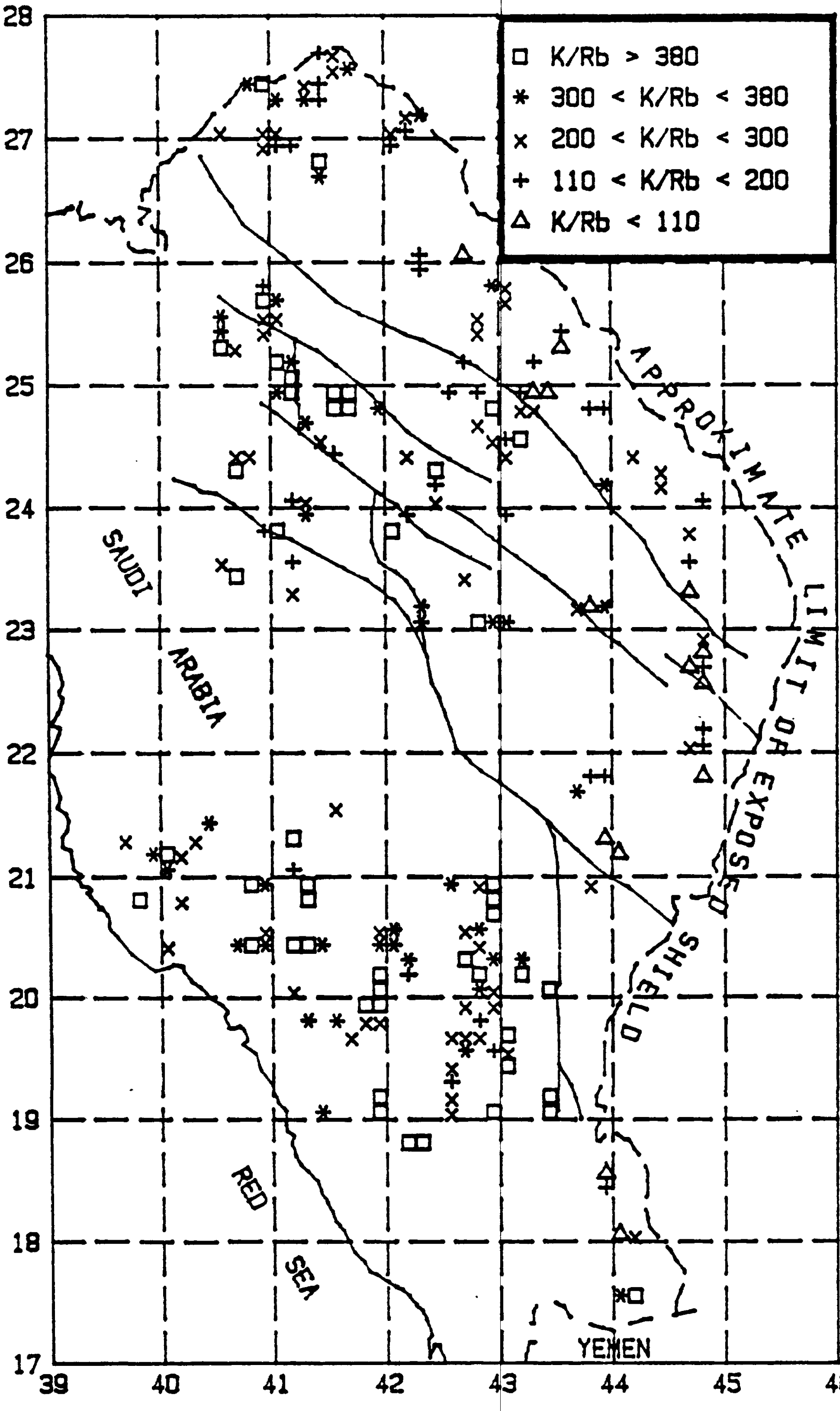



**Figure 12.**--Map showing the distribution of K/Rb values for postorogenic samples from the Arabian Shield averaged within 7-1/2 minute quadrangle areas. Data sources are Stuckless and others (1982; 1983; 1985) and this report.

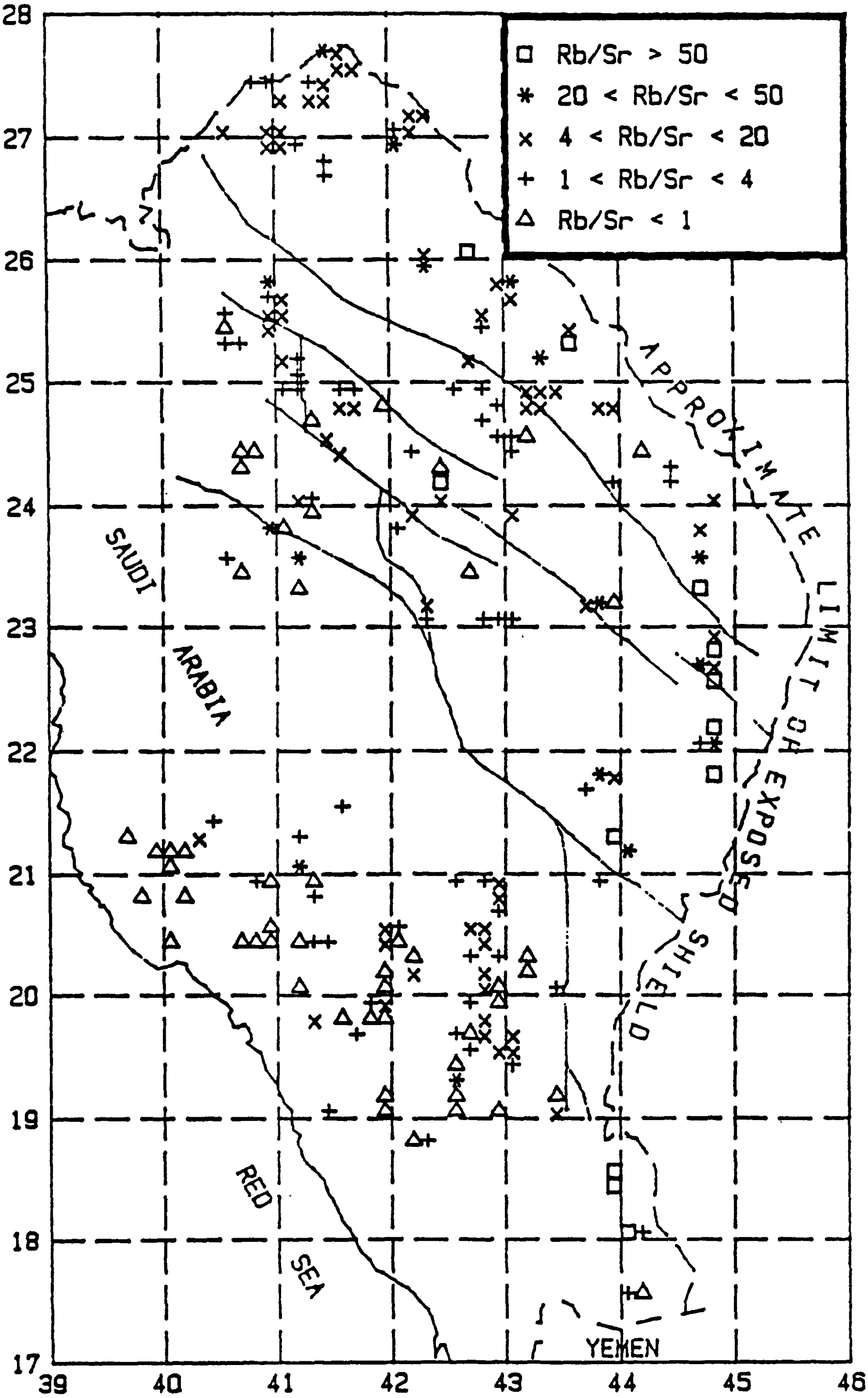



**Figure 13.**--Map showing the distribution of Rb/Sr values for postorogenic samples from the Arabian Shield averaged within 7-1/2 minute quadrangle areas. Data sources are Stuckless and others (1982; 1983; 1985) and this report.

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield.

[Analyses reported in weight percent. D. I. is differentiation index of Thornton and Tuttle (1960). $Fe_2O_3$ and FeO calculated from total iron assuming 2/3 of the iron is present as FeO. LOI is loss on ignition at 920°C. Analyst, A. J. Bartel].

| SAMPLE | 155575 | 155576 | 155577 | 155578 | 155579 | 155580 | 155581 | 155582 | 155583 | 155584 | 155585 | 155586 | 155587 | 155588 | 155589 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 70.79 | 70.64 | 69.49 | 71.54 | 76.27 | 74.2 | 73.89 | 76.27 | 69.38 | 72.58 | 71.94 | 65.93 | 70.12 | 70 | 74.28 |
| Al2O3 | 14.14 | 14.52 | 14.36 | 14.33 | 13.35 | 13.25 | 13.54 | 12.46 | 15.36 | 14.5 | 14.65 | 15.98 | 15.68 | 15.55 | 13.49 |
| Fe2O3 | 1.04 | .79 | 1.11 | .71 | .2 | .4 | .44 | .34 | .92 | .43 | .59 | 1.26 | .57 | .59 | .48 |
| FeO | 1.82 | 1.38 | 1.94 | 1.25 | .36 | .7 | .78 | .6 | 1.61 | .76 | 1.03 | 2.2 | .99 | 1.03 | .85 |
| MgO | .58 | .44 | .61 | .39 | .05 | .16 | .14 | .13 | .67 | .23 | .31 | .96 | .59 | .64 | .21 |
| CaO | 1.86 | 1.8 | 2.2 | 1.58 | .39 | .72 | .65 | .35 | 1.51 | 1.14 | 1.19 | 2.37 | 2.17 | 2.2 | .9 |
| Na2O | 3.83 | 3.77 | 3.83 | 4.05 | 4.07 | 3.83 | 3.78 | 3.47 | 3.91 | 4.16 | 4.02 | 4.22 | 4.51 | 4.39 | 3.94 |
| K2O | 4.08 | 4.62 | 4.26 | 4.39 | 4.72 | 5.11 | 5.49 | 5.03 | 4.97 | 4.51 | 4.8 | 4.45 | 3.43 | 3.47 | 4.57 |
| LOI | .56 | .48 | .5 | .69 | .49 | .62 | .45 | .41 | .33 | .66 | .32 | .52 | .64 | .66 | 1.03 |
| TiO2 | .43 | .32 | .45 | .25 | .01 | .17 | .2 | .15 | .46 | .15 | .21 | .72 | .27 | .3 | .14 |
| P2O5 | .12 | .1 | .14 | .08 | .02 | .02 | .02 | .02 | .29 | .06 | .08 | .32 | .1 | .11 | .02 |
| MnO | .04 | .03 | .04 | .03 | .04 | .05 | .05 | .03 | .03 | .03 | .03 | .05 | .01 | .01 | .03 |
| Zr2O | .03 | .03 | .04 | .02 | .01 | .02 | .03 | .02 | .04 | .02 | .02 | .04 | .02 | .02 | .02 |
| TOTAL | 99.32 | 98.92 | 98.97 | 99.31 | 99.98 | 99.25 | 99.46 | 99.28 | 99.48 | 99.23 | 99.19 | 99.02 | 99.1 | 98.97 | 99.96 |
| NORM | | | | | | | | | | | | | | | |
| Q | 27.72 | 26.43 | 25.15 | 27 | 33.43 | 30.51 | 29.12 | 35.91 | 23.63 | 28.33 | 27.11 | 18.04 | 25.31 | 25.66 | 31.24 |
| C | .33 | .29 | --- | .24 | .88 | .16 | .25 | .72 | 1.51 | .85 | .88 | .69 | .85 | .84 | .47 |
| Z | .05 | .04 | .05 | .03 | .01 | .03 | .04 | .03 | .06 | .03 | .03 | .06 | .03 | .03 | .02 |
| OR | 24.27 | 27.6 | 25.44 | 26.12 | 27.9 | 30.42 | 32.62 | 29.94 | 29.52 | 26.86 | 28.6 | 26.56 | 20.45 | 20.72 | 27.02 |
| AB | 32.63 | 32.25 | 32.75 | 34.51 | 34.45 | 32.65 | 32.16 | 29.58 | 33.26 | 35.47 | 34.29 | 36.06 | 38.51 | 37.53 | 33.35 |
| AN | 8.5 | 8.37 | 9.51 | 7.37 | 1.8 | 3.47 | 3.11 | 1.62 | 5.63 | 5.3 | 5.42 | 9.76 | 10.2 | 10.3 | 4.34 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | .25 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EN | 1.45 | 1.11 | 1.54 | .98 | .12 | .4 | .35 | .33 | 1.68 | .58 | .78 | 2.41 | 1.48 | 1.61 | .52 |
| FS | 1.86 | 1.42 | 2 | 1.36 | .55 | .77 | .84 | .63 | 1.5 | .86 | 1.12 | 1.92 | .93 | .94 | .99 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | 1.52 | 1.16 | 1.63 | 1.04 | .29 | .58 | .64 | .5 | 1.34 | .63 | .86 | 1.84 | .83 | .86 | .7 |
| IL | .82 | .61 | .86 | .48 | .02 | .33 | .38 | .29 | .88 | .29 | .4 | 1.38 | .52 | .58 | .27 |
| AP | .29 | .24 | .34 | .19 | .05 | .05 | .05 | .05 | .69 | .14 | .19 | .77 | .24 | .26 | .05 |
| TOTAL | 99.44 | 99.52 | 99.5 | 99.31 | 99.51 | 99.38 | 99.55 | 99.59 | 99.68 | 99.34 | 99.68 | 99.49 | 99.36 | 99.34 | 98.97 |
| SALIC | 93.5 | 94.98 | 92.9 | 95.27 | 98.48 | 97.25 | 97.29 | 97.8 | 93.6 | 96.85 | 96.33 | 91.16 | 95.36 | 95.09 | 96.45 |
| FEMIC | 5.94 | 4.54 | 6.61 | 4.04 | 1.03 | 2.13 | 2.26 | 1.79 | 6.09 | 2.49 | 3.36 | 8.33 | 4 | 4.25 | 2.52 |
| D INDEX | 84.62 | 86.28 | 83.33 | 87.63 | 95.78 | 93.59 | 93.89 | 95.43 | 86.41 | 90.66 | 90 | 80.65 | 84.27 | 83.91 | 91.61 |
| DI | --- | --- | .5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIEN | --- | --- | .11 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIFS | --- | --- | .14 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIWO | --- | --- | .25 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HY | 3.31 | 2.53 | 3.28 | 2.34 | .68 | 1.17 | 1.19 | .96 | 3.18 | 1.43 | 1.9 | 4.34 | 2.41 | 2.55 | 1.51 |
| HYEN | 1.45 | 1.11 | 1.43 | .98 | .12 | .4 | .35 | .33 | 1.68 | .58 | .78 | 2.41 | 1.48 | 1.61 | .52 |
| HYFS | 1.86 | 1.42 | 1.86 | 1.36 | .55 | .77 | .84 | .63 | 1.5 | .86 | 1.12 | 1.92 | .93 | .94 | .99 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155591 | 155592 | 155593 | 155594 | 155595 | 155596 | 155597 | 155598 | 1555981 | 155599 | 155600 | 155601 | 155602 | 155603 | 155604 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 64.16 | 57.04 | 65.04 | 66.14 | 58.01 | 74.05 | 65.76 | 64.76 | 60.04 | 73.98 | 74.13 | 77.49 | 74.37 | 75.5 | 77.19 |
| Al2O3 | 17.08 | 16.17 | 18.39 | 18.98 | 20.12 | 13.13 | 16.05 | 16.35 | 16 | 13.38 | 13.45 | 11.3 | 12.37 | 11.86 | 11.35 |
| Fe2O3 | 1.4 | 2.13 | .75 | .21 | 1.3 | .58 | 1.49 | 1.5 | 2.3 | .39 | .39 | .56 | .75 | .73 | .55 |
| FeO | 2.45 | 3.72 | 1.31 | .38 | 2.27 | 1.01 | 2.6 | 2.63 | 4.02 | .68 | .68 | .99 | 1.31 | 1.28 | .97 |
| MgO | .54 | .64 | .24 | .05 | 1.27 | .24 | 2.27 | 2.33 | 3.65 | .26 | .24 | .05 | .23 | .05 | .05 |
| CaO | 1 | 3.96 | .5 | .16 | 4.61 | 1.08 | 5.01 | 5.41 | 6.36 | 1 | .79 | .25 | .9 | .71 | .31 |
| Na2O | 6.46 | 5.17 | 7.02 | 7.48 | 6.54 | 3.7 | 3.7 | 3.67 | 3.69 | 4.01 | 4.01 | 4.16 | 4.39 | 4.62 | 4.2 |
| K2O | 5.12 | 4.26 | 5.37 | 5.2 | 2.4 | 4.34 | 1.73 | 1.6 | 1.51 | 4.45 | 4.53 | 3.89 | 3.34 | 3.27 | 3.88 |
| LOI | .21 | 3.39 | .11 | .21 | .4 | .85 | .43 | .48 | .35 | .59 | .46 | .44 | .84 | .69 | .3 |
| TiO2 | .59 | 1.48 | .38 | .06 | 1.07 | .15 | .44 | .46 | .69 | .17 | .17 | .09 | .22 | .15 | .12 |
| P2O5 | .2 | .79 | .02 | .02 | .52 | .02 | .12 | .14 | .14 | .02 | .02 | .02 | .02 | .02 | .02 |
| MnO | .12 | .18 | .05 | .01 | .07 | .03 | .07 | .07 | .14 | .08 | .08 | .01 | .05 | .04 | .02 |
| Zr2O | .02 | .02 | 0 | 0 | .01 | .02 | .01 | .01 | .01 | .01 | .01 | .04 | .04 | .04 | .04 |
| TOTAL | 99.35 | 98.95 | 99.18 | 98.9 | 98.59 | 99.2 | 99.68 | 99.41 | 98.9 | 99.02 | 98.96 | 99.29 | 98.83 | 98.96 | 99 |
| NORM | | | | | | | | | | | | | | | |
| Q | 3.7 | 3.46 | 1.73 | 2.19 | .03 | 33.02 | 22.99 | 21.94 | 13.9 | 31.09 | 31.43 | 37.64 | 33.55 | 34.5 | 37.21 |
| C | --- | --- | .17 | .81 | --- | .43 | --- | --- | --- | .2 | .57 | --- | --- | --- | --- |
| Z | .03 | .03 | 0 | 0 | .01 | .02 | .02 | .02 | .02 | .02 | .02 | .06 | .07 | .07 | .07 |
| OR | 30.45 | 25.44 | 31.99 | 31.07 | 14.39 | 25.85 | 10.26 | 9.51 | 9.02 | 26.36 | 27.05 | 23.15 | 19.97 | 19.53 | 23.16 |
| AB | 55.02 | 44.21 | 59.89 | 64 | 56.13 | 31.56 | 31.41 | 31.24 | 31.57 | 34.27 | 34.29 | 35.45 | 37.59 | 39.5 | 35.9 |
| AN | 2.5 | 8.42 | 2.37 | .67 | 18.72 | 5.27 | 22.15 | 23.55 | 22.89 | 4.88 | 3.83 | .68 | 4.23 | 1.99 | .66 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | .49 | 2.6 | --- | --- | .43 | --- | .84 | 1.05 | 3.38 | --- | --- | .18 | .06 | .6 | .32 |
| EN | 1.35 | 1.61 | .6 | .13 | 3.21 | .6 | 5.67 | 5.84 | 9.19 | .65 | .6 | .13 | .58 | .13 | .13 |
| FS | 2.61 | 2.99 | 1.26 | .45 | 1.48 | 1.19 | 2.96 | 2.98 | 4.65 | .8 | .8 | 1.23 | 1.53 | 1.59 | 1.18 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | 2.04 | 3.12 | 1.1 | .31 | 1.91 | .85 | 2.17 | 2.19 | 3.37 | .57 | .57 | .82 | 1.1 | 1.07 | .81 |
| IL | 1.13 | 2.84 | .73 | .12 | 2.06 | .29 | .84 | .88 | 1.32 | .33 | .33 | .17 | .42 | .29 | .23 |
| AP | .48 | 1.89 | .05 | .05 | 1.25 | .05 | .29 | .33 | .34 | .05 | .05 | .05 | .05 | .05 | .05 |
| TOTAL | 99.8 | 96.62 | 99.89 | 99.79 | 99.62 | 99.14 | 99.58 | 99.53 | 99.66 | 99.41 | 99.54 | 99.56 | 99.15 | 99.3 | 99.7 |
| SALIC | 91.7 | 81.56 | 96.15 | 98.74 | 89.28 | 96.17 | 86.82 | 86.25 | 77.4 | 97.01 | 97.18 | 96.98 | 95.4 | 95.58 | 97 |
| FEMIC | 8.1 | 15.05 | 3.74 | 1.05 | 10.34 | 2.98 | 12.75 | 13.27 | 22.26 | 2.4 | 2.35 | 2.58 | 3.75 | 3.72 | 2.7 |
| D INDEX | 89.17 | 73.12 | 93.61 | 97.26 | 70.55 | 90.44 | 64.66 | 62.69 | 54.49 | 91.91 | 92.77 | 96.24 | 91.11 | 93.53 | 96.26 |
| DI | .99 | 5.25 | --- | --- | .83 | --- | 1.62 | 2.05 | 6.55 | --- | --- | .39 | .13 | 1.27 | .66 |
| DIEN | .17 | .93 | --- | --- | .28 | --- | .32 | .66 | 2.11 | --- | --- | .02 | .02 | .05 | .03 |
| DIFS | .33 | 1.73 | --- | --- | .13 | --- | .27 | .34 | 1.07 | --- | --- | .18 | .05 | .62 | .31 |
| DIWO | .49 | 2.6 | --- | --- | .43 | --- | .84 | 1.05 | 3.38 | --- | --- | .18 | .06 | .6 | .32 |
| HY | 3.46 | 1.95 | 1.86 | .57 | 4.28 | 1.8 | 7.84 | 7.82 | 10.67 | 1.46 | 1.41 | 1.16 | 2.05 | 1.05 | .95 |
| HYEN | 1.18 | .68 | .6 | .13 | 2.93 | .6 | 5.15 | 5.18 | 7.08 | .65 | .6 | .11 | .56 | .08 | .09 |
| HYFS | 2.28 | 1.27 | 1.26 | .45 | 1.35 | 1.19 | 2.69 | 2.64 | 3.59 | .8 | .8 | 1.05 | 1.49 | .97 | .86 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155605 | 155606 | 155607 | 155608 | 155609 | 155610 | 155611 | 155612 | 155613 | 155614 | 155615 | 155616 | 1556161 | 155618 | 155619 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 76.77 | 73.66 | 74.42 | 69.58 | 73.22 | 71.97 | 74.98 | 67.58 | 67.72 | 68 | 70.31 | 73.18 | 64.78 | 71.56 | 72.51 |
| Al2O3 | 11.68 | 13.4 | 13.3 | 16.95 | 13.99 | 14.11 | 13.69 | 15.05 | 15.18 | 15.11 | 13.79 | 13.28 | 17.11 | 14.08 | 13.99 |
| Fe2O3 | .55 | .73 | .25 | .49 | .4 | .37 | .25 | 1.16 | 1.17 | 1.16 | 1.01 | .74 | 1.34 | .78 | .7 |
| FeO | .96 | 1.27 | .44 | .86 | .71 | .65 | .45 | 2.03 | 2.04 | 2.03 | 1.76 | 1.29 | 2.35 | 1.37 | 1.23 |
| MgO | .05 | .6 | .12 | .44 | .29 | .32 | .05 | .68 | .62 | .65 | .21 | .13 | .51 | .44 | .39 |
| CaO | .28 | 1.56 | 1.28 | 3.7 | 1.32 | 1.37 | .51 | 1.51 | 1.81 | 1.63 | .59 | .28 | 1.21 | 1.62 | 1.61 |
| Na2O | 4.26 | 5.89 | 4.74 | 4.87 | 3.8 | 3.94 | 4.39 | 4.74 | 4.61 | 4.55 | 5.13 | 4.9 | 5.85 | 3.56 | 3.44 |
| K2O | 3.79 | .82 | 2.7 | 1.11 | 4.51 | 4.37 | 4.07 | 4.57 | 4.62 | 4.64 | 5 | 4.64 | 5.03 | 4.63 | 4.76 |
| LOI | .59 | .75 | 2.05 | 1.24 | .59 | 1.72 | .65 | .54 | .68 | .96 | .84 | .26 | .34 | .41 | .48 |
| TiO2 | .1 | .35 | .06 | .15 | .17 | .17 | .03 | .49 | .49 | .49 | .31 | .18 | .66 | .31 | .29 |
| P2O5 | .02 | .08 | .02 | .07 | .05 | .07 | .02 | .11 | .12 | .11 | .02 | .02 | .14 | .11 | .09 |
| MnO | .02 | .04 | .02 | .04 | .02 | .03 | .06 | .06 | .06 | .06 | .09 | .04 | .1 | .04 | .04 |
| ZrO2 | .04 | .02 | .01 | .01 | .01 | .01 | .01 | .05 | .05 | .05 | .08 | .05 | .04 | .03 | .02 |
| TOTAL | 99.11 | 99.17 | 99.41 | 99.51 | 99.08 | 99.1 | 99.16 | 98.57 | 99.17 | 99.44 | 99.14 | 98.99 | 99.46 | 98.94 | 99.55 |
| NORM | | | | | | | | | | | | | | | |
| Q | 36.64 | 31.95 | 33.6 | 28.29 | 30.68 | 29.06 | 32.72 | 17.97 | 18.18 | 18.82 | 19.65 | 25.88 | 7.52 | 28.96 | 30.05 |
| C | .11 | .18 | .3 | 1.18 | .58 | .58 | 1.19 | --- | --- | --- | --- | --- | .18 | .54 | .47 |
| Z | .06 | .03 | .02 | .02 | .02 | .02 | .01 | .08 | .08 | .08 | .12 | .08 | .06 | .04 | .04 |
| OR | 22.6 | 4.89 | 16.05 | 6.59 | 26.9 | 26.06 | 24.26 | 27.4 | 27.53 | 27.57 | 29.8 | 27.7 | 29.89 | 27.65 | 28.25 |
| AB | 36.37 | 50.26 | 40.35 | 41.41 | 32.45 | 33.64 | 37.46 | 40.69 | 39.33 | 38.72 | 43.47 | 41.88 | 49.77 | 30.45 | 29.24 |
| AN | 1.27 | 7.28 | 6.26 | 17.99 | 6.28 | 6.4 | 2.42 | 6.38 | 7.14 | 7.14 | --- | .54 | 5.12 | 7.4 | 7.43 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .28 | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | --- | --- | --- | --- | --- | .2 | .47 | .11 | 1.18 | .3 | --- | --- | --- |
| EN | .13 | 1.51 | .3 | 1.1 | .73 | .8 | .13 | 1.72 | 1.56 | 1.63 | .53 | .33 | 1.28 | 1.11 | .98 |
| FS | 1.19 | 1.24 | .54 | 1.01 | .74 | .67 | .69 | 2.1 | 2.1 | 2.08 | 2.15 | 1.55 | 2.32 | 1.45 | 1.28 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | .8 | 1.07 | .36 | .71 | .59 | .54 | .37 | 1.71 | 1.71 | 1.69 | 1.34 | 1.08 | 1.95 | 1.14 | 1.02 |
| IL | .19 | .67 | .11 | .29 | .33 | .33 | .06 | .94 | .94 | .94 | .59 | .35 | 1.26 | .6 | .55 |
| AP | .05 | .19 | .05 | .17 | .12 | .17 | .05 | .26 | .29 | .26 | .05 | .05 | .33 | .26 | .21 |
| TOTAL | 99.41 | 99.25 | 97.94 | 98.76 | 99.41 | 98.27 | 99.35 | 99.46 | 99.32 | 99.04 | 99.15 | 99.74 | 99.67 | 99.59 | 99.52 |
| SALIC | 97.05 | 94.58 | 96.57 | 95.48 | 96.91 | 95.76 | 98.06 | 92.52 | 92.26 | 92.33 | 93.04 | 96.08 | 92.53 | 95.03 | 95.48 |
| FEMIC | 2.36 | 4.67 | 1.37 | 3.27 | 2.5 | 2.51 | 1.28 | 6.94 | 7.06 | 6.71 | 6.11 | 3.66 | 7.14 | 4.56 | 4.04 |
| D INDEX | 95.6 | 87.09 | 89.99 | 76.29 | 90.03 | 88.76 | 94.44 | 86.06 | 85.04 | 85.11 | 92.92 | 95.46 | 87.17 | 87.06 | 87.54 |
| DI | --- | --- | --- | --- | --- | --- | --- | .41 | .94 | .22 | 2.44 | .63 | --- | --- | --- |
| DIEN | --- | --- | --- | --- | --- | --- | --- | .09 | .2 | .05 | .25 | .06 | --- | --- | --- |
| DIFS | --- | --- | --- | --- | --- | --- | --- | .11 | .27 | .06 | 1.01 | .27 | --- | --- | --- |
| DIWO | --- | --- | --- | --- | --- | --- | --- | .2 | .47 | .11 | 1.18 | .3 | --- | --- | --- |
| HY | 1.32 | 2.74 | .84 | 2.11 | 1.47 | 1.47 | .81 | 3.62 | 3.19 | 3.6 | 1.42 | 1.55 | 3.59 | 2.56 | 2.26 |
| HYEN | .13 | 1.51 | .3 | 1.1 | .73 | .8 | .13 | 1.63 | 1.36 | 1.58 | .28 | .27 | 1.28 | 1.11 | .98 |
| HYFS | 1.19 | 1.24 | .54 | 1.01 | .74 | .67 | .69 | 1.99 | 1.83 | 2.02 | 1.14 | 1.28 | 2.32 | 1.45 | 1.28 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155620 | 155621 | 155622 | 155623 | 155624 | 155625 | 155626 | 155627 | 155628 | 155629 | 155630 | 155631 | 155632 | 155633 | 155634 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 69.9 | 71 | 74.55 | 69.6 | 75.75 | 67.56 | 67.65 | 74.05 | 72.1 | 73.26 | 67.95 | 73.1 | 76.11 | 68.43 | 64.32 |
| Al2O3 | 14.83 | 14.24 | 13.27 | 15.19 | 13.01 | 15.22 | 15.39 | 13.83 | 14.58 | 14.2 | 15.69 | 14.11 | 12.48 | 15.44 | 18.62 |
| Fe2O3 | .96 | .88 | .72 | .95 | .49 | 1.4 | 1.33 | .45 | .54 | .42 | 1.06 | .43 | .32 | 1.04 | .43 |
| FeO | 1.68 | 1.53 | 1.26 | 1.66 | .86 | 2.45 | 2.33 | .78 | .95 | .74 | 1.85 | .76 | .56 | 1.81 | .75 |
| MgO | .72 | .55 | .26 | .65 | .11 | .77 | .75 | .35 | .48 | .31 | 1.04 | .33 | .11 | .79 | .3 |
| CaO | 2.14 | 1.71 | 1.99 | 2.12 | 1.5 | 2.59 | 2.66 | 1.62 | 1.92 | 1.33 | 2.9 | 1.55 | .52 | 1.94 | .89 |
| Na2O | 3.51 | 3.39 | 3.72 | 3.59 | 3.74 | 3.73 | 3.85 | 3.63 | 3.83 | 3.99 | 4.03 | 3.87 | 3.33 | 4.86 | 5.75 |
| K2O | 4.29 | 4.67 | 2.68 | 4.5 | 3.14 | 4.2 | 4.14 | 4.22 | 4.16 | 4.29 | 3.55 | 4.18 | 5.16 | 4.18 | 6.81 |
| LOI | .41 | .46 | .31 | .4 | .35 | .39 | .41 | .37 | .34 | .24 | .41 | .6 | .33 | .34 | .55 |
| TiO2 | .43 | .37 | .15 | .39 | .08 | .56 | .54 | .16 | .22 | .16 | .5 | .16 | .1 | .7 | .44 |
| P2O5 | .16 | .13 | .02 | .14 | .02 | .21 | .21 | .05 | .08 | .06 | .16 | .02 | .02 | .16 | .08 |
| MnO | .04 | .04 | .03 | .03 | .01 | .05 | .04 | .01 | .03 | .03 | .04 | .03 | .03 | .07 | .01 |
| Zr2O | .03 | .03 | .02 | .02 | .01 | .03 | .03 | .01 | .01 | .01 | .02 | .01 | .01 | .05 | .05 |
| TOTAL | 99.1 | 99 | 98.98 | 99.24 | 99.07 | 99.16 | 99.33 | 99.53 | 99.24 | 99.04 | 99.2 | 99.15 | 99.08 | 99.81 | 99 |
| NORM | | | | | | | | | | | | | | | |
| Q | 27.33 | 28.86 | 37.74 | 25.8 | 38.53 | 22.72 | 22.25 | 32.71 | 29.06 | 30.41 | 22.98 | 30.71 | 35.8 | 18.77 | 2.54 |
| C | .91 | .82 | .69 | .9 | .79 | .33 | .24 | .47 | .48 | .73 | .33 | .45 | .52 | --- | .37 |
| Z | .05 | .04 | .03 | .03 | .02 | .04 | .04 | .01 | .02 | .02 | .03 | .02 | .02 | .08 | .07 |
| OR | 25.58 | 27.88 | 16 | 26.79 | 18.73 | 25.03 | 24.63 | 25.06 | 24.77 | 25.6 | 21.15 | 24.91 | 30.77 | 24.75 | 40.65 |
| AB | 29.97 | 28.98 | 31.8 | 30.61 | 31.94 | 31.83 | 32.8 | 30.86 | 32.66 | 34.09 | 34.38 | 33.03 | 28.44 | 41.2 | 49.15 |
| AN | 9.66 | 7.71 | 9.84 | 9.68 | 7.38 | 11.57 | 11.9 | 7.75 | 9.07 | 6.27 | 13.45 | 7.62 | 2.47 | 7.98 | 3.93 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .26 | --- |
| EN | 1.81 | 1.38 | .65 | 1.63 | .28 | 1.93 | 1.88 | .88 | 1.2 | .78 | 2.61 | .83 | .28 | 1.97 | .75 |
| FS | 1.67 | 1.56 | 1.54 | 1.69 | 1.07 | 2.53 | 2.38 | .82 | 1 | .81 | 1.78 | .84 | .66 | 1.44 | .32 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | 1.4 | 1.29 | 1.05 | 1.39 | .72 | 2.05 | 1.94 | .66 | .79 | .61 | 1.55 | .63 | .47 | 1.51 | .63 |
| IL | .82 | .71 | .29 | .75 | .15 | 1.07 | 1.03 | .31 | .42 | .31 | .96 | .31 | .19 | 1.33 | .84 |
| AP | .38 | .31 | .05 | .33 | .05 | .5 | .5 | .12 | .19 | .14 | .38 | .05 | .05 | .38 | .19 |
| TOTAL | 99.6 | 99.54 | 99.69 | 99.6 | 99.65 | 99.62 | 99.6 | 99.63 | 99.66 | 99.76 | 99.6 | 99.4 | 99.67 | 99.67 | 99.45 |
| SALIC | 93.5 | 94.29 | 96.1 | 93.82 | 97.38 | 91.53 | 91.86 | 96.86 | 96.06 | 97.11 | 92.31 | 96.75 | 98.02 | 92.78 | 96.71 |
| FEMIC | 6.09 | 5.25 | 3.59 | 5.79 | 2.27 | 8.09 | 7.73 | 2.77 | 3.6 | 2.66 | 7.28 | 2.65 | 1.64 | 6.89 | 2.74 |
| D INDEX | 82.88 | 85.72 | 85.54 | 83.21 | 89.2 | 79.58 | 79.68 | 88.63 | 86.49 | 90.1 | 78.5 | 88.65 | 95.01 | 84.72 | 92.34 |
| DI | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .5 | --- |
| DIEN | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .14 | --- |
| DIFS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .1 | --- |
| DIWO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .26 | --- |
| HY | 3.48 | 2.95 | 2.2 | 3.32 | 1.35 | 4.47 | 4.26 | 1.69 | 2.2 | 1.59 | 4.4 | 1.67 | .94 | 3.17 | 1.07 |
| HYEN | 1.81 | 1.38 | .65 | 1.63 | .28 | 1.93 | 1.88 | .88 | 1.2 | .78 | 2.61 | .83 | .28 | 1.83 | .75 |
| HYFS | 1.67 | 1.56 | 1.54 | 1.69 | 1.07 | 2.53 | 2.38 | .82 | 1 | .81 | 1.78 | .84 | .66 | 1.34 | .32 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155635 | 155636 | 155637 | 155638 | 155639 | 155640 | 155641 | 155642 | 155643 | 155644 | 155645 | 155646 | 155647 | 155648 | 155649 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 75.58 | 65.84 | 62.39 | 62.15 | 61.78 | 62.9 | 71.88 | 75.7 | 44.4 | 45.31 | 72.48 | 71.74 | 69.59 | 64.85 | 64.71 |
| Al2O3 | 12.84 | 15.75 | 14.98 | 15.3 | 14.99 | 15.23 | 13.88 | 13.15 | 22.56 | 26.2 | 14.01 | 13.8 | 13.31 | 16.33 | 16.7 |
| Fe2O3 | .34 | 1.49 | 2.17 | 2.42 | 2.44 | 2.29 | .84 | .4 | 2.3 | 1.88 | .63 | .89 | 1.85 | 1.61 | 1.56 |
| FeO | .6 | 2.61 | 3.79 | 4.24 | 4.27 | 4 | 1.47 | .71 | 4.03 | 3.28 | 1.1 | 1.56 | 3.23 | 2.81 | 2.72 |
| MgO | .05 | .05 | .18 | .17 | .11 | .13 | .29 | .05 | 6.43 | 2.96 | .55 | .68 | .05 | .2 | .34 |
| CaO | .44 | .6 | 1.73 | 1.4 | 1.79 | .78 | 1.11 | .3 | 14.64 | 14.35 | 2.02 | 1.72 | 1.08 | 1.3 | 1.75 |
| Na2O | 3.53 | 6.5 | 5.86 | 5.83 | 6.07 | 5.75 | 3.3 | 4.8 | 1.73 | 2.57 | 4.04 | 3.47 | 3.19 | 6.43 | 6.29 |
| K2O | 5.11 | 4.97 | 4.79 | 4.88 | 4.89 | 4.89 | 5.53 | 4.14 | .18 | .2 | 3.24 | 4.7 | 5.62 | 3.93 | 3.79 |
| LOI | .36 | .86 | 2.72 | 2.47 | 2.18 | 2.28 | .26 | .01 | 2.12 | 1.5 | .55 | .34 | .16 | .75 | .31 |
| TiO2 | .1 | .17 | .35 | .4 | .38 | .37 | .3 | .01 | 1.22 | 1.27 | .27 | .37 | .53 | .34 | .4 |
| P2O5 | .02 | .02 | .1 | .12 | .11 | .12 | .08 | .02 | .07 | .02 | .09 | .11 | .02 | .02 | .08 |
| MnO | .01 | .06 | .25 | .17 | .18 | .2 | .05 | .02 | .07 | .04 | .01 | .03 | .15 | .14 | .11 |
| Zr2O | .02 | .16 | .1 | .1 | .08 | .09 | .04 | .02 | .01 | 0 | .01 | .02 | .15 | .11 | .11 |
| TOTAL | 99 | 99.08 | 99.41 | 99.65 | 99.27 | 99.03 | 99.03 | 99.33 | 99.76 | 99.78 | 99 | 99.43 | 98.93 | 98.82 | 98.87 |
| NORM | | | | | | | | | | | | | | | |
| Q | 34.56 | 6.96 | 5.58 | 5.22 | 3.47 | 7.25 | 28.46 | 31.02 | --- | --- | 31.51 | 28.62 | 25.66 | 8.3 | 8.59 |
| C | .76 | --- | --- | --- | --- | --- | .65 | .28 | --- | --- | .4 | .14 | .06 | --- | --- |
| Z | .02 | .24 | .15 | .15 | .12 | .14 | .07 | .03 | .01 | .01 | .02 | .03 | .23 | .16 | .16 |
| OR | 30.5 | 29.64 | 28.47 | 28.94 | 29.11 | 29.18 | 33 | 24.63 | 1.07 | 1.18 | 19.34 | 27.93 | 33.57 | 23.5 | 22.65 |
| AB | 30.17 | 53.84 | 49.88 | 49.51 | 50.24 | 49.13 | 28.2 | 40.89 | 12.26 | 16.54 | 34.53 | 29.53 | 27.28 | 55.06 | 53.83 |
| AN | 2.07 | --- | .43 | 1.17 | --- | 1.32 | 5.03 | 1.37 | 53.39 | 59.49 | 9.53 | 7.86 | 5.28 | 4.14 | 6.21 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | 1.31 | 2.84 | --- | --- | --- | --- | --- |
| AC | --- | 1.47 | --- | --- | 1.32 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | 1.2 | 3.15 | 2.09 | 3.43 | .75 | --- | --- | 7.92 | 4.09 | --- | --- | --- | .94 | .85 |
| EN | .13 | .13 | .45 | .42 | .28 | .33 | .73 | .13 | 5.84 | 3.38 | 1.38 | 1.7 | .13 | .5 | .86 |
| FS | .68 | 3.85 | 5.08 | 5.46 | 5.95 | 5.27 | 1.62 | 1 | 1.32 | 1.12 | 1.08 | 1.58 | 3.85 | 3.57 | 3.29 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | 7.16 | 2.81 | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | 1.78 | 1.03 | --- | --- | --- | --- | --- |
| MT | .5 | 1.44 | 3.17 | 3.52 | 2.9 | 3.35 | 1.23 | .58 | 3.34 | 2.73 | .92 | 1.3 | 2.71 | 2.36 | 2.29 |
| IL | .19 | .33 | .67 | .76 | .73 | .71 | .58 | .02 | 2.32 | 2.42 | .52 | .71 | 1.02 | .65 | .77 |
| AP | .05 | .05 | .24 | .29 | .26 | .29 | .19 | .05 | .17 | .05 | .22 | .26 | .05 | .05 | .19 |
| TOTAL | 99.64 | 99.13 | 97.27 | 97.53 | 97.81 | 97.71 | 99.74 | 99.99 | 97.88 | 98.5 | 99.45 | 99.66 | 99.84 | 99.24 | 99.69 |
| SALIC | 98.09 | 90.67 | 84.51 | 84.98 | 82.94 | 87.01 | 95.4 | 98.21 | 68.04 | 80.07 | 95.33 | 94.11 | 92.09 | 91.16 | 91.45 |
| FEMIC | 1.54 | 8.46 | 12.76 | 12.55 | 14.87 | 10.69 | 4.34 | 1.78 | 29.84 | 18.43 | 4.12 | 5.55 | 7.75 | 8.08 | 8.24 |
| D INDEX | 95.24 | 90.44 | 83.94 | 83.67 | 82.82 | 85.56 | 89.65 | 96.54 | 14.64 | 20.57 | 85.37 | 86.08 | 86.51 | 86.86 | 85.08 |
| DI | --- | 2.55 | 6.64 | 4.42 | 7.28 | 1.59 | --- | --- | 15.07 | 9.39 | --- | --- | --- | 1.97 | 1.76 |
| DIEN | --- | .04 | .28 | .17 | .17 | .05 | --- | --- | 5.84 | 3.38 | --- | --- | --- | .13 | .19 |
| DIFS | --- | 1.31 | 3.21 | 2.16 | 3.67 | .79 | --- | --- | 1.32 | 1.12 | --- | --- | --- | .9 | .72 |
| DIWO | --- | 1.2 | 3.15 | 2.09 | 3.43 | .75 | --- | --- | 7.92 | 4.89 | --- | --- | --- | .94 | .85 |
| HY | .81 | 2.62 | 2.04 | 3.56 | 2.38 | 4.75 | 2.35 | 1.13 | --- | --- | 2.47 | 3.29 | 3.97 | 3.04 | 3.23 |
| HYEN | .13 | .08 | .17 | .26 | .11 | .28 | .73 | .13 | --- | --- | 1.38 | 1.7 | .13 | .38 | .67 |
| HYFS | .68 | 2.54 | 1.88 | 3.3 | 2.27 | 4.48 | 1.62 | 1 | --- | --- | 1.08 | 1.58 | 3.85 | 2.67 | 2.57 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | 8.94 | 3.84 | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155650 | 155651 | 155652 | 155653 | 155654 | 155655 | 155656 | 155657 | 155658 | 155659 | 155660 | 155661 | 155662 | 155663 | 155664 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 65.46 | 63.43 | 70.44 | 72.04 | 74.61 | 62.75 | 74.66 | 70.61 | 75.63 | 73.74 | 76.19 | 71.96 | 70.97 | 72.6 | 73.4 |
| Al2O3 | 16.58 | 16.42 | 15.34 | 13.97 | 14.11 | 15.82 | 13.72 | 14.77 | 13.4 | 12.97 | 12.19 | 14.42 | 15.05 | 14.19 | 14.19 |
| Fe2O3 | 1.33 | 2 | .49 | .59 | .17 | 1.65 | .22 | .62 | .22 | .6 | .5 | .76 | .6 | .6 | .52 |
| FeO | 2.33 | 3.5 | .86 | 1.03 | .3 | 2.88 | .39 | 1.09 | .39 | 1.05 | .87 | 1.33 | 1.05 | 1.06 | .92 |
| MgO | .26 | .38 | .41 | .64 | .05 | 1.86 | .12 | .57 | .05 | .16 | .05 | .61 | .62 | .46 | .44 |
| CaO | 1.05 | 2.24 | 1.71 | 1.58 | 1.06 | 3.97 | .99 | 2.05 | .58 | .9 | .41 | 2.3 | 1.9 | 2.04 | 2.25 |
| Na2O | 6.33 | 6.51 | 3.92 | 3.69 | 4.1 | 4.3 | 3.62 | 3.84 | 3.45 | 2.95 | 3.8 | 3.6 | 4.08 | 3.83 | 3.77 |
| K2O | 4.18 | 2.96 | 5.14 | 4.2 | 4.31 | 3.62 | 4.86 | 4.58 | 5.55 | 5.63 | 4.63 | 3.29 | 3.92 | 2.99 | 2.63 |
| LOI | .22 | .51 | .34 | .81 | .41 | .53 | .51 | .72 | .4 | .64 | .61 | .41 | .44 | .86 | .79 |
| TiO2 | .32 | .54 | .27 | .28 | .04 | 1.2 | .06 | .35 | .07 | .17 | .08 | .31 | .29 | .14 | .14 |
| P2O5 | .02 | .12 | .1 | .11 | .02 | .5 | .02 | .12 | .02 | .02 | .02 | .1 | .09 | .07 | .05 |
| MnO | .09 | .18 | .01 | .02 | .01 | .06 | .01 | .01 | .01 | .03 | .01 | .04 | .03 | .06 | .04 |
| Zr2O | .07 | .09 | .01 | .02 | 0 | .04 | .01 | .02 | .01 | .03 | .03 | .02 | .02 | .01 | .01 |
| TOTAL | 98.24 | 98.88 | 99.04 | 98.98 | 99.19 | 99.18 | 99.19 | 99.35 | 99.78 | 98.89 | 99.39 | 99.15 | 99.06 | 98.91 | 99.15 |
| NORM | | | | | | | | | | | | | | | |
| Q | 9.03 | 8.09 | 23.86 | 30.33 | 32.07 | 13.88 | 32.81 | 25.58 | 32.93 | 32.72 | 35.19 | 32.51 | 27.28 | 33.78 | 35.87 |
| C | --- | --- | .46 | .75 | .83 | --- | .76 | .06 | .71 | .44 | .23 | 1 | .86 | 1.12 | 1.18 |
| Z | .1 | .14 | .02 | .03 | .01 | .06 | .02 | .03 | .01 | .05 | .04 | .04 | .03 | .02 | .02 |
| OR | 25.14 | 17.69 | 30.67 | 25.07 | 25.68 | 21.57 | 28.95 | 27.24 | 32.87 | 33.64 | 27.53 | 19.61 | 23.38 | 17.86 | 15.67 |
| AB | 54.52 | 55.71 | 33.49 | 31.54 | 34.97 | 36.69 | 30.88 | 32.71 | 29.26 | 25.24 | 32.35 | 30.72 | 34.85 | 32.77 | 32.17 |
| AN | 4.56 | 6.92 | 7.91 | 7.19 | 5.17 | 13.28 | 4.82 | 9.45 | 2.75 | 4.38 | 1.92 | 10.85 | 8.92 | 9.77 | 10.93 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | .25 | 1.47 | --- | --- | --- | 1.37 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EN | .66 | .96 | 1.03 | 1.61 | .13 | 4.67 | .3 | 1.43 | .12 | .4 | .13 | 1.53 | 1.56 | 1.16 | 1.11 |
| FS | 2.87 | 4.27 | .75 | .99 | .37 | 2.07 | .46 | .94 | .44 | 1.22 | 1.08 | 1.39 | 1.02 | 1.35 | 1.11 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | 1.96 | 2.93 | .72 | .86 | .25 | 2.41 | .32 | .9 | .32 | .88 | .73 | 1.11 | .88 | .88 | .76 |
| IL | .62 | 1.04 | .52 | .54 | .08 | 2.3 | .11 | .67 | .13 | .33 | .15 | .59 | .56 | .27 | .27 |
| AP | .05 | .29 | .24 | .26 | .05 | 1.19 | .05 | .29 | .05 | .05 | .05 | .24 | .22 | .17 | .12 |
| TOTAL | 99.78 | 99.49 | 99.66 | 99.19 | 99.59 | 99.49 | 99.49 | 99.28 | 99.6 | 99.35 | 99.39 | 99.59 | 99.56 | 99.13 | 99.21 |
| SALIC | 93.37 | 88.54 | 96.4 | 94.92 | 98.72 | 85.47 | 98.24 | 95.06 | 98.54 | 96.48 | 97.25 | 94.73 | 95.33 | 95.31 | 95.84 |
| FEMIC | 6.41 | 10.95 | 3.26 | 4.26 | .86 | 14.02 | 1.24 | 4.23 | 1.06 | 2.88 | 2.13 | 4.86 | 4.23 | 3.82 | 3.37 |
| D INDEX | 88.7 | 81.49 | 88.01 | 86.95 | 92.72 | 72.13 | 92.65 | 85.53 | 95.06 | 91.61 | 95.07 | 82.84 | 85.52 | 84.41 | 83.71 |
| DI | .53 | 3.06 | --- | --- | --- | 2.65 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIEN | .05 | .29 | --- | --- | --- | .89 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIFS | .22 | 1.29 | --- | --- | --- | .39 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DIWO | .25 | 1.47 | --- | --- | --- | 1.37 | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HY | 3.26 | 3.64 | 1.79 | 2.6 | .49 | 5.46 | .76 | 2.37 | .56 | 1.62 | 1.2 | 2.92 | 2.58 | 2.5 | 2.22 |
| HYEN | .61 | .67 | 1.03 | 1.61 | .13 | 3.79 | .3 | 1.43 | .12 | .4 | .13 | 1.53 | 1.56 | 1.16 | 1.11 |
| HYFS | 2.65 | 2.97 | .75 | .99 | .37 | 1.68 | .46 | .94 | .44 | 1.22 | 1.08 | 1.39 | 1.02 | 1.35 | 1.11 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155665 | 155666 | 155667 | 155668 | 155669 | 155670 | 155671 | 155672 | 155673 | 155674 | 155675 | 155676 | 155677 | 155678 | 155679 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 73.41 | 73.69 | 73 | 72.77 | 71.08 | 72.93 | 75.89 | 70.05 | 67.22 | 73.85 | 71.89 | 70.61 | 70.96 | 73.23 | 74.61 |
| Al2O3 | 14.38 | 14.16 | 14.27 | 14.24 | 14.82 | 13.54 | 13.39 | 14.36 | 16.44 | 14.28 | 15.7 | 14.48 | 14.28 | 13.43 | 11.64 |
| Fe2O3 | .52 | .48 | .51 | .56 | .74 | .63 | .21 | 1.07 | 1.02 | .39 | .44 | .8 | .77 | .65 | 1.25 |
| FeO | .9 | .85 | .9 | .97 | 1.3 | 1.11 | .38 | 1.87 | 1.79 | .68 | .77 | 1.4 | 1.34 | 1.15 | 2.19 |
| MgO | .44 | .41 | .37 | .41 | .6 | .28 | .12 | .5 | .84 | .34 | .38 | .52 | .31 | .31 | .05 |
| CaO | 2.27 | 2.32 | 1.72 | 1.84 | 2.07 | 1.56 | 1.19 | 2.02 | 3.38 | 2.22 | 2.31 | 1.71 | 1.36 | 1.03 | .3 |
| Na2O | 3.95 | 3.72 | 3.93 | 3.91 | 3.48 | 3.03 | 3.48 | 3.36 | 4.11 | 4.11 | 4.54 | 3.98 | 3.64 | 3.67 | 2.27 |
| K2O | 2.38 | 2.6 | 3.87 | 3.9 | 4.45 | 4.99 | 4.46 | 4.74 | 3.06 | 2.08 | 2.09 | 4.72 | 5.33 | 5.13 | 6.57 |
| LOI | .89 | .89 | .3 | .32 | .38 | .54 | .32 | .59 | .57 | .81 | .72 | .28 | .41 | .39 | .16 |
| TiO2 | .14 | .13 | .2 | .22 | .3 | .22 | .05 | .37 | .48 | .09 | .11 | .39 | .26 | .26 | .22 |
| P2O5 | .06 | .07 | .07 | .07 | .11 | .06 | .02 | .12 | .18 | .02 | .02 | .11 | .09 | .02 | .02 |
| MnO | .04 | .05 | .03 | .04 | .02 | .01 | .01 | .05 | .03 | .06 | .05 | .04 | .04 | .03 | .03 |
| Zr2O | .01 | .01 | .01 | .02 | .03 | .02 | .01 | .04 | .04 | .01 | .01 | .02 | .04 | .02 | .13 |
| TOTAL | 99.39 | 99.38 | 99.18 | 99.27 | 99.38 | 98.92 | 99.53 | 99.14 | 99.16 | 98.94 | 99.03 | 99.06 | 98.83 | 99.32 | 99.44 |
| NORM | | | | | | | | | | | | | | | |
| Q | 35.7 | 36.46 | 31.1 | 30.49 | 28.35 | 32.42 | 35.87 | 26.92 | 23.01 | 36.76 | 31.89 | 24.89 | 25.88 | 29.28 | 34.51 |
| C | 1.33 | 1.18 | .66 | .41 | .78 | .47 | .73 | .32 | .66 | 1.29 | 1.83 | --- | .27 | .02 | .3 |
| Z | .02 | .02 | .02 | .03 | .04 | .03 | .01 | .06 | .06 | .02 | .02 | .03 | .05 | .04 | .2 |
| OR | 14.15 | 15.46 | 23.06 | 23.22 | 26.46 | 29.81 | 26.48 | 28.25 | 18.23 | 12.42 | 12.47 | 28.16 | 31.87 | 30.52 | 39.04 |
| AB | 33.63 | 31.67 | 33.53 | 33.33 | 29.63 | 25.92 | 29.59 | 28.68 | 35.07 | 35.15 | 38.79 | 34 | 31.17 | 31.27 | 19.32 |
| AN | 10.94 | 11.12 | 8.14 | 8.73 | 9.61 | 7.43 | 5.8 | 9.32 | 15.72 | 11 | 11.44 | 7.78 | 6.23 | 5.01 | 1.37 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .03 | --- | --- | --- |
| EN | 1.1 | 1.03 | .93 | 1.03 | 1.5 | .7 | .3 | 1.26 | 2.11 | .86 | .96 | 1.31 | .78 | .78 | .13 |
| FS | 1.07 | 1.05 | .96 | 1.04 | 1.33 | 1.19 | .46 | 2.05 | 1.72 | .9 | .97 | 1.35 | 1.49 | 1.21 | 2.7 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | .76 | .7 | .75 | .82 | 1.08 | .92 | .31 | 1.56 | 1.49 | .57 | .64 | 1.17 | 1.13 | .95 | 1.82 |
| IL | .27 | .25 | .38 | .42 | .57 | .42 | .1 | .71 | .92 | .17 | .21 | .75 | .5 | .5 | .42 |
| AP | .14 | .17 | .17 | .17 | .26 | .14 | .05 | .29 | .43 | .05 | .05 | .26 | .22 | .05 | .05 |
| TOTAL | 99.11 | 99.11 | 99.7 | 99.68 | 99.62 | 99.46 | 99.68 | 99.41 | 99.43 | 99.18 | 99.27 | 99.72 | 99.59 | 99.61 | 99.84 |
| SALIC | 95.76 | 95.92 | 96.51 | 96.21 | 94.88 | 96.08 | 98.47 | 93.55 | 92.76 | 96.64 | 96.44 | 94.86 | 95.48 | 96.13 | 94.73 |
| FEMIC | 3.34 | 3.19 | 3.19 | 3.47 | 4.74 | 3.38 | 1.21 | 5.87 | 6.67 | 2.55 | 2.83 | 4.87 | 4.11 | 3.48 | 5.11 |
| D INDEX | 83.48 | 83.6 | 87.69 | 87.04 | 84.44 | 88.15 | 91.93 | 83.85 | 76.32 | 84.33 | 83.15 | 87.04 | 88.92 | 91.06 | 92.86 |
| DI | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .05 | --- | --- | --- |
| DIEN | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .01 | --- | --- | --- |
| DIFS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .01 | --- | --- | --- |
| DIWO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .03 | --- | --- | --- |
| HY | 2.18 | 2.08 | 1.89 | 2.07 | 2.83 | 1.89 | .76 | 3.31 | 3.83 | 1.75 | 1.93 | 2.64 | 2.27 | 1.99 | 2.82 |
| HYEN | 1.1 | 1.03 | .93 | 1.03 | 1.5 | .7 | .3 | 1.26 | 2.11 | .86 | .96 | 1.3 | .78 | .78 | .13 |
| HYFS | 1.07 | 1.05 | .96 | 1.04 | 1.33 | 1.19 | .46 | 2.05 | 1.72 | .9 | .97 | 1.34 | 1.49 | 1.21 | 2.7 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155680 | 155681 | 155682 | 155683 | 155684 | 155685 | 155686 | 155687 | 155688 | 155689 | 155690 | 155691 | 155692 | 155693 | 155694 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 74.26 | 74.89 | 75.77 | 74.43 | 72.48 | 72.97 | 72.77 | 70.65 | 72.22 | 73.59 | 71.98 | 75.55 | 73.03 | 73.88 | 71.04 |
| Al2O3 | 12.64 | 13.06 | 12.45 | 13.26 | 13.41 | 13.45 | 13.46 | 13.46 | 13.42 | 12.7 | 13.83 | 11.3 | 11.18 | 11.8 | 12.64 |
| Fe2O3 | .64 | .35 | .57 | .51 | .77 | .69 | .73 | 1.25 | 1.16 | .78 | .69 | .82 | 1.79 | 1.22 | 1.46 |
| FeO | 1.12 | .62 | 1 | .89 | 1.34 | 1.2 | 1.28 | 2.18 | 2.03 | 1.36 | 1.21 | 1.44 | 3.13 | 2.13 | 2.55 |
| MgO | .15 | .13 | .1 | .19 | .28 | .23 | .32 | .39 | .32 | .14 | .4 | .14 | .05 | .05 | .33 |
| CaO | .5 | .5 | .51 | .85 | .83 | .74 | .85 | 1.12 | 1.43 | .69 | 1.04 | .33 | .29 | .22 | .93 |
| Na2O | 3.75 | 3.33 | 4.63 | 4.18 | 3.74 | 3.66 | 3.7 | 4.53 | 4.43 | 4.01 | 3.79 | 4.16 | 4.36 | 4.01 | 4.61 |
| K2O | 5.21 | 5.98 | 3.66 | 4.31 | 5.33 | 5.41 | 5.47 | 4.84 | 3.53 | 5 | 5.02 | 4.74 | 4.76 | 5.25 | 4.78 |
| LOI | .4 | .34 | .31 | .45 | .35 | .52 | .25 | .24 | .29 | .45 | .64 | .33 | .01 | .25 | .14 |
| TiO2 | .18 | .14 | .12 | .2 | .31 | .26 | .28 | .37 | .29 | .21 | .25 | .17 | .82 | .28 | .46 |
| P2O5 | .02 | .02 | .02 | .02 | .02 | .02 | .02 | .07 | .06 | .02 | .02 | .02 | .02 | .02 | .09 |
| MnO | .01 | .01 | .02 | .01 | .02 | .02 | .02 | .05 | .08 | .04 | .03 | .03 | .14 | .08 | .1 |
| Zr2O | .05 | .03 | .03 | .03 | .05 | .03 | .03 | .09 | .03 | .05 | .03 | .09 | .01 | .03 | .02 |
| TOTAL | 98.93 | 99.4 | 99.19 | 99.33 | 98.93 | 99.2 | 99.18 | 99.24 | 99.29 | 99.04 | 98.93 | 99.12 | 99.59 | 99.22 | 99.15 |
| NORM | | | | | | | | | | | | | | | |
| Q | 31.03 | 31.31 | 33.36 | 31.36 | 27.85 | 28.75 | 27.71 | 22.65 | 28.74 | 29.34 | 27.65 | 32.88 | 28.44 | 29.5 | 23.51 |
| C | --- | .25 | --- | .22 | .03 | .28 | --- | --- | --- | --- | .32 | --- | --- | --- | --- |
| Z | .07 | .04 | .05 | .04 | .07 | .05 | .05 | .13 | .04 | .08 | .04 | .14 | .02 | .05 | .03 |
| OR | 31.12 | 35.55 | 21.8 | 25.64 | 31.84 | 32.23 | 32.59 | 28.82 | 21.01 | 29.83 | 29.99 | 28.26 | 28.24 | 31.27 | 28.49 |
| AB | 32.08 | 28.35 | 39.5 | 35.61 | 31.99 | 31.22 | 31.57 | 38.63 | 37.76 | 34.26 | 32.42 | 32.02 | 31.13 | 31.71 | 38.73 |
| AN | 2.29 | 2.36 | 2.4 | 4.11 | 4.03 | 3.57 | 4 | 2.11 | 6.35 | 1.9 | 5.08 | --- | --- | --- | --- |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 2.39 | 5.2 | 2.19 | .54 |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .18 | 0 | --- | --- |
| WO | .03 | --- | .01 | --- | --- | --- | .05 | 1.26 | .17 | .59 | --- | .63 | .55 | .4 | 1.7 |
| EN | .38 | .33 | .25 | .48 | .7 | .58 | .8 | .98 | .8 | .35 | 1.01 | .35 | .13 | .13 | .83 |
| FS | 1.26 | .64 | 1.21 | .91 | 1.36 | 1.25 | 1.33 | 2.47 | 2.46 | 1.6 | 1.31 | 2.44 | 4.67 | 3.24 | 3.08 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | .94 | .51 | .83 | .74 | 1.13 | 1.01 | 1.07 | 1.83 | 1.69 | 1.14 | 1.01 | --- | --- | .69 | 1.87 |
| IL | .35 | .27 | .23 | .38 | .6 | .5 | .54 | .71 | .55 | .4 | .48 | .33 | 1.56 | .54 | .88 |
| AP | .05 | .05 | .05 | .05 | .05 | .05 | .05 | .17 | .14 | .05 | .05 | .05 | .05 | .05 | .22 |
| TOTAL | 99.6 | 99.66 | 99.69 | 99.55 | 99.65 | 99.48 | 99.75 | 99.76 | 99.71 | 99.55 | 99.35 | 99.67 | 99.99 | 99.75 | 99.86 |
| SALIC | 96.59 | 97.87 | 97.1 | 96.99 | 95.81 | 96.09 | 95.91 | 92.35 | 93.89 | 95.41 | 95.5 | 93.29 | 87.83 | 92.53 | 90.76 |
| FEMIC | 3.01 | 1.79 | 2.58 | 2.56 | 3.84 | 3.38 | 3.84 | 7.41 | 5.82 | 4.13 | 3.85 | 6.38 | 12.16 | 7.22 | 9.1 |
| D INDEX | 94.23 | 95.21 | 94.66 | 92.61 | 91.68 | 92.19 | 91.86 | 90.1 | 87.5 | 93.43 | 90.05 | 93.15 | 87.81 | 92.48 | 90.73 |
| DI | .07 | --- | .02 | --- | --- | --- | .1 | 2.58 | .34 | 1.23 | --- | 1.33 | 1.17 | .86 | 3.5 |
| DIEN | .01 | --- | 0 | --- | --- | --- | .02 | .37 | .04 | .12 | --- | .09 | .02 | .02 | .38 |
| DIFS | .03 | --- | .01 | --- | --- | --- | .03 | .94 | .13 | .52 | --- | .61 | .6 | .44 | 1.42 |
| DIWO | .03 | --- | .01 | --- | --- | --- | .05 | 1.26 | .17 | .59 | --- | .63 | .55 | .4 | 1.7 |
| HY | 1.6 | .97 | 1.46 | 1.38 | 2.07 | 1.83 | 2.08 | 2.13 | 3.08 | 1.31 | 2.32 | 2.1 | 4.18 | 2.91 | 2.1 |
| HYEN | .37 | .33 | .25 | .48 | .7 | .58 | .78 | .61 | .76 | .24 | 1.01 | .26 | .11 | .11 | .45 |
| HYFS | 1.24 | .64 | 1.21 | .91 | 1.36 | 1.25 | 1.3 | 1.53 | 2.32 | 1.07 | 1.31 | 1.83 | 4.07 | 2.8 | 1.66 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155695 | 155696 | 155697 | 155698 | 155699 | 155700 | 155701 | 155702 | 155703 | 155704 | 155705 | 155706 | 155707 | 155708 | 155709 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 69.98 | 70.44 | 75.36 | 72.37 | 72.44 | 52.72 | 73.05 | 59.92 | 49.82 | 64.19 | 71.09 | 70.99 | 75.08 | 75.79 | 73.45 |
| Al2O3 | 12.81 | 12.53 | 13.33 | 14.17 | 14.54 | 15.3 | 13.6 | 19.26 | 18.67 | 18.86 | 14.71 | 14.8 | 13.36 | 13.5 | 13.7 |
| Fe2O3 | 1.56 | 1.72 | .25 | .42 | .38 | 3.1 | .8 | 1.48 | 2.75 | .69 | .83 | .73 | .14 | .12 | .36 |
| FeO | 2.72 | 3.01 | .45 | .73 | .67 | 5.41 | 1.4 | 2.59 | 4.8 | 1.2 | 1.46 | 1.28 | .26 | .22 | .64 |
| MgO | .39 | .39 | .11 | .33 | .32 | 6.88 | .21 | .66 | 8.77 | .17 | .65 | .58 | .05 | .05 | .19 |
| CaO | 1.13 | 1.22 | .65 | 1.17 | 1.43 | 8.73 | .78 | 2.9 | 9.7 | 1.2 | 2.09 | 2.05 | 1.24 | .52 | 1.2 |
| Na2O | 4.64 | 4.56 | 4.44 | 4 | 3.97 | 3.23 | 4.3 | 5.06 | 2.99 | 5.8 | 4.1 | 3.99 | 4.65 | 3.91 | 3.92 |
| K2O | 4.8 | 4.7 | 4.2 | 4.41 | 4.53 | 2.04 | 5.03 | 5.74 | .62 | 6.65 | 3.67 | 4.03 | 3.92 | 4.71 | 4.57 |
| LOI | .04 | .01 | .28 | .93 | .45 | .01 | .01 | .26 | .35 | .65 | .55 | .71 | .99 | .52 | .94 |
| TiO2 | .47 | .52 | .06 | .18 | .19 | 1.18 | .17 | .73 | .62 | .29 | .37 | .31 | .01 | .03 | .1 |
| P2O5 | .1 | .12 | .02 | .07 | .06 | .43 | .02 | .17 | .15 | .02 | .13 | .11 | .02 | .02 | .02 |
| MnO | .1 | .12 | .04 | .02 | .01 | .15 | .05 | .07 | .11 | .01 | .04 | .04 | .1 | .01 | .04 |
| Zr2O | .07 | .02 | .01 | .02 | .02 | .02 | .04 | .11 | .01 | .07 | .02 | .02 | .01 | .01 | .01 |
| TOTAL | 98.81 | 99.36 | 99.2 | 98.82 | 99.01 | 99.2 | 99.46 | 98.95 | 99.36 | 99.8 | 99.71 | 99.64 | 99.83 | 99.41 | 99.14 |
| NORM | | | | | | | | | | | | | | | |
| Q | 21.79 | 22.8 | 31.94 | 29.43 | 28.63 | --- | 26.37 | .72 | --- | 1.68 | 27.52 | 26.9 | 30.6 | 33.96 | 30.26 |
| C | --- | --- | .35 | .87 | .66 | --- | --- | --- | --- | --- | .51 | .41 | --- | 1.08 | .17 |
| Z | .1 | .03 | .01 | .03 | .03 | .03 | .06 | .16 | .01 | .11 | .03 | .03 | .01 | .01 | .02 |
| OR | 28.71 | 27.95 | 25.02 | 26.37 | 27.04 | 12.15 | 29.88 | 34.28 | 3.69 | 39.37 | 21.75 | 23.9 | 23.2 | 28 | 27.24 |
| AB | 39.64 | 38.53 | 37.87 | 34.25 | 33.93 | 27.55 | 36.58 | 43.27 | 25.46 | 49.17 | 34.79 | 33.88 | 39.42 | 33.28 | 33.46 |
| AN | --- | --- | 3.12 | 5.41 | 6.77 | 21.4 | 2.97 | 13.02 | 35.92 | 5.8 | 9.55 | 9.49 | 4.01 | 2.46 | 5.87 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | .08 | .27 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | 2.09 | 2.21 | --- | --- | --- | 8.11 | .33 | .16 | 4.81 | .01 | --- | --- | .84 | --- | --- |
| EN | .98 | .98 | .28 | .83 | .8 | 17.1 | .53 | 1.66 | 12.12 | .42 | 1.62 | 1.45 | .12 | .13 | .48 |
| FS | 3.18 | 3.57 | .6 | .74 | .63 | 5.69 | 1.73 | 2.48 | 3.18 | 1.18 | 1.46 | 1.31 | .53 | .28 | .79 |
| FO | --- | --- | --- | --- | --- | .12 | --- | --- | 6.91 | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | .05 | --- | --- | 2 | --- | --- | --- | --- | --- | --- |
| MT | 2.25 | 2.38 | .37 | .62 | .56 | 4.53 | 1.17 | 2.17 | 4.01 | 1 | 1.21 | 1.06 | .2 | .18 | .53 |
| IL | .9 | .99 | .11 | .35 | .36 | 2.26 | .32 | 1.4 | 1.19 | .55 | .7 | .59 | .02 | .06 | .19 |
| AP | .24 | .29 | .05 | .17 | .14 | 1.03 | .05 | .41 | .36 | .05 | .31 | .26 | .05 | .05 | .05 |
| TOTAL | 99.97 | 100 | 99.72 | 99.06 | 99.55 | 100.01 | 99.99 | 99.75 | 99.66 | 99.35 | 99.46 | 99.29 | 99.01 | 99.48 | 99.05 |
| SALIC | 90.24 | 89.31 | 98.32 | 96.36 | 97.05 | 61.13 | 95.87 | 91.46 | 65.09 | 96.13 | 94.15 | 94.61 | 97.24 | 98.8 | 97.02 |
| FEMIC | 9.73 | 10.68 | 1.4 | 2.7 | 2.5 | 38.89 | 4.13 | 8.29 | 34.57 | 3.22 | 5.31 | 4.68 | 1.77 | .68 | 2.04 |
| D INDEX | 90.14 | 89.28 | 94.83 | 90.06 | 89.6 | 39.71 | 92.84 | 78.27 | 29.15 | 90.22 | 84.06 | 84.69 | 93.22 | 95.24 | 90.95 |
| DI | 4.31 | 4.57 | --- | --- | --- | 15.57 | .68 | .33 | 9.19 | .03 | --- | --- | 1.27 | --- | --- |
| DIEN | .52 | .51 | --- | --- | --- | 5.6 | .08 | .07 | 3.47 | 0 | --- | --- | .12 | --- | --- |
| DIFS | 1.69 | 1.85 | --- | --- | --- | 1.86 | .27 | .1 | .91 | .01 | --- | --- | .53 | --- | --- |
| DIWO | 2.09 | 2.21 | --- | --- | --- | 8.11 | .33 | .16 | 4.81 | .01 | --- | --- | .61 | --- | --- |
| HY | 1.95 | 2.19 | .88 | 1.57 | 1.43 | 15.33 | 1.91 | 3.98 | 10.92 | 1.58 | 3.09 | 2.76 | --- | .4 | 1.27 |
| HYEN | .46 | .47 | .28 | .83 | .8 | 11.5 | .44 | 1.59 | 8.65 | .42 | 1.62 | 1.45 | --- | .13 | .48 |
| HYFS | 1.49 | 1.72 | .6 | .74 | .63 | 3.83 | 1.46 | 2.39 | 2.27 | 1.16 | 1.46 | 1.31 | --- | .28 | .79 |
| OL | --- | --- | --- | --- | --- | .17 | --- | --- | 8.91 | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155710 | 155711 | 155712 | 155713 | 155714 | 155715 | 155716 | 155717 | 155718 | 155719 | 155720 | 155721 | 155722 | 155723 | 155724 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 75.88 | 75.11 | 71.2 | 72.63 | 74.55 | 73.92 | 73.21 | 63.99 | 75.66 | 76.83 | 76.87 | 74.46 | 74.95 | 76.59 | 75.4 |
| Al2O3 | 13.45 | 13.65 | 14.06 | 13.64 | 13.14 | 13.34 | 13.8 | 16.42 | 12.92 | 12.24 | 12.28 | 12.53 | 12.78 | 11.96 | 12.73 |
| Fe2O3 | .19 | .23 | .8 | .47 | .49 | .52 | .51 | 1.37 | .33 | .3 | .28 | .64 | .42 | .43 | .46 |
| FeO | .33 | .4 | 1.41 | .83 | .86 | .9 | .89 | 2.4 | .58 | .53 | .49 | 1.13 | .74 | .76 | .8 |
| MgO | .05 | .05 | .5 | .32 | .22 | .2 | .44 | 1.3 | .16 | .11 | .05 | .17 | .16 | .05 | .22 |
| CaO | .76 | .81 | 1.41 | 1.44 | .7 | .82 | 1.54 | 3.44 | .54 | .48 | .51 | .63 | .57 | .32 | .72 |
| Na2O | 4.6 | 4.45 | 3.48 | 3.5 | 3.8 | 4.03 | 4 | 5.42 | 3.36 | 3.44 | 3.52 | 3.78 | 3.83 | 3.87 | 3.62 |
| K2O | 3.62 | 3.91 | 5.04 | 4.57 | 4.75 | 4.74 | 4.13 | 2.53 | 5.46 | 4.94 | 4.96 | 5.19 | 5.42 | 4.86 | 4.99 |
| LOI | .39 | .48 | .47 | 1.29 | .55 | .54 | .49 | 1.3 | .36 | .55 | .5 | .32 | .28 | .4 | .46 |
| TiO2 | .01 | .01 | .36 | .22 | .14 | .13 | .21 | .68 | .16 | .11 | .12 | .16 | .16 | .1 | .16 |
| P2O5 | .02 | .02 | .13 | .02 | .02 | .02 | .06 | .24 | .02 | .02 | .02 | .02 | .02 | .02 | .02 |
| MnO | .06 | .09 | .04 | .03 | .01 | .02 | .04 | .16 | .02 | .04 | .05 | .01 | .01 | .01 | .01 |
| Zr2O | .01 | .01 | .03 | .02 | .02 | .02 | .01 | .03 | .02 | .02 | .01 | .06 | .01 | .03 | .02 |
| TOTAL | 99.37 | 99.22 | 98.93 | 98.98 | 99.25 | 99.2 | 99.33 | 99.28 | 99.59 | 99.61 | 99.66 | 99.1 | 99.35 | 99.4 | 99.61 |
| NORM | | | | | | | | | | | | | | | |
| Q | 33.58 | 32.44 | 27.91 | 31.21 | 32.29 | 30.1 | 30.12 | 13.65 | 33.75 | 36.63 | 36.16 | 30.96 | 30.59 | 34.69 | 33.17 |
| C | .63 | .68 | .63 | .37 | .53 | .14 | .09 | --- | .55 | .41 | .24 | --- | --- | --- | .11 |
| Z | .02 | .02 | .05 | .03 | .03 | .03 | .02 | .05 | .03 | .03 | .02 | .09 | .02 | .04 | .03 |
| OR | 21.53 | 23.29 | 30.1 | 27.28 | 28.28 | 28.24 | 24.57 | 15.06 | 32.4 | 29.31 | 29.41 | 30.95 | 32.24 | 28.89 | 29.6 |
| AB | 39.17 | 37.95 | 29.77 | 29.92 | 32.4 | 34.38 | 34.07 | 46.19 | 28.55 | 29.22 | 29.89 | 32.28 | 32.62 | 32.95 | 30.75 |
| AN | 3.66 | 3.92 | 6.21 | 7.09 | 3.37 | 3.97 | 7.3 | 13.1 | 2.56 | 2.26 | 2.41 | 1.91 | 1.68 | .91 | 3.45 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | --- | --- | --- | --- | --- | 1.05 | --- | --- | --- | .46 | .43 | .23 | --- |
| EN | .13 | .13 | 1.26 | .81 | .55 | .5 | 1.1 | 3.26 | .4 | .28 | .12 | .43 | .4 | .13 | .55 |
| FS | .55 | .7 | 1.42 | .84 | .97 | 1.05 | .95 | 2.47 | .57 | .62 | .57 | 1.31 | .77 | .9 | .85 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | .28 | .34 | 1.17 | .69 | .72 | .76 | .74 | 2 | .48 | .44 | .41 | .94 | .61 | .63 | .67 |
| IL | .02 | .02 | .69 | .42 | .27 | .25 | .4 | 1.3 | .31 | .21 | .23 | .31 | .31 | .19 | .31 |
| AP | .05 | .05 | .31 | .05 | .05 | .05 | .14 | .57 | .05 | .05 | .05 | .05 | .05 | .05 | .05 |
| TOTAL | 99.61 | 99.52 | 99.53 | 98.7 | 99.45 | 99.46 | 99.51 | 98.71 | 99.64 | 99.45 | 99.5 | 99.68 | 99.72 | 99.6 | 99.54 |
| SALIC | 98.59 | 98.29 | 94.68 | 95.9 | 96.89 | 96.84 | 96.17 | 88.05 | 97.84 | 97.86 | 98.13 | 96.18 | 97.15 | 97.48 | 97.12 |
| FEMIC | 1.02 | 1.23 | 4.86 | 2.8 | 2.55 | 2.61 | 3.34 | 10.65 | 1.8 | 1.59 | 1.37 | 3.49 | 2.57 | 2.12 | 2.42 |
| D INDEX | 94.28 | 93.68 | 87.78 | 88.42 | 92.97 | 92.71 | 88.76 | 74.9 | 94.7 | 95.16 | 95.46 | 94.18 | 95.45 | 96.52 | 93.52 |
| DI | --- | --- | --- | --- | --- | --- | --- | 2.06 | --- | --- | --- | .95 | .87 | .48 | --- |
| DIEN | --- | --- | --- | --- | --- | --- | --- | .58 | --- | --- | --- | .12 | .15 | .03 | --- |
| DIFS | --- | --- | --- | --- | --- | --- | --- | .44 | --- | --- | --- | .37 | .29 | .22 | --- |
| DIWO | --- | --- | --- | --- | --- | --- | --- | 1.05 | --- | --- | --- | .46 | .43 | .23 | --- |
| HY | .67 | .83 | 2.68 | 1.64 | 1.52 | 1.56 | 2.05 | 4.72 | .97 | .9 | .69 | 1.25 | .73 | .77 | 1.4 |
| HYEN | .13 | .13 | 1.26 | .81 | .55 | .5 | 1.1 | 2.69 | .4 | .28 | .12 | .31 | .25 | .09 | .55 |
| HYFS | .55 | .7 | 1.42 | .84 | .97 | 1.05 | .95 | 2.03 | .57 | .62 | .57 | .94 | .48 | .68 | .85 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155725 | 155726 | 155726A | 155727 | 155728 | 155729 | 155730 | 155731 | 155732 | 155733 | 155734 | 155735 | 155736 | 155737 | 155738 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 75.83 | 76.21 | 76.11 | 76.6 | 72.48 | 74.44 | 73.73 | 74.47 | 77.3 | 72.06 | 76.6 | 74.32 | 73.74 | 76.16 | 75.85 |
| Al2O3 | 12.57 | 12.19 | 12.19 | 12.18 | 13.96 | 13.51 | 13.42 | 13.35 | 12.37 | 14.12 | 12.65 | 12.62 | 12.7 | 12.2 | 12.69 |
| Fe2O3 | .46 | .42 | .44 | .42 | .61 | .36 | .48 | .41 | .27 | .62 | .35 | .69 | .83 | .38 | .36 |
| FeO | .81 | .74 | .78 | .74 | 1.08 | .63 | .85 | .73 | .48 | 1.09 | .61 | 1.21 | 1.45 | .66 | .62 |
| MgO | .18 | .17 | .17 | .16 | .46 | .22 | .34 | .29 | .12 | .51 | .11 | .15 | .14 | .14 | .05 |
| CaO | .62 | .56 | .6 | .44 | 1.56 | 1.36 | 1.4 | 1.17 | .71 | 1.56 | .8 | .56 | .63 | .76 | .47 |
| Na2O | 3.67 | 3.47 | 3.39 | 3.27 | 3.31 | 3.61 | 3.21 | 3.32 | 3.4 | 3.55 | 3.41 | 4.27 | 4.24 | 3.64 | 3.87 |
| K2O | 4.94 | 4.88 | 4.86 | 4.97 | 5.09 | 4.51 | 5.01 | 4.79 | 4.33 | 5.04 | 4.67 | 4.62 | 4.7 | 4.61 | 4.52 |
| LOI | .53 | .66 | .76 | .69 | .55 | .4 | .66 | .51 | .43 | .53 | .33 | .31 | .44 | .66 | .62 |
| TiO2 | .15 | .13 | .14 | .13 | .24 | .13 | .18 | .14 | .09 | .26 | .07 | .15 | .19 | .08 | .06 |
| P2O5 | .02 | .02 | .02 | .02 | .06 | .02 | .02 | .02 | .02 | .08 | .02 | .02 | .02 | .02 | .02 |
| MnO | .01 | .01 | .01 | .01 | .04 | .03 | .03 | .03 | .1 | .3 | .02 | .01 | .03 | .04 | .01 |
| Zr2O | .02 | .02 | .02 | .02 | .02 | .01 | .02 | .01 | 0 | .02 | .01 | .04 | .06 | .02 | .01 |
| TOTAL | 99.81 | 99.48 | 99.49 | 99.65 | 99.46 | 99.23 | 99.35 | 99.24 | 99.62 | 99.74 | 99.65 | 98.97 | 99.17 | 99.37 | 99.15 |
| NORM | | | | | | | | | | | | | | | |
| Q | 33.69 | 35.76 | 36.09 | 37.18 | 29.51 | 32.92 | 32.22 | 33.82 | 39.14 | 27.57 | 36.85 | 30.3 | 29.29 | 35.46 | 34.96 |
| C | .11 | .23 | .31 | .67 | .31 | .27 | .22 | .63 | .85 | .18 | .58 | --- | --- | --- | .63 |
| Z | .03 | .03 | .03 | .03 | .03 | .02 | .02 | .02 | .01 | .03 | .02 | .06 | .09 | .03 | .02 |
| OR | 29.25 | 20.99 | 28.87 | 29.47 | 30.24 | 26.86 | 29.8 | 28.52 | 25.68 | 29.86 | 27.69 | 27.58 | 20.01 | 27.42 | 26.94 |
| AB | 31.11 | 29.52 | 28.83 | 27.77 | 20.16 | 30.78 | 27.34 | 28.31 | 28.88 | 30.12 | 20.95 | 36.51 | 36.18 | 31 | 33.03 |
| AN | 2.95 | 2.66 | 2.86 | 2.06 | 7.39 | 6.67 | 6.86 | 5.72 | 3.4 | 7.24 | 3.85 | 1.64 | 1.75 | 3.36 | 2.22 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .43 | .53 | .13 | --- |
| EN | .45 | .43 | .43 | .4 | 1.15 | .55 | .85 | .73 | .3 | 1.27 | .27 | .38 | .35 | .35 | .13 |
| FS | .88 | .82 | .86 | .82 | 1.16 | .71 | .93 | .83 | .7 | 1.62 | .76 | 1.44 | 1.73 | .85 | .77 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | .67 | .61 | .64 | .61 | .89 | .53 | .7 | .6 | .39 | .9 | .51 | 1.01 | 1.21 | .55 | .53 |
| IL | .29 | .25 | .27 | .25 | .46 | .25 | .34 | .27 | .17 | .5 | .13 | .29 | .36 | .15 | .11 |
| AP | .05 | .05 | .05 | .05 | .14 | .05 | .05 | .05 | .05 | .19 | .05 | .05 | .05 | .05 | .05 |
| TOTAL | 99.47 | 99.34 | 99.24 | 99.31 | 99.45 | 99.6 | 99.34 | 99.49 | 99.57 | 99.48 | 99.67 | 99.69 | 99.56 | 99.34 | 99.38 |
| SALIC | 97.14 | 97.18 | 97 | 97.18 | 95.64 | 97.52 | 96.46 | 97.01 | 97.96 | 94.99 | 97.95 | 96.09 | 95.32 | 97.26 | 97.79 |
| FEMIC | 2.33 | 2.15 | 2.24 | 2.12 | 3.81 | 2.08 | 2.87 | 2.48 | 1.61 | 4.48 | 1.72 | 3.59 | 4.24 | 2.08 | 1.58 |
| D INDEX | 94.05 | 94.26 | 93.79 | 94.42 | 87.91 | 90.57 | 89.36 | 90.65 | 93.7 | 87.55 | 93.5 | 94.39 | 93.48 | 93.87 | 94.92 |
| DI | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .89 | 1.1 | .26 | --- |
| DIEN | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .1 | .1 | .04 | --- |
| DIFS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .36 | .47 | .09 | --- |
| DIWO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | .43 | .53 | .13 | --- |
| HY | 1.33 | 1.25 | 1.29 | 1.22 | 2.32 | 1.26 | 1.78 | 1.56 | 1 | 2.9 | 1.03 | 1.35 | 1.52 | 1.06 | .89 |
| HYEN | .45 | .43 | .43 | .4 | 1.15 | .55 | .85 | .73 | .3 | 1.27 | .27 | .28 | .26 | .31 | .13 |
| HYFS | .88 | .82 | .86 | .82 | 1.16 | .71 | .93 | .83 | .7 | 1.62 | .76 | 1.07 | 1.26 | .75 | .77 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 1.--Chemical and normative compositions of postorogenic plutonic rocks from the southwestern Arabian Shield--(Continued)

| SAMPLE | 155739 | 155742 | 155743 | 155744 | 155745 | 155746 | 155747 | 155748 | 155749 | 155750 | 155751 | 155752 | 155753 | 155754 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SiO2 | 72.02 | 65.5 | 65.77 | 76.06 | 76.04 | 74.27 | 74.09 | 72.66 | 72.25 | 72.89 | 69.58 | 70.13 | 74.65 | 71.58 |
| Al2O3 | 14.1 | 17.97 | 16.27 | 11.92 | 11.91 | 11.62 | 12.53 | 13.03 | 12.95 | 14.48 | 15.33 | 15.12 | 13.76 | 15.25 |
| Fe2O3 | .71 | .64 | .98 | .68 | .56 | 1.13 | .88 | .84 | 1.19 | .42 | .92 | .87 | .32 | .54 |
| FeO | 1.25 | 1.12 | 1.72 | 1.19 | .98 | 1.98 | 1.54 | 1.47 | 2.09 | .74 | 1.61 | 1.52 | .56 | .94 |
| MgO | .4 | .34 | .7 | .12 | .11 | .05 | .11 | .15 | .2 | .32 | .79 | .71 | .19 | .58 |
| CaO | 1.47 | .69 | 1.41 | .5 | .42 | .44 | .53 | .9 | .68 | 1.85 | 2.66 | 2.56 | 1.27 | 2.22 |
| Na2O | 4.09 | 6.39 | 5.86 | 3.75 | 3.7 | 4.05 | 4.08 | 4.25 | 4.08 | 4.3 | 3.8 | 3.82 | 3.26 | 4.11 |
| K2O | 4.2 | 5.78 | 4.82 | 4.76 | 4.95 | 4.89 | 5.01 | 4.77 | 4.94 | 3.75 | 3.75 | 3.72 | 5.34 | 3.64 |
| LOI | .4 | .21 | .29 | .23 | .39 | .55 | .14 | .84 | .72 | .64 | .59 | .25 | .21 | .27 |
| TiO2 | .23 | .5 | .71 | .11 | .13 | .31 | .23 | .22 | .33 | .21 | .45 | .4 | .1 | .24 |
| P2O5 | .09 | .06 | .19 | .02 | .02 | .02 | .02 | .02 | .02 | .06 | .15 | .14 | .02 | .08 |
| MnO | .05 | .06 | .11 | .01 | .01 | .07 | .03 | .03 | .08 | .03 | .04 | .04 | .01 | .02 |
| ZrO2 | .02 | .09 | .08 | .04 | .04 | .03 | .05 | .04 | .04 | .01 | .04 | .03 | .01 | .02 |
| TOTAL | 99.03 | 99.35 | 98.91 | 99.39 | 99.26 | 99.41 | 99.24 | 99.22 | 99.57 | 99.7 | 99.71 | 99.31 | 99.7 | 99.49 |
| NORM | | | | | | | | | | | | | | |
| Q | 28.28 | 4.01 | 9.55 | 34.52 | 34.43 | 30.79 | 29.64 | 27.43 | 27.06 | 29.01 | 26.03 | 27.02 | 32.11 | 28.06 |
| C | .37 | .09 | --- | --- | --- | --- | --- | --- | --- | .13 | .54 | .49 | .36 | .71 |
| Z | .03 | .14 | .13 | .06 | .05 | .05 | .08 | .06 | .07 | .02 | .06 | .05 | .02 | .03 |
| OR | 25.06 | 34.38 | 28.8 | 28.3 | 29.47 | 29.07 | 29.03 | 28.41 | 29.32 | 22.23 | 22.22 | 22.13 | 31.65 | 21.62 |
| AB | 34.95 | 54.42 | 50.13 | 31.93 | 31.54 | 32.74 | 34.79 | 36.24 | 34.67 | 36.49 | 32.25 | 32.55 | 27.67 | 34.96 |
| AN | 6.77 | 3.05 | 3.9 | 1.64 | 1.28 | --- | 1.09 | 2.41 | 2.44 | 8.81 | 12.25 | 11.87 | 6.19 | 10.54 |
| NE | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AC | --- | --- | --- | --- | --- | 1.53 | --- | --- | --- | --- | --- | --- | --- | --- |
| NS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WO | --- | --- | .8 | .3 | .29 | .86 | .6 | .82 | .34 | --- | --- | --- | --- | --- |
| EN | 1.01 | .85 | 1.76 | .3 | .28 | .13 | .28 | .38 | .5 | .8 | 1.97 | 1.78 | .47 | 1.45 |
| FS | 1.44 | .82 | 1.4 | 1.47 | 1.15 | 2.77 | 1.79 | 1.71 | 2.47 | .72 | 1.53 | 1.5 | .62 | .93 |
| FO | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FA | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MT | 1.04 | .93 | 1.44 | .99 | .82 | .88 | 1.29 | 1.23 | 1.73 | .61 | 1.34 | 1.27 | .47 | .79 |
| IL | .44 | .96 | 1.36 | .21 | .25 | .59 | .44 | .42 | .63 | .4 | .86 | .76 | .19 | .46 |
| AP | .22 | .14 | .45 | .05 | .05 | .05 | .05 | .05 | .05 | .14 | .36 | .33 | .05 | .19 |
| TOTAL | 99.6 | 99.79 | 99.72 | 99.77 | 99.61 | 99.45 | 99.86 | 99.15 | 99.28 | 99.36 | 99.42 | 99.76 | 99.79 | 99.73 |
| SALIC | 95.46 | 96.09 | 92.5 | 96.45 | 96.78 | 92.64 | 95.42 | 94.55 | 93.56 | 96.69 | 93.36 | 94.11 | 97.99 | 95.92 |
| FEMIC | 4.14 | 3.7 | 7.21 | 3.32 | 2.03 | 6.81 | 4.44 | 4.6 | 5.72 | 2.68 | 6.06 | 5.65 | 1.8 | 3.81 |
| D INDEX | 88.29 | 92.81 | 88.48 | 94.74 | 95.45 | 92.59 | 94.26 | 92.08 | 91.05 | 87.73 | 80.51 | 81.7 | 91.43 | 84.64 |
| DI | --- | --- | 1.58 | .62 | .59 | 1.03 | 1.25 | 1.7 | .71 | --- | --- | --- | --- | --- |
| DIEN | --- | --- | .43 | .06 | .06 | .04 | .09 | .16 | .06 | --- | --- | --- | --- | --- |
| DIFS | --- | --- | .34 | .27 | .25 | .92 | .56 | .72 | .31 | --- | --- | --- | --- | --- |
| DIWO | --- | --- | .8 | .3 | .29 | .86 | .6 | .82 | .34 | --- | --- | --- | --- | --- |
| HY | 2.44 | 1.67 | 2.38 | 1.45 | 1.12 | 1.93 | 1.42 | 1.21 | 2.6 | 1.52 | 3.51 | 3.28 | 1.09 | 2.38 |
| HYEN | 1.01 | .85 | 1.33 | .25 | .22 | .08 | .19 | .22 | .44 | .8 | 1.97 | 1.78 | .47 | 1.45 |
| HYFS | 1.44 | .82 | 1.05 | 1.2 | .9 | 1.85 | 1.23 | .99 | 2.16 | .72 | 1.53 | 1.5 | .62 | .93 |
| OL | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | J. Nis | | | | | | | |
| 155575 | 20 2 49 | 41 13 12 | 133.0 | 190.0 | 24 | 261 | 21 | 3.45 | 4.81 | 13.50 | 13.90 |
| 155576 | 20 3 22 | 41 13 1 | 127.0 | 227.0 | 22 | 217 | 17 | 3.54 | 4.03 | 9.29 | 11.20 |
| 155577 | 20 3 7 | 41 13 23 | 139.0 | 226.0 | 24 | 268 | 22 | 4.33 | 3.78 | 14.10 | 12.50 |
| | | | | J. Shada | | | | | | | |
| 155578 | 19 50 31 | 41 18 47 | 106.0 | 203.0 | 21 | 150 | 15 | 3.51 | 3.25 | 9.13 | 8.84 |
| 155579 | 19 50 31 | 41 18 47 | 167.0 | 8.2 | 25 | 57 | 8 | 3.75 | 3.48 | 6.99 | 7.08 |
| 155587 | 19 51 4 | 41 19 19 | 87.0 | 532.0 | 14 | 156 | 5 | 1.90 | 1.53 | 10.10 | 9.35 |
| 155588 | 19 51 4 | 41 19 19 | 88.9 | 519.0 | 9 | 174 | 4 | 1.44 | 1.47 | 6.53 | 6.19 |
| 155589 | 19 51 18 | 41 19 55 | 131.0 | 98.8 | 28 | 122 | 14 | 3.61 | 3.05 | 12.00 | 11.40 |
| | | | | J. Durram | | | | | | | |
| 155580 | 18 46 8 | 42 16 26 | 110.0 | 73.6 | 23 | 174 | 25 | 4.93 | 3.58 | 12.80 | 13.20 |
| 155581 | 18 46 8 | 42 16 26 | 115.0 | 58.9 | 27 | 193 | 28 | 5.13 | 4.11 | 15.30 | 15.00 |
| 155582 | 18 46 44 | 42 17 49 | 92.4 | 41.4 | 20 | 154 | 24 | 3.74 | 3.36 | 12.70 | 14.00 |
| | | | | J. Barquq | | | | | | | |
| 155583 | 18 48 14 | 42 11 28 | 69.5 | 394.0 | 13 | 283 | 10 | 1.05 | .85 | 6.08 | 6.51 |
| 155584 | 18 47 46 | 42 11 42 | 149.0 | 168.0 | 14 | 131 | 19 | 6.44 | 4.77 | 6.80 | 8.95 |
| 155585 | 18 47 46 | 42 11 42 | 158.0 | 184.0 | 15 | 143 | 20 | 5.84 | 4.74 | 13.40 | 13.90 |
| 155586 | 18 47 28 | 42 12 0 | 61.9 | 405.0 | 13 | 319 | 12 | 1.38 | 1.44 | 1.80 | 3.22 |
| | | | | Al Ajarda | | | | | | | |
| 155591 | 19 10 19 | 41 58 19 | 80.3 | 153.0 | 16 | 127 | 24 | .78 | .74 | 3.34 | 2.12 |
| 155592 | 19 10 19 | 41 58 19 | 52.0 | 379.0 | 27 | 128 | 51 | .98 | .91 | 3.10 | 2.41 |
| 155593 | 19 7 23 | 41 57 18 | 49.9 | 115.0 | 4 | 12 | 8 | .05 | .10 | .40 | <.10 |
| 155594 | 19 7 23 | 41 57 18 | 48.7 | 252.0 | 3 | 24 | 6 | .05 | .13 | .50 | .18 |
| 155595 | 19 6 29 | 41 59 49 | 17.3 | 1,750.0 | 10 | 56 | 14 | .29 | .35 | .55 | .80 |
| | | | | J. Fuqa'ah | | | | | | | |
| 155596 | 19 3 4 | 41 26 10 | 116.0 | 79.2 | 42 | 125 | 6 | 4.00 | 2.14 | 7.12 | 7.30 |
| | | | | Dar al Jabal | | | | | | | |
| 155597 | 19 50 38 | 41 32 38 | 41.8 | 296.0 | 14 | 95 | 6 | .97 | .59 | 2.20 | 3.00 |
| 155598 | 19 50 28 | 41 32 56 | 38.2 | 333.0 | 15 | 85 | 6 | 1.04 | .69 | .80 | 2.71 |
| 155598I | 19 50 28 | 41 32 56 | 36.0 | 297.0 | 20 | 109 | 2 | .32 | .50 | .80 | .35 |
| | | | | J. Dugayna | | | | | | | |
| 155599 | 19 43 26 | 41 37 44 | 157.0 | 133.0 | 22 | 109 | 43 | 10.20 | 6.40 | 2.00 | 12.50 |
| 155600 | 19 42 32 | 41 40 5 | 140.0 | 134.0 | 24 | 105 | 36 | 6.10 | 3.30 | 13.40 | 13.90 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J. Nis | | | | | |
| 155575 | 3.30 | 2.76 | .70 | 248 | 4.03 | .96 | 4.21 | 1.39 | 1.32 | 1.00 |
| 155576 | 3.90 | 2.10 | .56 | 307 | 3.16 | 1.10 | 2.87 | 1.14 | 1.30 | 1.00 |
| 155577 | 3.64 | 2.95 | .62 | 262 | 2.89 | .84 | 3.43 | .87 | 1.32 | .96 |
| | | | | | J. Shada | | | | | |
| 155578 | 3.55 | 1.90 | .52 | 335 | 2.52 | 1.01 | 2.49 | .93 | 1.26 | 1.00 |
| 155579 | 3.87 | .55 | 20.35 | 232 | 1.89 | 1.03 | 1.83 | .93 | 1.13 | 1.07 |
| 155587 | 2.89 | 1.51 | .16 | 332 | 4.92 | 1.52 | 3.24 | .81 | 1.41 | 1.04 |
| 155588 | 2.91 | 1.57 | .17 | 327 | 4.30 | 2.02 | 2.13 | 1.02 | 1.42 | 1.04 |
| 155589 | 3.91 | 1.30 | 1.33 | 298 | 3.16 | 1.08 | 2.92 | .84 | 1.18 | 1.03 |
| | | | | | J. Durram | | | | | |
| 155580 | 4.23 | 1.07 | 1.50 | 385 | 2.68 | .86 | 3.12 | .73 | 1.12 | 1.01 |
| 155581 | 4.57 | 1.19 | 1.94 | 397 | 2.92 | .89 | 3.28 | .80 | 1.11 | 1.01 |
| 155582 | 4.42 | .92 | 2.23 | 478 | 3.74 | 1.18 | 3.17 | .90 | 1.12 | 1.06 |
| | | | | | J. Barqug | | | | | |
| 155583 | 4.23 | 2.45 | .18 | 609 | 6.20 | 4.03 | 1.54 | .81 | 1.30 | 1.06 |
| 155584 | 3.83 | 1.15 | .88 | 257 | 1.39 | .59 | 2.34 | .74 | 1.24 | 1.05 |
| 155585 | 4.05 | 1.57 | .86 | 256 | 2.38 | .69 | 3.43 | .81 | 1.24 | 1.05 |
| 155586 | 3.75 | 3.34 | .13 | 606 | 2.33 | 2.72 | .86 | 1.04 | 1.36 | .99 |
| | | | | | Al Ajarda | | | | | |
| 155591 | 4.28 | 3.73 | .53 | 533 | 2.72 | 5.49 | .50 | .95 | 1.06 | .95 |
| 155592 | 3.60 | 5.65 | .14 | 692 | 2.46 | 3.67 | .67 | .93 | 1.23 | .80 |
| 155593 | 4.58 | 1.99 | .43 | 918 | -- | 91.60 | -- | 2.00 | 1.06 | 1.01 |
| 155594 | 4.44 | .58 | .19 | 912 | 3.60 | 88.80 | .04 | 2.69 | 1.06 | 1.04 |
| 155595 | 2.08 | 3.45 | .01 | 1,202 | 2.76 | 7.17 | .38 | 1.21 | 1.51 | .93 |
| | | | | | J. Fuqa'ah | | | | | |
| 155596 | 3.76 | 1.54 | 1.47 | 324 | 1.82 | .94 | 1.94 | .54 | 1.22 | 1.03 |
| | | | | | Dar al Jabal | | | | | |
| 155597 | 1.57 | 3.95 | .14 | 376 | 3.09 | 1.62 | 1.91 | .61 | 2.02 | .94 |
| 155598 | 1.48 | 4.00 | .11 | 387 | 2.61 | 1.42 | 1.83 | .66 | 2.10 | .93 |
| 155598I | 1.67 | 6.10 | .12 | 464 | 1.09 | 5.22 | .21 | 1.56 | 2.08 | .83 |
| | | | | | J. Duqayna | | | | | |
| 155599 | 3.79 | 1.03 | 1.19 | 241 | 1.23 | .37 | 3.32 | .63 | 1.17 | 1.01 |
| 155600 | 3.88 | 1.04 | 1.05 | 277 | 2.28 | .64 | 3.58 | .54 | 1.17 | 1.04 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | J. Rafa | | | | | | | |
| 155601 | 20 27 47 | 41 58 5 | 103.0 | 11.9 | 80 | 305 | 20 | 4.00 | 2.31 | 7.31 | 7.96 |
| 155602 | 20 29 35 | 42 0 36 | 83.0 | 75.9 | 67 | 330 | 21 | 4.43 | 2.65 | 5.40 | 6.17 |
| 155603 | 20 30 29 | 42 1 8 | 72.7 | 51.6 | 72 | 335 | 18 | 3.69 | 2.26 | 4.30 | 5.38 |
| 155604 | 20 30 11 | 41 55 30 | 118.0 | 14.0 | 77 | 339 | 28 | 5.40 | 3.37 | 8.79 | 10.00 |
| 155605 | 20 28 41 | 41 55 48 | 101.0 | 23.3 | 73 | 310 | 21 | 5.15 | 2.76 | 5.20 | 7.73 |
| 155606 | 20 26 24 | 42 0 29 | 18.7 | 155.0 | 23 | 175 | 10 | 2.64 | 1.66 | 2.70 | 4.26 |
| | | | | Al Mu'taridah | | | | | | | |
| 155607 | 20 18 25 | 42 12 40 | 88.8 | 66.1 | 21 | 88 | 17 | 11.70 | 4.89 | 2.15 | 10.30 |
| 155608 | 20 18 25 | 42 12 40 | 25.2 | 429.0 | 11 | 111 | 4 | 1.26 | .66 | .90 | 1.05 |
| 155609 | 20 14 6 | 42 14 24 | 182.0 | 180.0 | 12 | 92 | 12 | 8.90 | 4.18 | 12.10 | 13.40 |
| 155610 | 20 12 58 | 42 14 35 | 229.0 | 127.0 | 15 | 117 | 14 | 8.07 | 4.25 | 13.50 | 12.20 |
| 155611 | 20 12 50 | 42 12 32 | 623.0 | 25.9 | 53 | 54 | 60 | 14.00 | 6.98 | 19.80 | 20.90 |
| | | | | J. Balas | | | | | | | |
| 155612 | 19 48 25 | 41 52 26 | 137.0 | 207.0 | 32 | 377 | 51 | 10.10 | 6.39 | 17.80 | 19.80 |
| 155613 | 19 48 47 | 41 53 24 | 134.0 | 204.0 | 34 | 406 | 47 | 6.36 | 3.45 | 18.00 | 19.30 |
| 155614 | 19 51 29 | 41 53 28 | 138.0 | 209.0 | 35 | 410 | 47 | 7.07 | 5.35 | 18.00 | 18.20 |
| | | | | Wadi Shumms | | | | | | | |
| 155615 | 19 53 42 | 41 51 32 | 97.0 | 37.0 | 56 | 590 | 89 | 6.91 | 3.84 | 19.20 | 18.30 |
| 155616 | 19 53 28 | 41 55 5 | 88.7 | 11.2 | 36 | 393 | 58 | 2.43 | 2.12 | 8.77 | 8.32 |
| 155617 | 19 57 11 | 41 52 59 | 44.5 | 132.0 | 24 | 289 | 32 | 1.15 | 1.20 | 4.18 | 4.64 |
| | | | | J. Abu Sadi | | | | | | | |
| 155618 | 20 25 16 | 40 0 22 | 168.0 | 180.0 | 28 | 199 | 17 | 3.71 | 3.93 | 12.80 | 15.50 |
| 155619 | 20 25 55 | 40 0 47 | 169.0 | 175.0 | 25 | 192 | 18 | 5.72 | 5.33 | 10.50 | 14.00 |
| 155620 | 20 26 49 | 40 1 5 | 124.0 | 305.0 | 21 | 242 | 12 | 2.89 | 3.21 | 11.80 | 11.90 |
| 155621 | 20 24 50 | 40 2 10 | 148.0 | 232.0 | 23 | 202 | 14 | 3.87 | 3.29 | 14.00 | 15.10 |
| | | | | Adam Pluton | | | | | | | |
| 155622 | 20 23 24 | 40 52 19 | 48.0 | 241.0 | 10 | 146 | 4 | 1.32 | 1.52 | 6.67 | 7.82 |
| 155623 | 20 23 24 | 40 52 19 | 119.0 | 358.0 | 14 | 169 | 9 | 1.41 | 1.60 | 6.68 | 8.40 |
| 155624 | 20 23 24 | 40 52 19 | 40.4 | 199.0 | 7 | 85 | 1 | .78 | .79 | 5.64 | 4.99 |
| 155625 | 20 24 11 | 40 55 44 | 120.0 | 320.0 | 24 | 198 | 16 | 2.30 | 2.55 | 7.62 | 7.57 |
| 155626 | 20 24 11 | 40 55 44 | 103.0 | 330.0 | 24 | 210 | 18 | 1.78 | 1.90 | 7.01 | 6.00 |
| | | | | J. Ibraham | | | | | | | |
| 155627 | 20 26 35 | 41 9 58 | 83.7 | 261.0 | 6 | 66 | 8 | 1.44 | 1.70 | 3.60 | 5.06 |
| 155628 | 20 26 35 | 41 9 58 | 76.8 | 327.0 | 4 | 92 | 8 | 1.12 | 1.19 | 4.43 | 5.05 |
| 155629 | 20 25 55 | 41 8 13 | 115.0 | 208.0 | 7 | 80 | 11 | 1.24 | 1.49 | 6.87 | 6.61 |
| 155630 | 20 24 54 | 41 7 59 | 63.0 | 530.0 | 10 | 165 | 8 | 1.19 | 1.96 | 4.51 | 6.54 |
| 155631 | 20 24 36 | 41 9 4 | 125.0 | 233.0 | 10 | 85 | 11 | 1.98 | 1.28 | 5.97 | 4.14 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J. Rafa | | | | | |
| 155601 | 3.37 | 1.50 | 8.68 | 327 | 1.99 | .84 | 2.36 | .58 | 1.02 | .98 |
| 155602 | 2.81 | 2.00 | 1.09 | 339 | 1.39 | .63 | 2.20 | .60 | 1.14 | .99 |
| 155603 | 2.80 | 1.94 | 1.41 | 385 | 1.46 | .76 | 1.92 | .61 | 1.06 | .95 |
| 155604 | 3.34 | 1.48 | 8.39 | 283 | 1.85 | .62 | 2.99 | .62 | 1.02 | .97 |
| 155605 | 3.24 | 1.46 | 4.33 | 321 | 1.50 | .63 | 2.39 | .54 | 1.05 | 1.01 |
| 155606 | .70 | 1.93 | .12 | 374 | 1.61 | .27 | 6.09 | .63 | 1.27 | 1.00 |
| | | | | | Al Mu'taridah | | | | | |
| 155607 | 2.19 | .67 | 1.34 | 247 | .88 | .19 | 4.70 | .42 | 1.24 | 1.02 |
| 155608 | .93 | 1.30 | .06 | 369 | .83 | .74 | 1.13 | .52 | 1.84 | 1.06 |
| 155609 | 3.67 | 1.08 | 1.01 | 202 | 1.51 | .41 | 3.65 | .47 | 1.26 | 1.03 |
| 155610 | 3.80 | 1.30 | 1.80 | 166 | 1.51 | .47 | 3.21 | .53 | 1.26 | 1.03 |
| 155611 | 3.53 | .68 | 24.06 | 57 | 1.49 | .25 | 5.92 | .50 | 1.18 | 1.09 |
| | | | | | J. Balas | | | | | |
| 155612 | 3.99 | 3.09 | .66 | 291 | 1.96 | .40 | 4.96 | .63 | 1.18 | .97 |
| 155613 | 4.06 | 3.10 | .66 | 303 | 3.03 | .64 | 4.75 | .54 | 1.21 | .96 |
| 155614 | 3.98 | 3.08 | .66 | 288 | 2.57 | .56 | 4.57 | .76 | 1.21 | .98 |
| | | | | | Wadi Shumas | | | | | |
| 155615 | 4.33 | 2.68 | 2.62 | 446 | 2.65 | .63 | 4.23 | .56 | 1.00 | .92 |
| 155616 | 4.00 | 1.96 | 7.90 | 451 | 3.42 | 1.65 | 2.08 | .87 | 1.02 | .98 |
| 155617 | 4.28 | 3.57 | .34 | 962 | 4.03 | 3.72 | 1.08 | 1.04 | 1.14 | .99 |
| | | | | | J. Abu Sadi | | | | | |
| 155618 | 3.87 | 2.08 | .93 | 230 | 4.18 | 1.04 | 4.01 | 1.06 | 1.30 | 1.02 |
| 155619 | 4.11 | 1.87 | .97 | 243 | 2.45 | .72 | 3.41 | .93 | 1.29 | 1.02 |
| 155620 | 3.72 | 2.55 | .41 | 300 | 4.12 | 1.29 | 3.20 | 1.11 | 1.42 | 1.04 |
| 155621 | 3.98 | 2.33 | .64 | 269 | 3.90 | 1.03 | 3.79 | .85 | 1.34 | 1.04 |
| | | | | | Adam Pluton | | | | | |
| 155622 | 2.33 | 1.92 | .20 | 485 | 5.92 | 1.77 | 3.36 | 1.15 | 1.47 | 1.05 |
| 155623 | 3.81 | 2.52 | .33 | 320 | 5.96 | 2.70 | 2.20 | 1.13 | 1.41 | 1.04 |
| 155624 | 2.69 | 1.30 | .20 | 666 | 6.40 | 3.45 | 1.86 | 1.01 | 1.36 | 1.06 |
| 155625 | 3.54 | 3.73 | .37 | 295 | 3.29 | 1.54 | 2.14 | 1.11 | 1.42 | .99 |
| 155626 | 3.83 | 3.55 | .31 | 372 | 3.37 | 2.15 | 1.57 | 1.07 | 1.42 | .98 |
| | | | | | J. Ibraham | | | | | |
| 155627 | 3.58 | 1.20 | .32 | 428 | 3.51 | 2.49 | 1.41 | 1.18 | 1.31 | 1.03 |
| 155628 | 3.41 | 1.44 | .23 | 444 | 4.51 | 3.04 | 1.48 | 1.06 | 1.35 | 1.02 |
| 155629 | 3.55 | 1.12 | .55 | 309 | 5.33 | 2.86 | 1.86 | 1.20 | 1.27 | 1.04 |
| 155630 | 3.42 | 2.81 | .12 | 543 | 5.50 | 2.87 | 1.91 | 1.65 | 1.50 | 1.00 |
| 155631 | 3.09 | 1.15 | .54 | 247 | 2.09 | 1.56 | 1.34 | .65 | 1.30 | 1.03 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Hawil | | | | | | | |
| 155632 | 20 57 36 | 41 21 50 | 77.4 | 32.9 | 9 | 94 | 10 | 1.46 | 1.39 | 4.30 | 4.74 |
| 155633 | 20 55 48 | 41 21 32 | 72.8 | 408.0 | 23 | 384 | 18 | .91 | .83 | 3.66 | 3.26 |
| 155634 | 20 54 36 | 41 20 49 | 39.6 | 126.0 | 18 | 342 | 9 | .13 | .10 | .50 | .68 |
| 155635 | 20 51 29 | 41 17 28 | 81.8 | 29.6 | 14 | 118 | 12 | 1.76 | 1.36 | 5.51 | 5.42 |
| 155641 | 20 52 34 | 41 19 30 | 64.2 | 129.0 | 19 | 331 | 13 | 1.25 | 1.13 | 6.92 | 5.50 |
| | | | | J. An | | | | | | | |
| 155636 | 21 17 28 | 41 10 23 | 135.0 | 28.4 | 91 | 1,170 | 120 | 2.24 | 1.79 | 9.30 | 9.46 |
| 155637 | 21 17 38 | 41 10 30 | 87.7 | 48.3 | 60 | 726 | 65 | 1.47 | 1.59 | 4.90 | 5.04 |
| 155638 | 21 17 17 | 41 10 59 | 82.6 | 42.7 | 59 | 727 | 66 | 1.41 | 1.38 | 4.50 | 5.28 |
| 155639 | 21 17 17 | 41 10 59 | 84.7 | 36.8 | 54 | 608 | 57 | 1.44 | 1.25 | 4.00 | 4.71 |
| 155640 | 21 17 28 | 41 10 41 | 86.5 | 43.2 | 61 | 675 | 65 | 1.42 | 1.28 | 5.38 | 5.67 |
| | | | | J. Qunnah | | | | | | | |
| 155642 | 21 4 16 | 41 9 7 | 204.0 | 6.0 | 91 | 177 | 140 | 6.24 | 2.72 | 19.60 | 20.40 |
| 155643 | 21 2 53 | 41 7 5 | 6.1 | 1,010.0 | 4 | 56 | 5 | .07 | .11 | .65 | .10 |
| 155644 | 21 2 53 | 41 7 5 | 8.1 | 1,270.0 | 4 | 43 | 3 | .07 | .17 | .65 | <.10 |
| | | | | Al Nahdah | | | | | | | |
| 155645 | 20 56 38 | 40 53 2 | 102.0 | 299.0 | 8 | 114 | 12 | 1.95 | 1.91 | 8.49 | 9.31 |
| 155646 | 20 53 28 | 40 52 34 | 112.0 | 198.0 | 16 | 152 | 14 | 1.25 | 1.46 | 7.26 | 6.55 |
| 155647 | 20 53 46 | 40 51 50 | 77.6 | 27.0 | 26 | 1,140 | 12 | .68 | .63 | .80 | .61 |
| | | | | J. Burgatinah | | | | | | | |
| 155648 | 20 47 56 | 39 51 18 | 45.9 | 70.3 | 56 | 793 | 47 | 1.51 | 1.71 | 5.62 | 4.67 |
| 155649 | 20 47 55 | 39 51 18 | 50.7 | 135.0 | 60 | 793 | 40 | 2.17 | 2.35 | 6.36 | 7.24 |
| 155650 | 20 47 56 | 39 51 18 | 59.9 | 72.6 | 58 | 508 | 37 | 2.52 | 2.33 | 6.42 | 6.36 |
| 155651 | 20 47 28 | 39 51 14 | 43.6 | 212.0 | 61 | 675 | 58 | 1.68 | 1.67 | 4.10 | 5.36 |
| | | | | Unnamed | | | | | | | |
| 155652 | 21 9 29 | 39 57 29 | 126.0 | 402.0 | 7 | 117 | 4 | 2.79 | 2.74 | 6.84 | 7.65 |
| 155653 | 21 9 11 | 39 57 7 | 136.0 | 446.0 | 9 | 164 | 4 | 2.57 | 2.50 | 9.58 | 8.77 |
| 155654 | 21 9 43 | 39 58 23 | 161.0 | 106.0 | 10 | 44 | 5 | 3.54 | 3.40 | 5.50 | 5.39 |
| 155655 | 21 10 59 | 39 59 2 | 61.0 | 823.0 | 21 | 297 | 12 | 2.00 | 2.22 | 5.10 | 5.63 |
| 155656 | 21 10 59 | 39 59 2 | 121.0 | 186.0 | 16 | 88 | 9 | 3.28 | 2.98 | 6.67 | 7.68 |
| 155657 | 21 10 59 | 39 59 2 | 85.2 | 501.0 | 10 | 133 | 8 | 2.92 | 3.03 | 8.48 | 8.61 |
| | | | | Judayrah | | | | | | | |
| 155658 | 21 23 28 | 40 25 23 | 171.0 | 34.9 | 6 | 56 | 8 | 5.05 | 3.25 | 55.20 | 51.30 |
| 155659 | 21 26 49 | 40 25 59 | 120.0 | 110.0 | 37 | 223 | 34 | 2.81 | 2.03 | 13.30 | 13.90 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Havil | | | | | |
| 155632 | 4.18 | .85 | 2.35 | 540 | 3.25 | 2.86 | 1.13 | .95 | 1.13 | 1.04 |
| 155633 | 3.47 | 2.75 | .18 | 477 | 3.58 | 3.81 | .94 | .91 | 1.23 | .96 |
| 155634 | 5.96 | 1.14 | .31 | 1,505 | 5.23 | 45.85 | .11 | .77 | 1.11 | 1.01 |
| 155635 | 4.17 | .92 | 2.77 | 510 | 3.08 | 2.37 | 1.30 | .77 | 1.13 | 1.06 |
| 155641 | 4.57 | 2.23 | .50 | 712 | 4.40 | 3.66 | 1.20 | .90 | 1.22 | 1.03 |
| | | | | | J. An | | | | | |
| 155636 | 4.29 | 3.96 | 4.78 | 318 | 4.22 | 1.92 | 2.21 | .80 | .98 | .92 |
| 155637 | 4.11 | 5.75 | 1.82 | 469 | 3.43 | 2.80 | 1.23 | 1.08 | 1.01 | .83 |
| 155638 | 4.14 | 6.42 | 1.93 | 501 | 3.74 | 2.94 | 1.28 | .98 | 1.03 | .88 |
| 155639 | 4.18 | 6.48 | 2.30 | 494 | 3.27 | 2.90 | 1.13 | .87 | .98 | .81 |
| 155640 | 4.21 | 6.06 | 2.00 | 487 | 3.99 | 2.96 | 1.35 | .90 | 1.03 | .94 |
| | | | | | J. Qunnah | | | | | |
| 155642 | 3.48 | 1.08 | 33.90 | 171 | 3.27 | .56 | 5.86 | .44 | 1.06 | 1.02 |
| 155643 | .15 | 6.11 | .01 | 246 | 1.43 | 2.14 | .67 | 1.57 | 7.42 | .76 |
| 155644 | .16 | 4.98 | .01 | 199 | -- | 2.29 | -- | 2.43 | 5.90 | .86 |
| | | | | | Al Mahdam | | | | | |
| 155645 | 2.81 | 1.67 | .34 | 275 | 4.77 | 1.44 | 3.31 | .98 | 1.38 | 1.01 |
| 155646 | 4.09 | 2.37 | .56 | 365 | 5.24 | 3.27 | 1.60 | 1.17 | 1.28 | .99 |
| 155647 | 4.77 | 4.90 | 2.87 | 615 | .90 | 7.01 | .13 | .93 | 1.17 | 1.00 |
| | | | | | J. Burqatinah | | | | | |
| 155548 | 3.41 | 4.27 | .65 | 743 | 3.09 | 2.26 | 1.37 | 1.13 | 1.10 | .95 |
| 155649 | 3.24 | 4.13 | .38 | 639 | 3.34 | 1.49 | 2.23 | 1.08 | 1.16 | .95 |
| 155650 | 3.57 | 3.55 | .82 | 596 | 2.52 | 1.42 | 1.78 | .92 | 1.11 | .98 |
| 155651 | 2.61 | 5.32 | .21 | 599 | 3.19 | 1.55 | 2.05 | .99 | 1.18 | .91 |
| | | | | | Unnamed | | | | | |
| 155652 | 4.46 | 1.30 | .31 | 354 | 2.74 | 1.60 | 1.72 | .98 | 1.28 | 1.01 |
| 155653 | 3.54 | 1.57 | .30 | 260 | 3.41 | 1.38 | 2.48 | .97 | 1.32 | 1.04 |
| 155654 | 3.57 | .46 | 1.52 | 222 | 1.52 | 1.01 | 1.51 | .96 | 1.24 | 1.06 |
| 155655 | 3.19 | 4.37 | .10 | 394 | 2.82 | 1.59 | 1.76 | 1.11 | 1.44 | .87 |
| 155556 | 4.01 | .60 | .65 | 331 | 2.34 | 1.22 | 1.92 | .91 | 1.22 | 1.05 |
| 155657 | 3.82 | 1.66 | .17 | 448 | 2.95 | 1.31 | 2.25 | 1.04 | 1.31 | .98 |
| | | | | | Judayrah | | | | | |
| 155658 | 4.54 | .50 | 4.91 | 265 | 10.16 | .90 | 11.30 | .64 | 1.15 | 1.05 |
| 155659 | 4.74 | 1.59 | 1.09 | 395 | 4.95 | 1.69 | 2.93 | .72 | 1.18 | 1.03 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | J. Sha'ir | | | | | | | |
| 155660 | 21 19 8 | 40 17 56 | 144.0 | 10.6 | 62 | 214 | 63 | 4.99 | 4.33 | 12.20 | 11.30 |
| | | | | Unnamed | | | | | | | |
| 155661 | 21 10 23 | 40 5 53 | 69.9 | 355.0 | 12 | 179 | 5 | 1.08 | .97 | 6.22 | 6.93 |
| 155662 | 21 10 1 | 40 9 7 | 122.0 | 464.0 | 7 | 142 | 5 | 3.73 | 4.23 | 6.99 | 8.54 |
| | | | | J. Abu Sibal | | | | | | | |
| 155663 | 21 19 55 | 39 37 30 | 75.8 | 258.0 | 9 | 75 | 2 | 1.34 | 1.50 | 3.90 | 4.22 |
| 155664 | 21 19 52 | 39 37 34 | 72.6 | 346.0 | 6 | 89 | 3 | 1.85 | 2.08 | 3.86 | 4.56 |
| 155665 | 21 19 52 | 39 37 34 | 70.8 | 366.0 | 7 | 89 | 3 | 1.62 | 1.82 | 3.84 | 4.65 |
| 155666 | 21 19 44 | 39 37 41 | 74.9 | 364.0 | 6 | 85 | 3 | 1.76 | 1.89 | 3.95 | 4.52 |
| | | | | Unnamed | | | | | | | |
| 155667 | 21 5 35 | 40 0 4 | 101.0 | 219.0 | 14 | 116 | 7 | 2.52 | 2.92 | 7.81 | 9.75 |
| 155668 | 21 5 35 | 40 0 4 | 104.0 | 225.0 | 15 | 133 | 7 | 2.65 | 2.34 | 10.70 | 11.00 |
| | | | | Unnamed | | | | | | | |
| 155569 | 21 5 35 | 40 5 56 | 98.3 | 461.0 | 9 | 206 | 4 | 1.71 | 1.52 | 11.70 | 11.90 |
| | | | | J. Sawdah | | | | | | | |
| 155670 | 20 47 56 | 40 13 1 | 131.0 | 221.0 | 15 | 177 | 11 | 1.73 | 1.69 | 12.10 | 12.20 |
| 155571 | 20 47 56 | 40 13 1 | 133.0 | 94.3 | 6 | 44 | 3 | 1.23 | 1.47 | 3.00 | 3.77 |
| 155672 | 20 47 24 | 40 14 13 | 145.0 | 284.0 | 30 | 303 | 22 | 1.49 | 1.39 | 10.00 | 11.50 |
| 155673 | 20 47 24 | 40 14 13 | 88.1 | 530.0 | 16 | 321 | 9 | 1.95 | 2.18 | 9.31 | 9.49 |
| | | | | J. Alonsa | | | | | | | |
| 155674 | 20 29 35 | 40 40 8 | 51.9 | 436.0 | 6 | 77 | 6 | .56 | .57 | 1.60 | 1.68 |
| 155675 | 20 29 35 | 40 40 8 | 56.1 | 545.0 | 6 | 81 | 6 | .45 | .48 | 1.70 | 1.80 |
| | | | | Unnamed | | | | | | | |
| 155676 | 20 32 24 | 40 57 40 | 145.0 | 215.0 | 33 | 175 | 38 | 3.59 | 3.70 | 9.54 | 10.40 |
| 155677 | 20 32 24 | 40 57 40 | 153.0 | 209.0 | 24 | 271 | 31 | 3.18 | 3.76 | 15.70 | 17.30 |
| | | | | J. Wajiah | | | | | | | |
| 155578 | 20 16 12 | 42 41 46 | 140.0 | 123.0 | 30 | 190 | 23 | 3.79 | 3.66 | 12.70 | 10.80 |
| 155679 | 20 16 59 | 42 38 46 | 88.5 | 83.0 | 54 | 1,010 | 14 | 2.32 | 2.27 | 11.60 | 9.90 |
| 155680 | 20 16 34 | 42 37 23 | 96.0 | 59.0 | 35 | 354 | 13 | 2.33 | 2.41 | 7.20 | 6.73 |
| 155681 | 20 16 34 | 42 37 23 | 113.0 | 36.0 | 35 | 217 | 11 | 2.07 | 1.83 | 7.26 | 7.81 |
| | | | | Sha'ib Dahthami | | | | | | | |
| 155682 | 20 24 54 | 41 24 22 | 83.0 | 21.0 | 72 | 232 | 10 | 2.65 | 2.71 | 6.96 | 7.55 |
| 155683 | 20 25 44 | 41 22 5 | 88.0 | 41.0 | 37 | 205 | 7 | 1.74 | 1.67 | 3.80 | 4.85 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | mTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J. Sha'ir | | | | | |
| 155660 | 3.97 | 1.33 | 13.67 | 276 | 2.26 | .80 | 2.85 | .87 | 1.08 | 1.02 |
| | | | | | Unnamed | | | | | |
| 155561 | 2.87 | 2.02 | .20 | 411 | 6.42 | 2.66 | 2.41 | .90 | 1.52 | 1.06 |
| 155662 | 3.40 | 1.60 | .26 | 279 | 2.29 | .91 | 2.51 | 1.13 | 1.37 | 1.04 |
| | | | | | J. Abu Sibal | | | | | |
| 155563 | 2.63 | 1.61 | .29 | 347 | 3.15 | 1.96 | 1.60 | 1.12 | 1.49 | 1.07 |
| 155664 | 2.31 | 1.39 | .21 | 318 | 2.46 | 1.25 | 1.97 | 1.12 | 1.57 | 1.08 |
| 155665 | 2.15 | 1.38 | .19 | 304 | 2.87 | 1.33 | 2.16 | 1.12 | 1.58 | 1.09 |
| 155666 | 2.35 | 1.30 | .21 | 314 | 2.57 | 1.34 | 1.92 | 1.07 | 1.58 | 1.08 |
| | | | | | Unnamed | | | | | |
| 155567 | 4.08 | 1.37 | .46 | 404 | 3.87 | 1.62 | 2.39 | 1.16 | 1.34 | 1.04 |
| 155668 | 3.39 | 1.48 | .46 | 326 | 4.15 | 1.28 | 3.24 | .89 | 1.34 | 1.02 |
| | | | | | Unnamed | | | | | |
| 155669 | 3.87 | 1.97 | .21 | 394 | 6.96 | 2.26 | 3.07 | .89 | 1.41 | 1.04 |
| | | | | | J. Sawdah | | | | | |
| 155670 | 4.45 | 1.68 | .59 | 340 | 7.05 | 2.57 | 2.74 | .98 | 1.30 | 1.02 |
| 155671 | 3.90 | .58 | 1.41 | 293 | 3.07 | 3.17 | .97 | 1.20 | 1.27 | 1.05 |
| 155672 | 4.29 | 2.84 | .51 | 296 | 7.72 | 2.88 | 2.68 | .93 | 1.35 | 1.00 |
| 155673 | 2.73 | 2.72 | .17 | 310 | 4.87 | 1.40 | 3.48 | 1.12 | 1.63 | 1.01 |
| | | | | | J. Alonsa | | | | | |
| 155674 | 1.79 | 1.03 | .12 | 345 | 3.00 | 3.20 | .94 | 1.02 | 1.59 | 1.09 |
| 155575 | 1.69 | 1.18 | .10 | 301 | 4.00 | 3.76 | 1.07 | 1.07 | 1.61 | 1.13 |
| | | | | | Unnamed | | | | | |
| 155676 | 3.95 | 2.12 | .67 | 272 | 2.90 | 1.10 | 2.63 | 1.03 | 1.24 | .98 |
| 155677 | 4.25 | 2.04 | .73 | 278 | 5.44 | 1.34 | 4.07 | 1.18 | 1.21 | 1.00 |
| | | | | | J. Najiah | | | | | |
| 155578 | 4.12 | 1.75 | 1.13 | 294 | 2.85 | 1.09 | 2.62 | .97 | 1.16 | 1.00 |
| 155679 | 5.39 | 3.32 | 1.07 | 609 | 4.27 | 2.32 | 1.84 | .98 | 1.07 | 1.02 |
| 155680 | 4.40 | 1.70 | 1.63 | 458 | 2.89 | 1.89 | 1.53 | 1.03 | 1.07 | .99 |
| 155681 | 5.10 | .94 | 3.14 | 451 | 3.77 | 2.46 | 1.53 | .88 | 1.09 | 1.02 |
| | | | | | Sha'ib Dahthami | | | | | |
| 155682 | 3.09 | 1.52 | 3.95 | 372 | 2.85 | 1.17 | 2.44 | 1.02 | 1.08 | 1.00 |
| 155683 | 3.60 | 1.35 | 2.15 | 409 | 2.79 | 2.07 | 1.35 | .96 | 1.15 | 1.01 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | J. Suliy | | | | | | | |
| 155684 | 20 28 12 | 41 30 54 | 177.0 | 50.0 | 44 | 350 | 20 | 6.79 | 6.27 | 15.90 | 16.80 |
| 155685 | 20 58 41 | 42 30 7 | 186.0 | 45.0 | 36 | 263 | 18 | 6.37 | 5.74 | 18.10 | 18.00 |
| 155686 | 20 58 41 | 42 30 7 | 174.0 | 50.0 | 39 | 264 | 18 | 5.29 | 4.82 | 17.20 | 16.00 |
| 155687 | 20 57 58 | 42 31 30 | 97.0 | 96.0 | 58 | 664 | 30 | 3.03 | 3.06 | 7.69 | 6.98 |
| | | | | J. Kor | | | | | | | |
| 155588 | 20 59 28 | 42 45 14 | 98.0 | 122.0 | 42 | 197 | 13 | 5.14 | 4.79 | 8.55 | 9.11 |
| 155689 | 20 58 59 | 42 48 36 | 141.0 | 52.0 | 71 | 383 | 34 | 6.50 | 5.29 | 13.40 | 13.90 |
| 155690 | 20 58 52 | 42 50 42 | 195.0 | 78.0 | 31 | 222 | 16 | 6.11 | 4.67 | 20.20 | 18.40 |
| 155691 | 20 58 52 | 42 50 42 | 145.0 | 27.0 | 80 | 684 | 40 | 6.31 | 5.67 | 10.80 | 12.10 |
| | | | | J. Taweel | | | | | | | |
| 155692 | 20 54 7 | 42 54 25 | 71.0 | 6.0 | 14 | 111 | 14 | .98 | .80 | 2.40 | 1.96 |
| 155693 | 20 50 17 | 42 55 19 | 78.0 | 2.0 | 22 | 235 | 26 | 1.78 | 1.87 | 5.72 | 5.68 |
| 155694 | 20 49 44 | 42 56 46 | 85.0 | 54.0 | 30 | 140 | 22 | 2.62 | 3.17 | 5.51 | 6.95 |
| 155695 | 20 46 34 | 42 57 25 | 92.0 | 76.0 | 42 | 500 | 23 | 2.88 | 2.58 | 4.30 | 6.13 |
| 155696 | 20 43 30 | 42 56 38 | 78.9 | 64.6 | 32 | 150 | 20 | 1.93 | 2.23 | 3.84 | 4.93 |
| | | | | J. Rafdah | | | | | | | |
| 155697 | 19 33 22 | 42 57 0 | 291.0 | 25.1 | 30 | 81 | 34 | 18.30 | 14.20 | 21.10 | 27.50 |
| 155698 | 19 33 14 | 42 55 37 | 169.0 | 216.0 | 16 | 131 | 12 | 4.61 | 4.50 | 14.50 | 14.10 |
| 155699 | 19 32 17 | 42 53 28 | 172.0 | 271.0 | 16 | 131 | 7 | 3.25 | 2.82 | 9.81 | 11.00 |
| | | | | Unnamed | | | | | | | |
| 155700 | 19 18 4 | 42 54 7 | 48.3 | 717.0 | 25 | 131 | 5 | .80 | .90 | .60 | 1.38 |
| | | | | Jazirah | | | | | | | |
| 155701 | 19 2 43 | 42 54 25 | 75.0 | 51.1 | 42 | 307 | 17 | 1.63 | 1.63 | 4.03 | 4.22 |
| 155702 | 19 1 5 | 42 55 26 | 29.7 | 387.0 | 18 | 810 | 3 | .50 | .48 | .50 | .30 |
| 155703 | 19 1 5 | 42 56 46 | 12.2 | 704.0 | 10 | 76 | 6 | .40 | .40 | .50 | .80 |
| 155704 | 19 2 35 | 42 57 22 | 34.5 | 45.5 | 11 | 558 | 3 | .44 | .48 | .50 | .50 |
| | | | | J. Harub | | | | | | | |
| 155705 | 19 6 36 | 42 35 53 | 114.0 | 219.0 | 24 | 167 | 10 | 2.79 | 2.69 | 10.20 | 12.60 |
| 155706 | 19 7 52 | 42 36 40 | 130.0 | 210.0 | 21 | 159 | 9 | 2.32 | 2.27 | 8.90 | 12.90 |
| | | | | Unnamed | | | | | | | |
| 155707 | 19 19 48 | 42 37 16 | 311.0 | 7.8 | 86 | 53 | 54 | 17.20 | 15.40 | 2.40 | 15.60 |
| 155708 | 19 20 42 | 42 34 52 | 217.0 | 59.8 | 18 | 55 | 10 | 5.69 | 3.50 | 16.90 | 17.50 |
| 155709 | 19 20 42 | 42 34 52 | 225.0 | 78.7 | 23 | 109 | 16 | 7.00 | 5.64 | 15.50 | 18.60 |
| 155710 | 19 21 32 | 42 37 1 | 283.0 | 5.3 | 59 | 82 | 100 | 25.90 | 21.70 | 3.10 | 20.50 |
| 155711 | 19 21 32 | 42 37 1 | 340.0 | 8.2 | 76 | 89 | 75 | 23.60 | 19.10 | 3.20 | 17.40 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | J. Suliy | | | | | |
| 155684 | 4.56 | 2.04 | 3.54 | 258 | 2.47 | .67 | 3.68 | .92 | 1.12 | 1.00 |
| 155685 | 4.63 | 1.83 | 4.13 | 249 | 2.83 | .73 | 3.89 | .90 | 1.13 | 1.02 |
| 155686 | 4.66 | 1.95 | 3.48 | 268 | 3.02 | .88 | 3.43 | .91 | 1.12 | .99 |
| 155687 | 4.11 | 3.31 | 1.01 | 424 | 2.30 | 1.36 | 1.70 | 1.01 | 1.06 | .91 |
| | | | | | J. Kor | | | | | |
| 155688 | 2.91 | 3.09 | .80 | 297 | 1.77 | .57 | 3.13 | .93 | 1.21 | .98 |
| 155689 | 4.31 | 2.07 | 2.71 | 306 | 2.14 | .66 | 3.23 | .81 | 1.06 | .96 |
| 155690 | 4.34 | 1.84 | 2.50 | 223 | 3.01 | .71 | 4.24 | .76 | 1.19 | 1.02 |
| 155691 | 4.11 | 2.19 | 5.37 | 283 | 1.92 | .65 | 2.94 | .90 | .94 | .90 |
| | | | | | J. Taweel | | | | | |
| 155692 | 3.88 | 4.75 | 11.83 | 546 | 2.00 | 3.96 | .51 | .82 | .91 | .87 |
| 155693 | 4.20 | 3.24 | 39.03 | 538 | 3.19 | 2.36 | 1.35 | 1.05 | .96 | .93 |
| 155694 | 4.07 | 3.87 | 1.57 | 479 | 2.65 | 1.55 | 1.71 | 1.21 | .99 | .87 |
| 155695 | 3.99 | 4.13 | 1.21 | 434 | 2.13 | 1.39 | 1.54 | .90 | 1.00 | .86 |
| 155696 | 3.92 | 4.57 | 1.22 | 497 | 2.55 | 2.03 | 1.26 | 1.16 | 1.00 | .85 |
| | | | | | J. Rafdah | | | | | |
| 155697 | 3.44 | .68 | 11.62 | 118 | 1.50 | .19 | 7.99 | .78 | 1.12 | 1.02 |
| 155698 | 3.65 | 1.12 | .78 | 216 | 3.06 | .79 | 3.86 | .98 | 1.25 | 1.05 |
| 155699 | 3.70 | 1.03 | .64 | 215 | 3.38 | 1.14 | 2.97 | .87 | 1.27 | 1.04 |
| | | | | | Unnamed | | | | | |
| 155700 | 1.64 | 8.21 | .07 | 340 | 1.73 | 2.05 | .84 | 1.00 | 2.03 | .65 |
| | | | | | Jazirah | | | | | |
| 155701 | 4.73 | 2.13 | 1.47 | 564 | 2.59 | 2.60 | 1.00 | 1.00 | 1.09 | .98 |
| 155702 | 4.78 | 3.93 | .08 | 1,609 | .60 | 9.56 | .06 | .96 | 1.32 | .97 |
| 155703 | .56 | 7.28 | .02 | 459 | 2.00 | 1.40 | 1.43 | 1.00 | 3.34 | .80 |
| 155704 | 5.61 | 1.83 | .76 | 1,626 | 1.14 | 12.75 | .09 | 1.09 | 1.13 | 1.00 |
| | | | | | J. Harub | | | | | |
| 155705 | 3.04 | 2.21 | .52 | 267 | 4.52 | 1.09 | 4.14 | .96 | 1.37 | 1.01 |
| 155706 | 3.36 | 1.94 | .62 | 258 | 5.56 | 1.45 | 3.84 | .98 | 1.35 | 1.01 |
| | | | | | Unnamed | | | | | |
| 155707 | 3.18 | .40 | 40.12 | 102 | .91 | .18 | 4.91 | .90 | 1.12 | .94 |
| 155708 | 4.04 | .34 | 3.63 | 186 | 3.08 | .71 | 4.33 | .62 | 1.17 | 1.08 |
| 155709 | 3.80 | .97 | 2.86 | 169 | 2.66 | .54 | 4.89 | .81 | 1.20 | 1.01 |
| 155710 | 2.99 | .51 | 53.43 | 106 | .79 | .12 | 6.86 | .84 | 1.17 | 1.05 |
| 155711 | 3.26 | .61 | 41.75 | 96 | .74 | .14 | 5.34 | .81 | 1.18 | 1.05 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Hadabiyah Pluton** | | | | | | | |
| 155712 | 19 24 22 | 42 37 16 | 132.0 | 214.0 | 35 | 228 | 23 | 2.76 | 2.64 | 8.26 | 10.30 |
| 155713 | 19 29 17 | 42 39 43 | 151.0 | 175.0 | 18 | 136 | 10 | 5.94 | 5.55 | 19.30 | 21.90 |
| | | | | **Galalah Dome** | | | | | | | |
| 155714 | 19 33 22 | 42 39 58 | 123.0 | 90.0 | 27 | 137 | 13 | .86 | .88 | 5.50 | 5.92 |
| 155715 | 19 33 54 | 42 40 48 | 110.0 | 59.0 | 22 | 134 | 10 | 1.43 | 1.44 | 3.30 | 3.20 |
| 155716 | 19 37 57 | 42 42 0 | 127.0 | 169.0 | 15 | 96 | 12 | 6.17 | 4.92 | 19.10 | 20.50 |
| 155717 | 19 37 52 | 42 42 0 | 106.0 | 179.0 | 19 | 261 | 23 | 15.10 | 13.00 | 16.20 | 20.00 |
| | | | | **Al Hidab** | | | | | | | |
| 155718 | 19 41 6 | 42 47 49 | 125.0 | 35.8 | 16 | 146 | 21 | 3.69 | 3.07 | 10.30 | 11.10 |
| 155719 | 19 43 12 | 42 47 53 | 180.0 | 7.6 | 32 | 139 | 35 | 6.85 | 6.20 | 15.40 | 15.10 |
| 155720 | 19 43 12 | 42 47 53 | 177.0 | 11.6 | 31 | 109 | 28 | 5.96 | 5.94 | 11.80 | 14.70 |
| | | | | **J. Munirah** | | | | | | | |
| 155721 | 20 36 7 | 42 46 37 | 94.7 | 31.6 | 47 | 452 | 7 | 2.27 | 2.26 | 4.90 | 5.27 |
| 155722 | 20 35 7 | 42 46 37 | 93.1 | 29.1 | 50 | 110 | 9 | 1.42 | 1.34 | 3.50 | 4.18 |
| 155723 | 20 33 25 | 42 42 47 | 140.0 | 6.8 | 65 | 198 | 25 | 3.74 | 3.94 | 9.28 | 11.40 |
| 155724 | 20 30 40 | 42 42 29 | 151.0 | 35.2 | 50 | 144 | 24 | 6.75 | 5.12 | 8.60 | 14.30 |
| | | | | **J. al Jafar** | | | | | | | |
| 155725 | 20 30 50 | 42 47 10 | 168.0 | 22.3 | 57 | 162 | 27 | 7.69 | 5.07 | 2.20 | 15.60 |
| 155726 | 20 30 35 | 42 46 59 | 152.0 | 26.1 | 53 | 154 | 26 | 7.26 | 6.16 | 7.80 | 16.80 |
| 155726A | 20 30 36 | 42 46 59 | 150.0 | 24.1 | 57 | 157 | 26 | 8.71 | 7.48 | 2.40 | 16.30 |
| 155727 | 20 27 18 | 42 46 44 | 156.0 | 23.1 | 52 | 144 | 26 | 4.24 | 3.63 | 13.30 | 16.80 |
| | | | | **J. al Fu'ad** | | | | | | | |
| 155728 | 20 59 6 | 43 47 17 | 214.0 | 162.0 | 29 | 174 | 14 | 5.99 | 5.04 | 16.50 | 16.40 |
| 155729 | 20 59 6 | 43 47 17 | 188.0 | 99.4 | 20 | 91 | 13 | 5.72 | 4.55 | 23.60 | 20.30 |
| 155730 | 20 57 0 | 43 49 48 | 189.0 | 128.0 | 25 | 121 | 15 | 5.12 | 5.19 | 14.10 | 16.40 |
| 155731 | 20 55 34 | 43 51 14 | 206.0 | 111.0 | 25 | 108 | 15 | 4.61 | 4.90 | 15.30 | 16.30 |
| | | | | **J. al Qarah** | | | | | | | |
| 155732 | 20 16 1 | 43 12 43 | 104.0 | 146.0 | 7 | 41 | 5 | 1.63 | 2.00 | 7.62 | 12.80 |
| 155733 | 20 16 1 | 43 12 43 | 163.0 | 201.0 | 10 | 136 | 8 | 4.54 | 5.48 | 8.63 | 15.40 |
| 155734 | 20 13 16 | 43 13 59 | 86.0 | 116.0 | 10 | 97 | 5 | 4.91 | 5.38 | 9.79 | 12.40 |
| | | | | **Bani Shawhatah** | | | | | | | |
| 155735 | 20 5 54 | 43 27 0 | 82.0 | 33.0 | 37 | 320 | 14 | 3.45 | 3.12 | 10.40 | 10.20 |
| 155736 | 20 2 31 | 43 27 22 | 82.0 | 31.0 | 43 | 434 | 13 | 3.14 | 2.86 | 10.40 | 11.40 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Madabiyah Pluton | | | | | |
| 155712 | 4.22 | 2.14 | .62 | 320 | 3.73 | 1.53 | 2.44 | .96 | 1.26 | 1.02 |
| 155713 | 3.92 | 1.26 | .86 | 260 | 3.69 | .66 | 5.59 | .93 | 1.27 | 1.02 |
| | | | | | Galalah Dome | | | | | |
| 155714 | 4.01 | 1.31 | 1.37 | 326 | 6.88 | 4.66 | 1.48 | 1.02 | 1.15 | 1.04 |
| 155715 | 3.99 | 1.38 | 1.86 | 363 | 2.24 | 2.79 | .80 | 1.01 | 1.13 | 1.01 |
| 155716 | 3.57 | 1.35 | .75 | 281 | 3.32 | .58 | 5.74 | .80 | 1.25 | 1.00 |
| 155717 | 2.07 | 3.64 | .60 | 195 | 1.32 | .14 | 9.66 | .86 | 1.41 | .92 |
| | | | | | Al Hidab | | | | | |
| 155718 | 4.21 | .89 | 3.49 | 337 | 3.01 | 1.14 | 2.64 | .83 | 1.13 | 1.04 |
| 155719 | 4.14 | .81 | 23.75 | 230 | 2.20 | .60 | 3.65 | .91 | 1.11 | 1.03 |
| 155720 | 4.07 | .75 | 15.28 | 239 | 2.47 | .68 | 3.61 | 1.00 | 1.10 | 1.02 |
| | | | | | J. Munirah | | | | | |
| 155721 | 4.32 | 1.72 | 2.99 | 456 | 2.32 | 1.90 | 1.22 | 1.00 | 1.06 | .97 |
| 155722 | 4.45 | 1.13 | 3.29 | 478 | 2.94 | 3.13 | .94 | .94 | 1.05 | .97 |
| 155723 | 4.13 | 1.16 | 20.52 | 295 | 3.05 | 1.10 | 2.76 | 1.05 | 1.03 | .98 |
| 155724 | 3.97 | 1.22 | 4.29 | 263 | 2.12 | .59 | 3.60 | .76 | 1.12 | 1.01 |
| | | | | | J. al Jafar | | | | | |
| 155725 | 4.17 | 1.23 | 7.51 | 248 | 2.03 | .54 | 3.74 | .66 | 1.10 | 1.00 |
| 155726 | 4.14 | 1.13 | 5.81 | 272 | 2.31 | .57 | 4.06 | .85 | 1.11 | 1.02 |
| 155726A | 4.20 | 1.19 | 6.21 | 280 | 1.87 | .48 | 3.88 | .86 | 1.12 | 1.02 |
| 155727 | 4.25 | 1.12 | 6.76 | 272 | 3.96 | 1.00 | 3.95 | .86 | 1.13 | 1.05 |
| | | | | | J. al Fu'ad | | | | | |
| 155728 | 4.22 | 1.64 | 1.32 | 197 | 2.74 | .70 | 3.89 | .84 | 1.27 | 1.01 |
| 155729 | 3.81 | .96 | 1.90 | 203 | 3.55 | .67 | 5.33 | .80 | 1.25 | 1.02 |
| 155730 | 4.25 | 1.30 | 1.48 | 225 | 3.20 | .83 | 3.86 | 1.01 | 1.25 | 1.01 |
| 155731 | 4.12 | 1.11 | 1.86 | 200 | 3.54 | .89 | 3.96 | 1.06 | 1.25 | 1.05 |
| | | | | | J. al Qarah | | | | | |
| 155732 | 3.64 | .74 | .71 | 369 | 7.85 | 2.36 | 3.33 | 1.23 | 1.20 | 1.07 |
| 155733 | 3.92 | 1.66 | .81 | 240 | 3.39 | .86 | 3.93 | 1.21 | 1.25 | 1.00 |
| 155734 | 3.95 | .93 | .74 | 459 | 2.53 | .80 | 3.14 | 1.03 | 1.19 | 1.04 |
| | | | | | Bani Shawhatah | | | | | |
| 155735 | 3.98 | 1.84 | 2.48 | 485 | 2.96 | 1.15 | 2.56 | .90 | 1.05 | .97 |
| 155736 | 4.13 | 2.20 | 2.65 | 504 | 3.63 | 1.32 | 2.76 | .91 | 1.05 | .96 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | Latitude | Longitude | Rb (ppm) | Sr (ppm) | Y (ppm) | Zr (ppm) | Nb (ppm) | U (ppm) | RaeU (ppm) | Th (ppm) | eTh (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unnamed | | | | | | | | | | | |
| 155737 | 19 43 55 | 42 34 30 | 161.0 | 83.0 | 35 | 134 | 19 | 5.81 | 5.06 | 15.00 | 13.40 |
| Wadi al Khanaq | | | | | | | | | | | |
| 155738 | 19 45 47 | 42 46 5 | 276.0 | 21.0 | 52 | 99 | 39 | 12.40 | 11.30 | 26.40 | 30.80 |
| Sirat Rishah | | | | | | | | | | | |
| 155739 | 19 52 37 | 42 42 0 | 174.0 | 135.0 | 24 | 174 | 22 | 3.42 | 3.22 | 13.80 | 12.50 |
| J. Asbah | | | | | | | | | | | |
| 155742 | 20 9 11 | 41 56 46 | 37.0 | 51.0 | 24 | 703 | 9 | .72 | .69 | 4.46 | 5.25 |
| 155743 | 20 6 11 | 41 54 58 | 47.0 | 232.0 | 43 | 631 | 31 | 2.16 | 2.22 | 5.10 | 4.75 |
| J. Amoudah | | | | | | | | | | | |
| 155744 | 20 4 52 | 42 47 49 | 112.0 | 24.0 | 86 | 304 | 16 | 4.78 | 4.10 | 10.60 | 7.71 |
| 155745 | 20 7 48 | 42 47 24 | 102.0 | 20.0 | 67 | 272 | 26 | 3.83 | 3.68 | 9.64 | 9.38 |
| 155746 | 20 12 54 | 42 47 28 | 78.0 | 21.0 | 27 | 234 | 24 | 1.70 | 1.63 | 3.90 | 3.56 |
| J. Khashaadheed | | | | | | | | | | | |
| 155747 | 20 15 4 | 42 52 52 | 114.0 | 31.0 | 58 | 393 | 32 | 4.31 | 3.78 | 11.50 | 10.80 |
| 155748 | 20 19 25 | 42 53 28 | 112.0 | 47.0 | 50 | 319 | 31 | 13.00 | 9.53 | 20.00 | 20.50 |
| 155749 | 20 19 26 | 42 53 28 | 109.0 | 49.0 | 48 | 337 | 33 | 6.86 | 5.72 | 15.70 | 14.70 |
| J. Umm Hashiyah | | | | | | | | | | | |
| 155750 | 20 1 1 | 42 55 1 | 112.0 | 239.0 | 16 | 105 | 10 | 3.63 | 3.26 | 13.30 | 13.40 |
| 155751 | 19 58 52 | 42 57 43 | 107.0 | 318.0 | 25 | 278 | 10 | 4.93 | 4.62 | 10.60 | 10.60 |
| 155752 | 19 58 52 | 42 57 43 | 116.0 | 326.0 | 23 | 257 | 11 | 2.56 | 2.46 | 8.17 | 9.20 |
| 155753 | 19 58 52 | 42 57 43 | 143.0 | 224.0 | 13 | 87 | 5 | 4.47 | 4.21 | 8.50 | 9.85 |
| 155754 | 19 58 52 | 42 57 43 | 112.0 | 296.0 | 13 | 135 | 9 | 4.10 | 4.01 | 9.82 | 9.56 |

Table 2.-- Sample locality data, Trace-element concentrations, and chemical ratios for postorogenic plutonic samples from the Southwestern Arabian Shield--Continued

| Sample | eK (wt %) | FeO(t) (wt %) | Rb/Sr | eK/Rb | eTh/U | eK/U | eTh/eK | RaeU/U | Al/ Na+K | Al/ Na+K+Ca |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Unnamed | | | | | |
| 155737 | 3.99 | 1.01 | 1.94 | 248 | 2.31 | .69 | 3.36 | .87 | 1.11 | .99 |
| | | | | | Wadi al Khanaq | | | | | |
| 155738 | 3.86 | .95 | 13.14 | 140 | 2.48 | .31 | 7.98 | .91 | 1.13 | 1.05 |
| | | | | | Sirat Bishah | | | | | |
| 155739 | 3.43 | 1.90 | 1.29 | 197 | 3.65 | 1.00 | 3.64 | .94 | 1.25 | 1.01 |
| | | | | | J. Asbah | | | | | |
| 155742 | 4.96 | 1.70 | .73 | 1,341 | 7.29 | 6.89 | 1.06 | .96 | 1.07 | 1.00 |
| 155743 | 4.08 | 2.61 | .20 | 868 | 2.20 | 1.89 | 1.16 | 1.03 | 1.10 | .93 |
| | | | | | J. Amoudah | | | | | |
| 155744 | 4.06 | 1.82 | 4.67 | 363 | 1.61 | .85 | 1.90 | .86 | 1.05 | .97 |
| 155745 | 4.17 | 1.49 | 5.10 | 409 | 2.45 | 1.09 | 2.25 | .96 | 1.04 | .98 |
| 155746 | 4.15 | 3.01 | 3.71 | 532 | 2.09 | 2.44 | .86 | .96 | .97 | .91 |
| | | | | | J. Khashmadheed | | | | | |
| 155747 | 4.12 | 2.35 | 3.68 | 361 | 2.51 | .96 | 2.62 | .88 | 1.03 | .96 |
| 155748 | 4.03 | 2.23 | 2.38 | 360 | 1.58 | .31 | 5.09 | .73 | 1.07 | .94 |
| 155749 | 4.19 | 3.17 | 2.22 | 376 | 2.14 | .60 | 3.59 | .83 | 1.07 | .97 |
| | | | | | J. Umm Hashiyah | | | | | |
| 155750 | 3.08 | 1.13 | .47 | 275 | 3.69 | .85 | 4.35 | .90 | 1.30 | 1.00 |
| 155751 | 3.05 | 2.45 | .34 | 285 | 2.15 | .62 | 3.48 | .94 | 1.49 | 1.01 |
| 155752 | 3.11 | 2.31 | .36 | 268 | 3.59 | 1.21 | 2.96 | .96 | 1.47 | 1.01 |
| 155753 | 4.38 | .85 | .64 | 306 | 2.20 | .98 | 2.25 | .94 | 1.23 | 1.02 |
| 155754 | 2.91 | 1.43 | .38 | 260 | 2.33 | .71 | 3.29 | .98 | 1.43 | 1.03 |

Table 3.--Statistical summary of chemical compositions for the post-orogenic granites from the southwestern Arabian Shield [Oxide concentrations are in weight percent; trace-element contents are in parts per million. Values for average granite are from Krauskopf (1967) with elements converted to oxides and normalized to 100 percent and Stuckless and VanTrump (1982)]

| | Number of samples | Minimum | Maximum | Mean | Standard deviation | Skew-ness | Kurtosis | Average granite |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 178 | 44.40 | 77.49 | 71.26 | ±5.27 | -2.25 | 7.30 | 72.64 |
| $Al_2O_3$ | 178 | 11.18 | 26.20 | 14.23 | ±1.98 | 2.16 | 8.58 | 13.67 |
| FeO(t) | 178 | 0.34 | 7.28 | 2.13 | ±1.38 | 1.46 | 1.96 | 3.27 |
| MgO | 178 | 0.05 | 8.77 | 0.47 | ±0.90 | 6.63 | 52.13 | 0.25 |
| CaO | 178 | 0.16 | 14.64 | 1.58 | ±1.80 | 4.96 | 30.98 | 2.10 |
| $Na_2O$ | 178 | 1.73 | 7.48 | 4.15 | ±0.89 | 1.32 | 2.28 | 3.54 |
| $K_2O$ | 178 | 0.18 | 6.81 | 4.32 | ±1.09 | -1.44 | 3.14 | 3.74 |
| $TiO_2$ | 178 | 0.01 | 1.48 | 0.29 | ±0.24 | 2.21 | 6.79 | 0.36 |
| $P_2O_5$ | 178 | 0.02 | 0.79 | 0.07 | ±0.09 | 4.22 | 25.56 | 0.03 |
| MnO | 178 | 0.01 | 0.30 | 0.05 | ±0.05 | 2.41 | 7.52 | 0.05 |
| RaeU/U | 178 | 0.42 | 21.70 | 0.94 | ±0.27 | 2.47 | 12.80 | --- |
| U | 178 | 0.05 | 25.90 | 2.60 | $^{+4.69}_{-1.67}$ | -1.15 | 3.01 | 3.54 |
| RaeU | 178 | 0.10 | 21.7 | 2.37 | $^{+3.44}_{-1.41}$ | -0.97 | 2.21 | --- |
| Th | 178 | 0.40 | 55.2 | 6.50 | $^{+9.64}_{-3.88}$ | -1.16 | 1.43 | 16.76 |
| eTh | 176 | 0.10 | 51.3 | 7.60 | $^{+11.54}_{-4.59}$ | -1.90 | 5.12 | --- |
| Rb | 178 | 6.1 | 623 | 100 | $^{+85.1}_{-46.0}$ | -1.29 | 4.19 | 150 |
| Sr | 178 | 2.0 | 1750 | 102 | $^{+247}_{-72.0}$ | -0.52 | -0.09 | 285 |
| Y | 178 | 2.7 | 91 | 22.9 | $^{+26.5}_{-12.3}$ | -0.31 | -0.46 | 40 |
| Nb | 178 | 1.3 | 140 | 14.7 | $^{+20.1}_{-8.5}$ | -0.02 | -0.09 | 20 |
| Zr | 178 | 12 | 1170 | 178 | $^{+201}_{-94}$ | 0.04 | 0.45 | 180 |
| eTh/U | 176 | 1.67 | 10.16 | 2.80 | $^{+1.72}_{-1.07}$ | -0.38 | 0.85 | 4.73 |
| K/U | 178 | 0.12 | 89.16 | 1.29 | $^{+2.07}_{-0.80}$ | 1.05 | 4.31 | 0.95 |
| eTh/K | 176 | 0.04 | 11.12 | 2.22 | $^{+2.85}_{-1.25}$ | -1.97 | 6.26 | 5.00 |
| Rb/Sr | 178 | 0.01 | 53.4 | 0.98 | $^{+3.83}_{-0.78}$ | -0.10 | 0.89 | --- |
| K/Rb | 178 | 54.2 | 1606 | 337 | $^{+206}_{-128}$ | 0.32 | 2.41 | --- |

Table 4a.--Comparison of chemistry for anomalous plutons and those from the southwestern Arabian Shield [Oxide concentrations are reported in weight percent; trace-element contents are in parts per million]

| | Southwestern | Anomalous |
|---|---|---|
| $SiO_2$ | 71.26 ± 5.27 | 75.45 ± 1.45 |
| $Al_2O_3$ | 14.23 ± 1.98 | 13.07 ± 0.97 |
| FeO(t) | 2.13 ± 1.38 | 0.99 ± 0.53 |
| MgO | 0.47 ± 0.90 | 0.10 ± 0.09 |
| CaO | 1.58 ± 1.80 | 0.50 ± 0.29 |
| $Na_2O$ | 4.15 ± 0.89 | 3.86 ± 0.81 |
| $K_2O$ | 4.32 ± 1.09 | 4.46 ± 0.57 |
| $TiO_2$ | 0.29 ± 0.24 | 0.05 ± 0.07 |
| $P_2O_5$ | 0.07 ± 0.09 | 0.02 ± 0.02 |
| MnO | 0.05 ± 0.05 | 0.03 ± 0.03 |
| RaeU/U | 0.94 ± 0.27 | 0.86 ± 0.11 |
| U | $2.60^{+4.49}_{-1.47}$ | $8.83^{+7.84}_{-4.07}$ |
| RaeU | $2.37^{+3.46}_{-1.41}$ | $7.50^{+7.12}_{-3.45}$ |
| Th | $6.50^{+9.44}_{-3.88}$ | $29.1^{+11.4}_{-8.2}$ |
| eTh | $7.6^{+11.56}_{-4.59}$ | $27.5^{+11.9}_{-8.29}$ |
| Rb | $100^{+85.1}_{-46.0}$ | $470^{+277}_{-174}$ |
| Sr | $102^{+247}_{-72}$ | $8.59^{+25.3}_{-6.4}$ |
| Y | $22.9^{+26.5}_{-12.3}$ | $70.1^{+69.2}_{-34.8}$ |
| Nb | $14.7^{+20.1}_{-8.5}$ | $25.9^{32.0}_{-14.3}$ |
| Zr | $178^{+201}_{-94}$ | $90^{+50}_{-32}$ |
| eTh/U | $2.80^{+1.72}_{-1.07}$ | $3.11^{+2.18}_{-1.28}$ |
| K/U | $1.29^{+2.07}_{-0.80}$ | $0.41^{+0.41}_{-0.19}$ |
| eTh/K | $2.22^{+2.85}_{-1.25}$ | $7.91^{+3.30}_{-2.34}$ |
| Rb/Sr | $0.98^{+3.83}_{-0.78}$ | $54.7^{+250}_{-44.9}$ |
| K/Rb | $337^{+206}_{-128}$ | $78.3^{+54.7}_{-32.6}$ |

Table 4b.--Comparison of chemistry for syenitic plutons and other postorogenic plutons from the southwestern Arabian Shield [Oxide concentrations are reported in weight percent; trace-element contents are in parts per million]

| | Non-syenitic (155 smples) | Syenitic (23 samples) |
|---|---|---|
| $SiO_2$ | 72.72 ± 3.03 | 61.38 ± 6.47 |
| $Al_2O_3$ | 13.72 ± 1.21 | 17.69 ± 2.67 |
| FeO(t) | 1.84 ± 1.02 | 4.07 ± 1.88 |
| MgO | 0.38 ± 0.44 | 1.12 ± 2.16 |
| CaO | 1.36 ± .96 | 3.10 ± 4.12 |
| $Na_2O$ | 3.94 ± 0.50 | 5.62 ± 1.41 |
| $K_2O$ | 4.34 ± 0.94 | 4.20 ± 1.83 |
| $TiO_2$ | 0.24 ± 0.17 | 0.58 ± 0.36 |
| $P_2O_5$ | 0.06 ± 0.07 | 0.14 ± 0.18 |
| MnO | 0.04 ± 0.04 | 0.10 ± 0.07 |
| RaeU/U | 0.91 ± 0.20 | 1.18 ± 0.50 |
| U | $3.24^{+3.80}_{-1.75}$ | $0.59^{+1.58}_{-0.43}$ |
| RaeU | $2.87^{+2.88}_{-1.44}$ | $0.66^{+1.27}_{-0.43}$ |
| Th | $7.73^{+8.30}_{-4.00}$ | $2.02^{+4.26}_{-1.37}$ |
| eTh | $9.08^{+8.99}_{-4.52}$ | $2.06^{+8.78}_{-1.52}$ |
| Rb | $114^{+68.1}_{-42.6}$ | $42.2^{+49.7}_{-22.8}$ |
| Sr | $95.2^{+229}_{-67.2}$ | $158^{+379}_{-112}$ |
| Y | $23.1^{+24.2}_{-11.8}$ | $22.0^{+42.2}_{-14.5}$ |
| Nb | $14.2^{+17.5}_{-7.8}$ | $18.9^{+42.0}_{-13.0}$ |
| Zr | $167^{+141}_{-76}$ | $268^{+750}_{-197}$ |
| eTh/U | $2.80^{+1.70}_{-1.06}$ | $2.79^{+1.98}_{-1.16}$ |
| K/U | $1.10^{+1.23}_{-0.58}$ | $4.65^{+11.55}_{-3.32}$ |
| eTh/K | $2.55^{+2.16}_{-1.17}$ | $0.67^{+1.58}_{-0.47}$ |
| Rb/Sr | $1.20^{+3.88}_{-0.91}$ | $.27^{+1.50}_{-0.23}$ |
| K/Rb | $313^{+150}_{-101}$ | $653^{+498}_{-283}$ |

Table 5.--Selected correlation coefficients for samples of postorogenic rocks from the southwestern Arabian Shield, Kingdom of Saudi Arabia

| Element Pair | All Samples | Syenitic Samples | Other Samples |
|---|---|---|---|
| Si:Al | -0.88 | -0.74 | -0.81 |
| Si:Fe | -.79 | -.58 | -.75 |
| Si:Mg | -.69 | -.78 | -.82 |
| Si:Ca | -.78 | -.93 | -.80 |
| Si:Ti | -.83 | -.71 | -.85 |
| Si:Na | -.32 | .75 | -.24 |
| Si:K | .38 | .76 | .31 |
| Si:eTh | .60 | .59 | .31 |
| Si:U | .61 | .49 | .32 |
| Si:Sr | -.51 | -.60 | -.62 |
| Si:Rb | .69 | .85 | .34 |
| Si:Y | .23 | .46 | .24 |
| Si:Nb | .07 | .34 | .15 |
| Si:Zr | -.13 | .42 | -.26 |
| Rb:Sr | -.41 | -.74 | -.32 |
| Ca:Sr | .58 | .70 | .72 |
| K:Rb | .50 | .68 | .49 |
| Fe:Mn | .67 | .74 | .50 |
| U:eTh | .87 | .92 | .80 |
| U:K | .23 | .21 | .26 |
| U:RaeU | .96 | .99 | .96 |
| U:Fe | -.41 | .26 | -.36 |
| U:Y | .53 | .92 | .51 |
| U:Nb | .50 | .71 | .64 |
| U:Zr | .12 | .80 | .01 |
| eTh:K | .30 | .17 | .42 |
| eTh:Fe | -.39 | .14 | -.40 |
| eTh:Y | .36 | .88 | .31 |
| eTh:Nb | .42 | .76 | .51 |
| eTh:Zr | .02 | .63 | .01 |

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