Fife Peak Quadrangle, Cochise County, Arizona—Analytic Data and Geologic Sample Catalog

U.S. GEOLOGICAL SURVEY BULLETIN 2021–A

Chapter A

Fife Peak Quadrangle, Cochise County, Arizona—Analytic Data and Geologic Sample Catalog

By EDWARD A. DU BRAY, DOUGLAS B. YAGER, and JOHN S. PALLISTER

Geochemical data for and availability of samples collected during geologic mapping of the quadrangle

U.S. GEOLOGICAL SURVEY BULLETIN 2021

GEOLOGIC SAMPLING OF THE CHIRICAHUA MOUNTAINS, ARIZONA

U.S. DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

UNITED STATES GOVERNMENT PRINTING OFFICE: 1992

For sale by
Book and Open-File Report Sales
U.S. Geological Survey
Federal Center, Box 25286
Denver, CO 80225

Library of Congress Cataloging-in-Publication Data

du Bray, E. A.
Fife Peak quadrangle, Cochise County, Arizona : analytic data and geologic sample catalog / by Edward A. du Bray, Douglas B. Yager, and John S. Pallister.
p. cm.—(Geologic sampling of the Chiricahua Mountains, Arizona ; Chapter A) (U.S. Geological Survey bulletin ; 2021)
"Geochemical data for and availability of samples collected during geologic mapping of the quadrangle."
"B2021A."
Includes bibliographical references.
Supt. of Docs. no.: I 19.3:2021A
1. Rocks—Arizona—Cochise County—Analysis. 2. Geology—Arizona—Cochise County. 3. Geological mapping—Arizona—Cochise County. I. Yager, Douglas B. II. Pallister, John S. III. Title. IV. Series. V. Series: U.S. Geological Survey bulletin ; 2021.
QE75.B9 no. 2021a
[QE445.A594]
557.3 s--dc20
[557.91'53] 92-13659
CIP

CONTENTS

PLATE

FIGURE

TABLES

Fife Peak Quadrangle, Cochise County, Arizona—Analytic Data and Geologic Sample Catalog

By Edward A. du Bray, Douglas B. Yager, *and* John S. Pallister

Abstract

More than 115 rock samples were collected during geologic mapping of the Fife Peak 7½-minute quadrangle in southeastern Arizona. Trace-element abundances were determined in most of these samples by energy-dispersive spectroscopy. Major-oxide abundances were determined for 81 samples, and instrumental neutron activation analyses were obtained for 46 samples. Miscellaneous wet chemical determinations (CO_2, FeO, F, and Cl) were also made for a small number of samples. Abundances of Be, Cr, Ni, Pb, Sn, and Ag were determined in two samples. Standard, and in some cases, polished thin sections were prepared for about half of the samples. All of these resources aided map unit characterization. The availability of chemical data, thin sections, and hand specimens for each of the samples collected in the quadrangle is tabulated in this report. The information presented in this report supplements the geologic map of the Fife Peak quadrangle (U.S. Geological Survey Quadrangle Map GQ–1708) and supports ongoing investigations of the evolution of the Turkey Creek caldera.

INTRODUCTION

The Fife Peak 7½-minute quadrangle is east-southeast of Tucson, Ariz., in the Chiricahua Mountains (fig. 1). The quadrangle is just southwest of Chiricahua National Monument and about 60 km (40 mi) southeast of Willcox, Ariz. The Fife Peak quadrangle includes a part of the Chiricahua Mountains, a range characterized by unusual ecologic diversity that ranges from Sonoran desert through subalpine environments. Altitudes within the quadrangle range from about 1,460 m (4,800 ft) on the pediment surface west of the Chiricahua Mountains to 2,040 m (6,700 ft) in the rugged area along the east edge of the quadrangle. The only paved road in the quadrangle (Arizona Highway 181) passes along the western base of the Chiricahua Mountains and traverses the length of the quadrangle near its west edge; several unpaved roads and a well-developed trail system provide reasonably good access to most of the area.

This report supplements the geologic map of the Fife Peak quadrangle (Pallister and du Bray, in press). It lists availability of chemical data, thin sections, and hand specimens for each of the samples collected in the quadrangle (table 1) and provides tabulations of chemical data (tables 2–6) for samples of Tertiary volcanic rocks that were collected during geologic mapping of the quadrangle. The mapping and data collection are both part of a continuing volcanologic study of the Chiricahua Mountains in general and of the Turkey Creek caldera in particular. The geology of the area has been summarized by Pallister and du Bray (1989 and in press) and by Pallister and others (1990). The data presented here are the subject of a study concerning evolution of the Turkey Creek caldera (du Bray and Pallister, 1991) and ongoing topical studies.

GENERAL GEOLOGY

Erosion and basin-range faulting in the Chiricahua Mountains have exposed multiple levels through the 27-Ma (Pallister and du Bray, 1989) Turkey Creek caldera. Parts of the 20-km-diameter caldera underlie most of the Fife Peak quadrangle. Components of the caldera exposed in the quadrangle include, from oldest to youngest, intracaldera and outflow facies of the Oligocene Rhyolite Canyon Tuff; dacite porphyry, which forms a resurgent core intrusion and a ring intrusion with associated lava flows; and rhyolite (mostly lava flows but including some tuff) that fills the caldera moat. Stratigraphic, structural, and geochronologic data indicate that the porphyry was emplaced soon after the Rhyolite Canyon Tuff was erupted and that the evolution of the caldera, including deposition of the moat deposits, was completed in less than 1 million years.

The part of the caldera exposed in the Fife Peak quadrangle is surrounded by, and was partly emplaced into, slightly older Tertiary volcanic rocks. Outflow tuff from the Turkey Creek caldera was deposited on a surface composed

Approved for publication February 9, 1992.

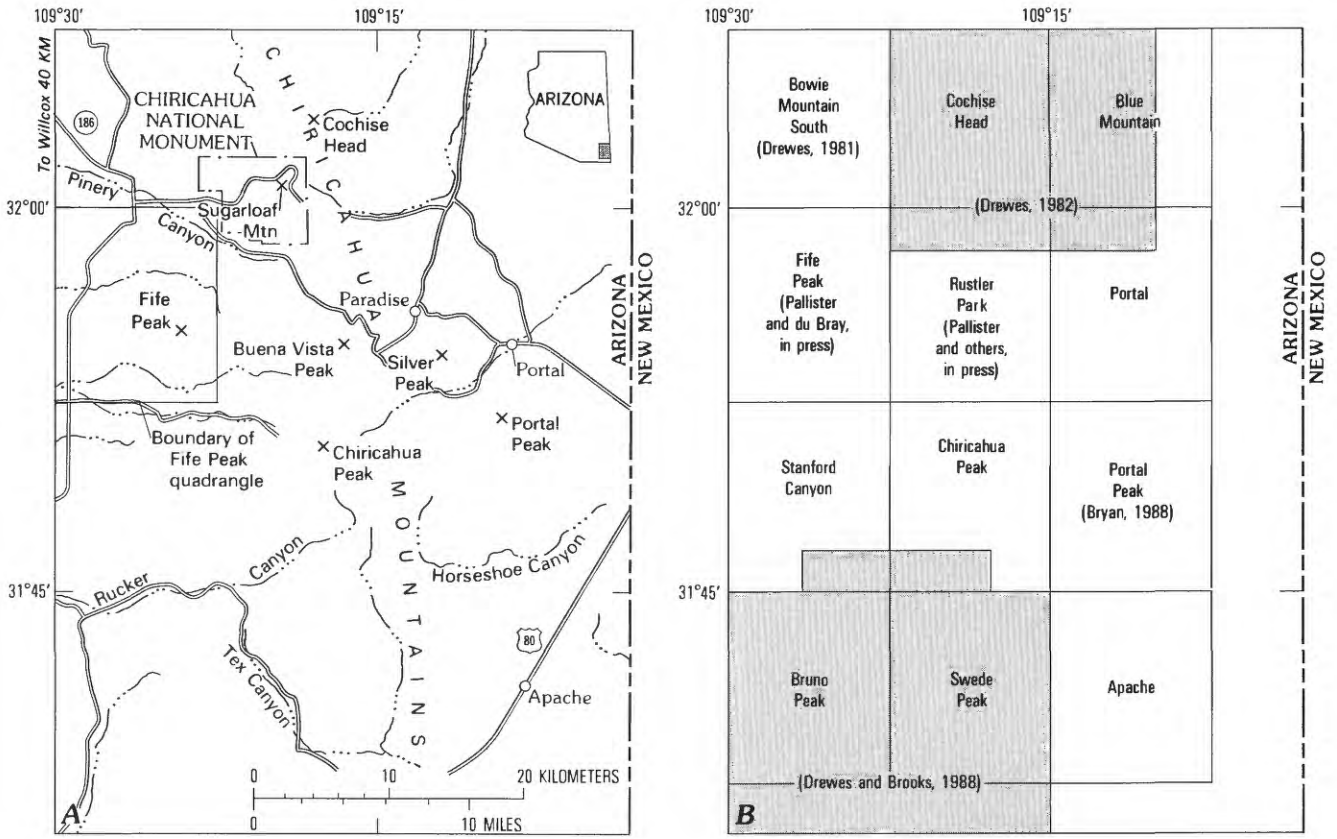


Figure 1. Location of the Fife Peak quadrangle and important geographic and geologic features in the Chiricahua Mountains area, Cochise County, Arizona.

A, Quadrangle location, roads, and important geographic features.
B, U.S. Geological Survey quadrangle names in the area and existing geological maps (cited in parentheses).
C (on facing page), Generalized geology (adapted from Marjaniemi, 1969).

EXPLANATION FOR GEOLOGIC MAP ON FACING PAGE

Quaternary surficial deposits

OLIGOCENE ROCKS ASSOCIATED WITH THE TURKEY CREEK CALDERA

Moat deposits—Mainly rhyolite lavas and pyroclastic rocks

Resurgent intrusion, ring dike, and extrusive equivalents—Dacite and monzonite porphyry

Rhyolite Canyon Tuff

ROCKS THAT PRE-DATE THE TURKEY CREEK CALDERA

Volcanic rocks—Mainly Oligocene rhyolite and dacite

Basement rocks—Mainly Mesozoic and Paleozoic sedimentary rocks; includes some Precambrian granite

Contact

Structural margin of Turkey Creek caldera

Fault—Dashed where approximately located; dotted where concealed

Streams

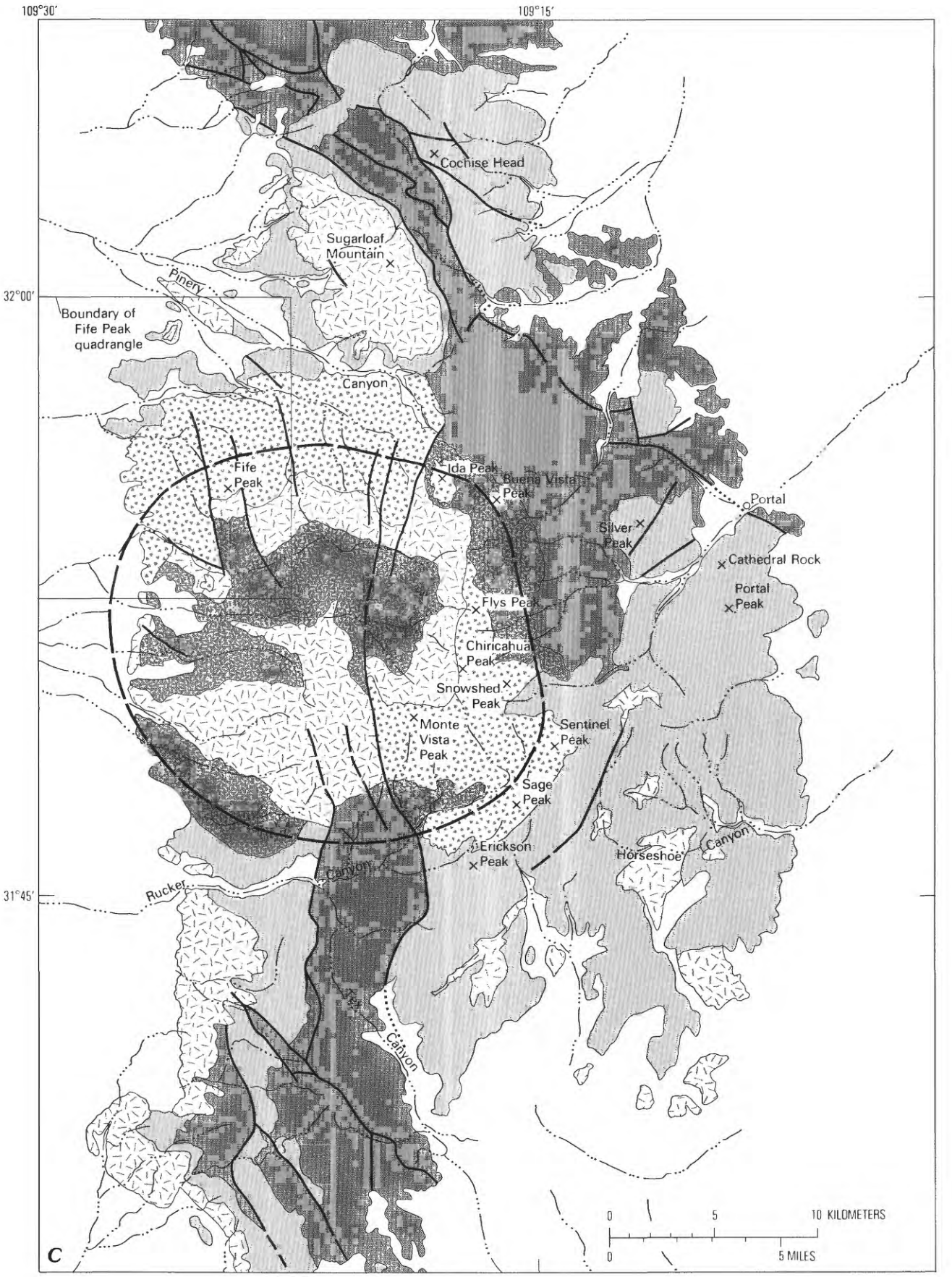
---

of rhyolite lavas of the Oligocene Faraway Ranch Formation, which form a coalescing dome field, and intermediate to mafic lava flows. The topographic margin of the caldera, where exposed, is composed of these same volcanic rocks. These older volcanic rocks are altered (silicified) and weakly mineralized along the northern edge of the quadrangle. Amethystine quartz veins cut these older volcanic rocks in several places within the region of altered rocks. The northern sector of the caldera margin thus appears to have been the locus for weak hydrothermal alteration that accompanied the waning stages of caldera magmatism.

The principal structural features in the quadrangle all result from evolution of the Turkey Creek caldera. These include inferred ring fracture faults, which are covered by rhyolitic moat deposits, and high-angle normal faults caused by central resurgent magmatism.

ANALYTIC DATA

More than 115 rock samples were collected during geologic mapping of the Fife Peak quadrangle. Trace-element abundances were determined in most of these samples by energy-dispersive spectroscopy. Major-oxide abundances were determined for 81 samples, and instrumental neutron


109°30′
109°15′
32°00′
31°45′
Cochise Head
Sugarloaf Mountain
Pinery Canyon
Boundary of Fife Peak quadrangle
Fife Peak
Ida Peak
Buena Vista Peak
Portal
Silver Peak
Cathedral Rock
Portal Peak
Flys Peak
Chiricahua Peak
Snowshed Peak
Monte Vista Peak
Sentinel Peak
Sage Peak
Erickson Peak
Horseshoe Canyon
Rucker Canyon
Rucker Canyon
0 5 10 KILOMETERS
0 5 MILES
C

activation analyses were obtained for 46 samples. Miscellaneous wet chemical determinations (CO_2, FeO, F, and Cl) were also made for a small number of samples. Abundances of Be, Cr, Ni, Pb, Sn, and Ag were determined in two samples.

Our sample collecting was designed to provide areal representation of the igneous rocks exposed in the quadrangle. By collecting and analyzing many samples from each map unit we have established the limits of chemical variability of these units. This procedure is especially important in sampling ash-flow tuffs, many of which are derived from chemically zoned magma chambers (Hildreth, 1981). Chemical data also facilitated lithologic and stratigraphic distinctions that in several instances could not be made in the field through examination of hand samples.

All of the geochemical abundances presented here were determined in analytical laboratories of the U.S. Geological Survey in Denver, Colo. Major oxide analyses (table 2) were performed (analysts, J.E. Taggart, A.J. Bartel, and D.F. Siems) using X-ray fluorescence techniques (Taggart and others, 1987) except FeO, CO_2, F, and Cl (table 5), which were determined (analysts, E.L. Brandt and J.D. Sharkey) by wet chemistry (Jackson and others, 1987). Fe^{2+}:total iron as Fe^{2+} ratios were adjusted to 0.8 and major oxide abundances recalculated to 100 percent, anhydrous basis. Abundances of selected trace elements (table 3) were determined (analysts, E.A. du Bray and D.B. Yager) by energy-dispersive X-ray fluorescence spectroscopy (Elsass and du Bray, 1982) using ^{109}Cd and ^{241}Am radio-isotope excitation sources; the accuracy of this type of data is discussed by Sawyer and Sargent (1989). Abundances of selected trace elements presented in table 4 were determined (analysts, J.R. Budahn, R.J. Knight, and D.M. McKown) by instrumental neutron activation analysis (Baedecker and McKown, 1987). Abundances of additional trace elements (table 6) were determined (analysts, C.J. Skeen and W. Doughten) by a combination of spectroscopic and wet chemical methods.

REFERENCES CITED

Baedecker, P.A, and McKown, D.M., 1987, Instrumental neutron activation analysis of geochemical samples, *in* Baedecker, P.A., ed., Methods for geochemical analysis: U.S. Geological Survey Bulletin 1770, p. H1–H14.

Bryan, C.R., 1988, Geology and geochemistry of mid-Tertiary volcanic rocks in the eastern Chiricahua Mountains, southeastern Arizona: Albuquerque, New Mexico, University of New Mexico, M.S. thesis, 137 p.

Drewes, Harald, 1981, Geologic map and sections of the Bowie Mountain South quadrangle, Cochise County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I–1363, scale 1:24,000.

_____1982, Geologic map of the Cochise Head quadrangle and adjacent areas, southeastern Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I–1312, scale 1:24,000.

Drewes, Harald, and Brooks, W.E., 1988, Geologic map and cross sections of the Pedregosa Mountains, Cochise County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I–1827, scale 1:48,000.

du Bray, E.A., and Pallister, J.S., 1991, An ash-flow caldera in cross section—Ongoing field and geochemical studies of the Turkey Creek caldera, Chiricahua Mountains, southeast Arizona: Journal of Geophysical Research, B., v. 96, p. 13,435–13,457.

Elsass, Francoise, and du Bray, E.A., 1982, Energy-dispersive X-ray fluorescence spectrometry with the Kevex 7000 system: Saudi Arabian Deputy Ministry Mineral Resources Open-File Report USGS–OF–02–52, 53 p.

Hildreth, Wes, 1981, Gradients in silicic magma chambers: Implications for lithospheric magmatism: Journal of Geophysical Research, v. 86, p. 10153–10192.

Jackson, L.L., Brown, F.W, and Neil, S.T., 1987, Major and minor elements requiring individual determination, classical whole rock analysis, and rapid rock analysis, *in* Baedecker, P.A., ed., Methods for geochemical analysis: U.S. Geological Survey Bulletin 1770, p. G1–G23.

Marjaniemi, D.K., 1969, Geologic history of an ash-flow sequence and its source area in the Basin and Range province of southeastern Arizona: Tucson, Ariz., University of Arizona Ph.D. dissertation, 176 p.

Pallister, J.S., and du Bray, E.A., 1989, Field guide to volcanic and plutonic features of the Turkey Creek caldera, Chiricahua Mountains southeast Arizona, *in* Chapin, C.E., and Zidek, Jiri, eds., Field excursions to volcanic terranes in the western United States, volume 1—Southern Rocky Mountain region: New Mexico Bureau of Mines and Mineral Resources Memoir 46, p. 138–152.

_____in press, Geologic map of the Fife Peak quadrangle, southeast Arizona: U.S. Geological Survey Geologic Quadrangle Map GQ–1708, scale 1:24,000.

Pallister, J.S., du Bray, E.A., and Latta, J.S., IV, in press, Geologic map of the Rustler Park quadrangle, southeast Arizona: U.S. Geological Survey Geologic Quadrangle Map GQ–1696, scale 1:24,000.

Pallister, J.S., du Bray, E.A., Rosenbaum, J.G., Snee, L.W., and Yager, D.B., 1990, Calderas in 3–D, Chiricahua Mountains, southeast Arizona, *in* Gehrels, G.E., and Spencer, J.E., eds., Geologic excursions through the Sonoran Desert region, Arizona and Sonora: Arizona Geological Survey Special Paper 7, p. 31–40.

Sawyer, D.A., and Sargent, K.A., 1989, Petrologic evolution of divergent peralkaline magmas from the Silent Canyon caldera complex, southwestern Nevada volcanic field: Journal of Geophysical Research, v. 94, p. 6021–6040.

Taggart, J.E., Jr., Lindsay, J.R., Scott, B.A., Vivit, D.V., Bartel, A.J., and Stewart, K.C., 1987, Analysis of geologic materials by X-ray fluorescence spectrometry, *in* Baedecker, P.A., ed., Methods for geochemical analysis: U.S. Geological Survey Bulletin 1770, p. E1–E19.

Table 1. Status and treatment of samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[X, data or sample type available, blank if unavailable. WRM, whole-rock major oxide analysis (table 2); NA, neutron activation analysis (table 4); KEV, energy-dispersive trace-element analysis (table 3); TS, thin section and hand sample available; PTS, polished thin section and hand sample available; REF, reference hand sample available. Map unit symbols (in parentheses) match those shown on Fife Peak geologic map (Pallister and du Bray, in press)]

Sample number	WRM	NA	KEV	Other data*	TS	PTS	REF	COMMENTS
Aphyric rhyolite lava, unit 3 (Tmr3)								
201612			X					POSSIBLY RHEOMORPHIC TUFF.
201782			X					
201891	X		X					
201892	X	X	X					
201899	X	X	X					
201990			X					
201999					X			
202000					X			
202001					X			
Aphyric rhyolite tuff, unit 3 (Tmt3)								
201596	X	X	X		X			VITROPHYRE.
201596B					X			DEVITRIFIED 201596.
201890	X		X		X			
201893	X	X	X					
201898	X	X	X					
201989			X					
201998					X			
Aphyric rhyolite lava, unit 2 (Tmr2)								
201610			X					
201611			X					GLASS.
201889			X					
201897	X		X					
201909					X			GLASS.
201987			X					
201988			X					
201991			X					
201992			X					
201993			X					
201994			X					
201995				4		X		GLASS.
P043	X	X	X		X			
P515	X		X				X	PALE GREEN PUMICE.
P561			X					
P562			X					
P563			X					
P566			X					
P567			X					
P568			X					
P569			X					
P570			X					
P571			X					

Table 1. Status and treatment of samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Sample number	WRM	NA	KEV	Other data*	TS	PTS	REF	COMMENTS
Aphyric rhyolite tuff, unit 2 (Tmt2)								
201616			X		X			
201895	X		X					
201900			X		X			
201905			X					
201906	X	X	X					
201913	X		X					
P564			X		X			
P565			X				X	
Aphyric rhyolite tuff, unit 1 (Tmt1)								
P227B						X		BASAL VITROPHYRE.
P503	X	X	X					
Biotite rhyolite lava (Tmrb)								
201593						X		GLASS.
201594	X	X	X	1,2		X		GLASS.
201595	X	X	X	1,2	X			DEVITRIFIED 201594.
201613			X			X		
201614			X			X		
201615	X	X	X	1,2		X		LAVA GLASS.
201779	X		X		X			ALTERED, SECONDARY SiO_2.
201894			X			X		
201902			X		X			
201904			X		X			
201908					X			
201914	X		X		X			
P497					X			UNWELDED, REWORKED AIRFALL TUFF.
P512						X		
P513					X			GLASS.
Sedimentary rocks (Tms)								
P496					X			TUFFACEOUS SANDSTONE AND BRECCIA.
Dacite and monzonite porphyry, resurgent intrusion (Tdpi)								
201780			X					
201787			X					
201907B					X			UNEXPECTED OCCURRENCE OF PORPHYRY.
Rhyolite Canyon Tuff, aplite and rhyolite (Trca)								
201781	X		X		X			
201785	X		X		X			FINE-GRAINED INTRUSIVE AT TDPI/TRCI CONTACT.
P367	X		X			X		WITH QUARTZ; PHANERITIC; SILL-LIKE.
P368	X		X			X		Do.

Table 1. Status and treatment of samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Sample number	WRM	NA	KEV	Other data*	TS	PTS	REF	COMMENTS
Rhyolite Canyon Tuff, aplite and rhyolite (Trca)--Continued								
P369A							X	PARTIAL MELTING AT TDPI/TRCI CONTACT.
P369B							X	Do.
P369C							X	Do.
P473					X			SILL IN TRCI NEAR TDPI/TRCI CONTACT AT MADRONO SPRING.
Rhyolite Canyon Tuff, intracaldera facies (Trci)								
201591			X		X			
201592			X		X			TOP OF LOWER TRCI?
201786			LOST					
201907			X			X		BLACK GLASS, APHYRIC.
201907C					X			ODD TEXTURE.
201910	X		X		X			CLOTTY, ODDLY PORPHYRITIC TRCI (MAFIC FIAMME).
201911	X		X		X			
201912	X		X		X			NEAR TOP OF UPPER PART OF TRCI.
P221					X			RECRYSTALLIZED TRCI.
P360	X		X		X			
P474	X	X	X	3,5	X			
P509A					X		X	SEDIMENTARY LAG BRECCIA.
P511A			X		X			DARK, PORPHYRITIC MAGMA BLEB.
P511B							X	REFERENCE SAMPLE IS A SLAB; LITHIC-RICH TRCI.
Rhyolite Canyon Tuff, lower or middle member ouflow facies (Trco)								
201883			X					ANOMALOUS TRACE-ELEMENT COMPOSITION.
201884			X					Do.
201885			X					
201888			X					
201915			X					
P494			X					
Faraway Ranch Formation, volcanic and volcaniclastic rocks, undifferentiated (Tfv)								
Tfv1:								
201857	X		X					
201896			X		X			
P506			X		X			
P507	X		X		X			
Tfv2:								
201783	X		X		X			BRECCIATED DACITE AT TDPI/TRCI CONTACT.
201784	X		X		X			BRECCIATED, HORNBLENDE-RICH DACITE AT TDPI/TRCI CONTACT.
P479	X	X	X	3,5	X			
P499			X					
Tfv3:								
201882			X					
201917	X		X		X			
Tfv4:								
201886	X		X		X			

Table 1. Status and treatment of samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Sample number	WRM	NA	KEV	Other data*	TS	PTS	REF	COMMENTS
Faraway Ranch Formation, volcanic and volcaniclastic rocks, undifferentiated (Tfv)--Continued								
Tfv4--Continued:								
201916			X					
Tfv?:								
201887A					X			GLASS.
201887B					X			CRYSTAL-RICH, DEVITRIFIED.
201901					X			GLASS.
P493					X			
P500							X	FLOW-BANDED, CRYSTAL-RICH, BIOTITE-FELDSPAR DACITE OR RHYOLITE PORPHYRY.
P502					X			CRYSTAL RICH, BT-FSPR DACITE.
Miscellaneous								
201609			X		X			INCLUSION IN DACITE PORPHYRY.
P498			X					MASSIVE HEMATITIC ALERATION OF TFV.

* Other geochemical data, identified by following codes:
1. Ferrous iron and carbon dioxide analyses (table 5).
2. Fluorine and chlorine analyses (table 5).
3. Miscellaneous trace-element analyses (Be, Cr, Ni, Pb, Sn, and Ag; table 6).
4. $^{40}Ar/^{39}Ar$ isotope analysis of glass by L.W. Snee (U.S. Geological Survey, unpub. data).
5. Lead and oxygen isotope analyses by Robert Ayuso (U.S. Geological Survey, unpub. data).

Table 2. Major oxide analyses for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[Data in weight percent. Fe^{2+}/total iron (as FeO) adjusted to 0.8 and abundances normalized to 100 weight percent, anhydrous. Map unit symbols above data columns match those shown on the Fife Peak geologic map (Pallister and du Bray, in press) and are defined in table 1. LOI, loss on ignition; ND, not detected. Analyses by X-ray fluorescence spectroscopy; J.E. Taggart, A.J. Bartel, and D.F. Siems, analysts]

Map unit	Tmr3			Tmt3				Tmr2
Sample No.	201891	201892	201899	201596	201890	201893	201898	201897
SiO_2---	77.53	77.48	77.34	78.18	76.42	77.20	77.81	77.26
Al_2O_3--	12.13	12.37	12.44	11.89	12.85	12.51	11.97	12.67
Fe_2O_3--	.25	.23	.23	.21	.24	.23	.23	.23
FeO----	.92	.83	.83	.75	.86	.83	.81	.84
MgO----	.12	.10	.11	.13	.12	.12	.11	.11
CaO----	.23	.11	.10	.30	.13	.31	.31	.09
Na_2O---	3.61	3.55	3.56	3.47	3.78	3.48	3.60	3.33
K_2O----	5.02	5.15	5.20	4.91	5.38	5.13	4.96	5.19
TiO_2---	.15	.14	.15	.14	.15	.15	.14	.15
P_2O_5---	ND	ND	ND	ND	ND	ND	ND	.08
MnO----	.03	.03	.04	.02	.06	.04	.05	.04
LOI----	.60	.45	.36	.41	.44	1.01	.34	.62

Map unit	Tmr2		Tmt2			Tmt1	Tmrb	
Sample No.	P043	P515	201895	201906	201913	P503	201594	201595
SiO_2---	77.27	77.10	77.49	77.65	77.44	76.70	73.89	74.51
Al_2O_3--	12.79	12.22	12.64	11.91	12.54	12.40	14.04	13.60
Fe_2O_3--	.21	.22	.23	.24	.23	.25	.40	.39
FeO----	.75	.78	.84	.85	.82	.91	1.43	1.39
MgO----	ND	.13	.15	.20	.12	.18	.50	.31
CaO----	.10	.40	.18	.36	.07	.59	1.54	1.12
Na_2O---	3.51	3.37	2.96	3.51	3.40	3.62	3.82	2.60
K_2O----	5.16	5.56	5.30	5.07	5.19	5.13	3.95	5.81
TiO_2---	.15	.15	.15	.15	.15	.17	.29	.27
P_2O_5---	ND	ND	ND	ND	ND	ND	.08	ND
MnO----	.05	.07	.05	.06	.04	.06	.05	ND
LOI----	.40	4.46	.90	.89	.47	3.21	3.94	.76

Map unit	Tmrb			Trca				Trci
Sample No.	201615	201779	201914	201781	201785	P367	P368	201910
SiO_2---	72.67	77.72	74.06	74.55	77.52	72.60	77.75	77.63
Al_2O_3--	14.66	12.04	13.51	12.75	11.94	13.56	11.85	11.69
Fe_2O_3--	.38	.35	.40	.47	.31	.60	.32	.38
FeO----	1.38	1.25	1.43	1.68	1.13	2.17	1.14	1.38
MgO----	.52	.58	.44	.42	.16	.60	.14	.36
CaO----	1.83	1.20	1.07	.85	.10	.97	.08	.38
Na_2O---	3.33	1.92	3.46	3.59	3.51	3.70	3.30	3.24
K_2O----	4.86	4.57	5.28	5.19	5.14	5.11	5.24	4.74
TiO_2---	.25	.25	.26	.31	.14	.47	.14	.17
P_2O_5---	.08	.08	.08	.09	ND	.17	ND	ND
MnO----	.04	.04	ND	.09	.04	.05	.03	.04
LOI----	3.42	3.06	.41	.60	.51	1.10	.44	.48

Table 2. Major oxide analyses for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Map unit	Trci				Tfv			
Sample No.	201911	201912	P360	P474	201857	P507	201783	201784
SiO_2---	76.54	78.10	76.76	76.74	60.09	69.56	61.95	63.40
Al_2O_3--	12.52	11.72	12.15	12.20	17.20	15.07	16.82	16.93
Fe_2O_3--	.40	.35	.42	.37	1.25	.73	1.08	1.10
FeO----	1.44	1.26	1.49	1.35	4.49	2.61	3.88	3.98
MgO----	.13	.10	.14	.15	2.81	.51	2.00	2.47
CaO----	.19	.22	.34	.16	1.47	1.31	2.68	2.82
Na_2O---	3.39	3.12	3.55	2.80	2.59	2.27	2.83	4.05
K_2O----	5.12	4.97	4.85	6.02	8.98	7.35	7.78	4.25
TiO_2---	.17	.15	.23	.18	.74	.42	.63	.65
P_2O_5---	ND	ND	ND	ND	.28	.14	.26	.27
MnO----	.09	ND	.06	.03	.10	.02	.09	.07
LOI----	.79	.85	.56	.81	2.42	.87	1.56	2.48

Map unit	Tfv		
Sample No.	P479	201917	201886
SiO_2---	62.95	52.88	68.15
Al_2O_3--	16.74	18.44	16.04
Fe_2O_3--	1.19	1.83	.73
FeO----	4.30	6.58	2.61
MgO----	2.73	5.15	.96
CaO----	3.49	9.65	3.04
Na_2O---	3.41	2.70	3.78
K_2O----	4.13	1.62	4.02
TiO_2---	.71	.82	.48
P_2O_5---	.26	.18	.15
MnO----	.07	.15	.04
LOI----	2.42	1.09	1.44

Table 3. Trace-element data for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[Data in parts per million. Map unit symbols above data columns match those shown on the Fife Peak geologic map (Pallister and du Bray, in press) and are defined in table 1. ND, not detected. Energy-dispersive X-ray fluorescence; E.A. du Bray and D.B. Yager, analysts]

Map unit	Tmr3						Tmt3	
Sample No.	201612	201782	201891	201892	201899	201990	201596	201890
Zn----	70	54	73	76	58	94	68	62
Rb----	389	389	375	393	383	416	380	409
Sr----	20	15	26	17	19	21	15	18
Y-----	27	33	47	28	35	59	69	50
Zr----	194	191	191	198	197	207	182	209
Nb----	51	48	51	50	54	52	47	56
Pb----	33	31	40	47	55	47	38	54
Th----	63	52	56	61	67	56	57	66
Ba----	14	6	14	17	13	6	15	24
La----	24	22	32	27	29	22	53	28
Ce----	54	71	81	74	61	93	99	94
Nd----	19	18	28	18	27	19	46	26

Map unit	Tmt3			Tmr2				
Sample No.	201893	201898	201989	201610	201611	201889	201897	201987
Zn----	61	25	82	89	81	76	68	53
Rb----	392	376	405	402	437	399	399	392
Sr----	18	17	22	15	29	14	42	14
Y-----	50	61	44	55	63	31	50	36
Zr----	207	195	190	202	193	195	186	198
Nb----	52	56	53	57	49	53	51	50
Pb----	35	62	48	62	54	44	58	49
Th----	70	65	58	61	70	56	68	70
Ba----	23	6	26	6	6	6	38	6
La----	45	51	28	24	45	34	50	26
Ce----	113	97	97	74	103	95	102	64
Nd----	35	43	29	36	44	31	44	19

Map unit	Tmr2							
Sample No.	201991	201993	P043	P515	P561	P562	P566	P568
Zn----	52	65	63	67	75	54	54	64
Rb----	356	405	384	377	421	426	399	389
Sr----	16	20	15	14	36	19	12	16
Y-----	67	42	41	63	58	35	64	46
Zr----	205	194	185	190	186	203	193	198
Nb----	53	55	48	56	56	58	51	51
Pb----	53	50	47	34	50	55	48	42
Th----	62	56	72	55	59	52	56	61
Ba----	30	25	14	6	23	20	6	25
La----	27	39	31	56	37	16	56	25
Ce----	93	114	74	98	108	53	104	83
Nd----	31	40	33	40	33	8	46	20

Map unit	Tmr2	Tmt2					
Sample No.	P570	201616	201895	201900	201905	201906	201913	P564
Zn----	25	62	91	72	51	25	25	71
Rb----	385	392	413	397	389	373	394	402
Sr----	15	19	22	34	15	30	16	20
Y-----	62	37	54	67	32	53	36	37
Zr----	198	204	200	201	199	190	209	198
Nb----	51	57	52	51	51	52	57	51
Pb----	46	37	67	48	35	32	47	51
Th----	50	67	63	70	61	64	46	60
Ba----	15	25	16	25	31	61	15	15
La----	42	35	44	51	22	43	39	25
Ce----	100	82	102	102	62	87	53	81
Nd----	34	31	28	42	27	37	28	28

Table 3. Trace-element data for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Map unit	Tmt2	Tmt1	Tmrb					
Sample No.	P565	P503	201594	201595	201613	201614	201615	201779
Zn----	231	51	70	25	25	78	25	25
Rb----	394	365	293	250	228	236	252	210
Sr----	15	37	147	134	223	223	235	131
Y-----	62	58	39	40	32	32	33	47
Zr----	199	183	195	170	166	164	161	164
Nb----	51	51	19	14	16	14	12	8
Pb----	43	54	37	42	15	45	37	35
Th----	51	57	35	33	39	48	41	36
Ba----	22	68	631	630	809	747	809	636
La----	43	48	54	58	52	44	50	54
Ce----	99	105	105	122	93	89	93	114
Nd----	38	45	54	64	50	54	48	45

Map unit	Tmrb				Trco			
Sample No.	201894	201902	201904	201914	201883	201884	201885	201888
Zn----	70	25	56	64	90	95	98	65
Rb----	243	321	198	265	406	435	410	453
Sr----	240	97	246	131	192	207	15	16
Y-----	31	32	35	47	44	69	34	90
Zr----	155	114	184	188	273	298	286	312
Nb----	15	11	9	15	50	63	58	66
Pb----	49	36	34	15	43	77	35	15
Th----	51	36	41	42	51	55	53	58
Ba----	811	427	823	694	85	58	24	17
La----	57	36	60	70	58	45	32	56
Ce----	96	76	107	124	125	137	128	150
Nd----	45	28	48	60	49	35	29	52

Map unit	Trco		Trca				Trci	
Sample No.	201915	P494	201781	201785	P367	P368	201591	201592
Zn----	65	25	65	25	73	63	80	25
Rb----	426	378	342	367	274	411	625	302
Sr----	25	19	74	26	103	21	32	18
Y-----	50	64	62	67	62	61	75	54
Zr----	293	285	320	255	370	243	293	350
Nb----	64	55	50	53	37	52	47	42
Pb----	15	15	44	15	34	15	42	15
Th----	56	65	39	50	39	52	45	39
Ba----	32	21	227	48	372	33	84	40
La----	63	66	82	64	87	50	76	108
Ce----	139	153	146	136	159	109	142	186
Nd----	51	58	65	58	68	44	66	80

Map unit	Trci							Tdpi
Sample No.	201907	201910	201911	201912	P360	P474	P511A	201780
Zn----	96	83	72	ND	89	56	73	98
Rb----	562	296	329	321	288	420	286	165
Sr----	31	54	23	29	39	28	22	256
Y-----	75	66	67	33	65	72	56	45
Zr----	353	283	378	305	351	335	310	478
Nb----	52	41	49	45	47	44	55	24
Pb----	46	35	15	54	30	38	15	51
Th----	41	43	58	50	39	45	57	28
Ba----	28	114	47	30	93	74	34	809
La----	99	81	121	38	101	96	78	82
Ce----	172	153	200	78	187	181	161	150
Nd----	73	65	90	40	75	74	58	66

Table 3. Trace-element data for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona—Continued

Map unit	Tdpi	Tfv						
Sample No.	201787	201857	201896	P506	P507	201783	201784	P479
Zn----	25	71	86	78	25	139	96	101
Rb----	293	516	696	489	426	472	211	183
Sr----	163	336	189	271	243	604	535	553
Y-----	51	36	41	36	33	33	29	24
Zr----	486	194	160	137	142	190	168	174
Nb----	30	3	3	3	9	7	7	7
Pb----	38	42	46	39	36	37	47	36
Th----	35	9	32	28	32	9	9	7
Ba----	592	809	668	699	793	801	738	926
La----	102	34	34	37	38	38	40	39
Ce----	185	69	72	71	65	70	76	71
Nd----	78	30	43	37	48	34	38	28

Map unit	Tfv					Miscellaneous	
Sample No.	P499	201882	201917	201886	201916	201609	P498
Zn----	92	109	126	71	63	75	96
Rb----	121	53	46	198	194	225	18
Sr----	495	580	557	396	349	328	68
Y-----	32	30	38	29	25	24	25
Zr----	217	141	137	181	179	241	296
Nb----	13	8	8	15	12	15	15
Pb----	53	41	49	41	37	15	55
Th----	9	ND	21	43	35	30	29
Ba----	676	464	470	796	801	642	13
La----	36	24	27	45	44	48	ND
Ce----	79	54	58	86	87	83	14
Nd----	50	30	30	44	38	43	ND

Table 4. Instrumental neutron activation data for selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[Data in parts per million. Map unit symbols above data columns match those shown on the Fife Peak geologic map (Pallister and du Bray, in press) and are defined in table 1. ND, not detected. J.R. Budahn, R.J. Knight, and D.M. McKown, analysts]

Map unit	Tmr3		Tmt3			Tmr2	Tmt2	Tmt1
Sample No.	201892	201899	201596	201893	201898	P043	201906	P503
Ba----	19	43.6	30	47.4	40.5	37.7	73.8	78.4
Sr----	ND	ND	ND	ND	ND	9.20	ND	35.5
Co----	.227	.219	.165	.207	.203	.241	.522	.558
Ni----	2.4	2.4	1.80	3.4	3.6	5.60	ND	3.4
Cr----	9.82	7.99	ND	6.74	8.22	ND	9.10	3.9
Cs----	6.30	7.90	6.73	8.17	8.43	6.90	11.7	15.8
Hf----	8.05	8.35	7.56	7.97	8.24	9.01	8.05	7.75
Rb----	384	391	363	376	376	399	382	379
Sb----	.162	.191	.222	.220	.196	.206	.426	.344
Ta----	4.43	4.65	4.21	4.40	4.49	4.48	4.36	4.18
Th----	45.3	44.4	41.3	43.1	43.2	50.9	44.1	41.7
U-----	6.73	9.49	9.78	8.97	8.38	10.7	10.1	11.7
Zn----	82.9	45.7	30.9	52.7	49.6	47.6	54.1	65.8
Zr----	182	186	198	194	198	194	197	201
Sc----	2.04	2.03	2.01	2.04	2.04	2.20	2.14	2.26
La----	24.3	25.6	50.2	39.4	42.1	28.7	38.8	45.2
Ce----	66.7	46.9	86.4	103	92.2	72.9	79.9	98.1
Nd----	13.6	17.9	39.8	32.3	32.7	18.3	28.5	34.2
Sm----	2.81	3.87	7.52	6.59	6.50	4.32	6.05	7.21
Eu----	.164	.189	.198	.194	.199	.209	.234	.277
Gd----	3.17	3.57	7.08	6.86	7.26	ND	6.61	7.64
Tb----	.520	.676	1.24	1.08	1.14	.722	1.03	1.19
Tm----	.597	.707	1.09	1.03	1.08	ND	.998	1.01
Yb----	4.36	4.69	7.07	6.59	7.42	5.24	6.83	7.52
Lu----	.679	.709	.998	.967	1.10	.786	1.02	1.11

Map unit	Tmrb			Trci	Tfv2
Sample No.	201594	201595	201615	P474	P479
Ba----	605	664	766	64.5	909
Sr----	132	120	227	ND	584
Co----	2.03	2.23	2.72	.521	15.8
Ni----	5.60	8.00	14.0	ND	13.0
Cr----	1.25	2.20	3.79	2.30	17.3
Cs----	6.05	1.59	4.82	7.16	3.03
Hf----	5.64	5.85	5.01	11.8	5.30
Rb----	285	265	256	419	178
Sb----	.098	.113	.105	2.79	9.48
Ta----	1.49	1.52	1.25	3.91	.863
Th----	27.6	28.8	24.3	42.2	11.3
U-----	3.53	4.04	3.72	8.61	2.62
Zn----	41.8	27.3	39.6	75.2	63.6
Zr----	208	211	187	387	195
Sc----	3.76	4.05	3.37	2.85	10.7
La----	55.4	57.3	41.1	94.6	34.1
Ce----	118	132	87.9	194	73.4
Nd----	48.1	52.2	32.0	79.8	33.5
Sm----	8.40	9.70	5.89	14.6	6.37
Eu----	1.00	1.08	.877	.252	1.38
Gd----	7.34	8.03	5.30	13.2	5.47
Tb----	1.11	1.18	.769	1.98	.743
Tm----	.642	.616	.453	1.23	.379
Yb----	3.87	3.82	2.74	7.74	2.44
Lu----	.551	.542	.386	1.12	.372

Table 5. Abundances of FeO, CO_2, F, and Cl in selected samples of biotite rhyolite lava (Tmrb) from the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[Data in weight percent. ND, not detected. Wet chemical analyses; E.L. Brandt and J.D. Sharkey, analysts]

Sample No.	201594	201595	201615
FeO----	0.50	0.15	0.34
CO_2----	.02	.02	ND
F------	.02	.01	.01
Cl-----	.07	ND	.06

Table 6. Abundances of Be, Cr, Ni, Pb, Sn, and Ag in selected samples collected in the Fife Peak quadrangle, Chiricahua Mountains, Cochise County, Arizona

[Data in parts per million. ND, not detected. Map unit symbols match those shown on the Fife Peak geologic map (Pallister and du Bray, in press) and are defined in table 1. Spectroscopic and wet chemical determinations by C.J. Skeen and M.W. Doughten]

Map unit	Trci	Tfv
Sample No.	P474	P479
Be----	6.5	1.7
Cr----	9.1	11
Ni----	ND	12
Pb----	10	11
Sn----	2.4	ND
Ag----	.06	.02

☆U.S. GOVERNMENT PRINTING OFFICE: 1992-673-049/66000