UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of heavy-mineral-concentrate samples from the Sawtooth Mountains Wilderness Study Area (CA-060-024B), San Diego County, California

By

David E. Detra and James E. Kilburn

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral values, if any. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Sawtooth Mountains Wilderness Study Area, California Desert Conservation Area, San Diego County, California.

INTRODUCTION

In April, 1984 the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Sawtooth Mountains Wilderness Study Area, San Diego County, California.

The Sawtooth Mountains Wilderness Study Area comprises about 38.5 mi^2 (24,690 acres) in the southwestern part of San Diego County, California, and lies about 1 mi southwest of Agua Caliente Springs (see figure 1). Access to the study area is provided by unimproved dirt roads that exit the Old Overland Stage Route at Canebreak Canyon and Vallecito Valley.

Most of the rocks exposed in the WSA are Cretaceous in age. These include tonalites and associated granodiorites and granites in the eastern half of the study area, as well as metasedimentary rocks located along the western length of the WSA. The valleys are locally covered by Quaternary terrane and alluvial deposits. The most prominent structural feature is the Elsinore Fault Zone which traverses the northeast corner of the study area.

The study area includes parts of the Sombrero Peak, Mount Laguna, Monument Peak, and Agua Caliente Springs 7.5-minute quadrangle maps. Topographic relief is great, rising from roughly 1,800 feet at numerous points along the valley floors, to over 5,600 feet near the southern periphery of the WSA. The climate is arid to semiarid, with a wide range in temperatures.

METHODS OF STUDY

Sample Media

Heavy-mineral-concentrate samples provide information about the chemistry of certain minerals in rock material eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which may be ore-related, permits determination of some elements that are not easily detected in stream-sediment samples.

Sample Collection

Samples were collected at 40 sites (plate 1). At all of those sites a heavy-mineral-concentrate sample was collected. Sampling density was about 1 sample site per 1 mi^2 for the heavy-mineral concentrates. The area of the drainage basins sampled ranged from 0.5 mi^2 to 3 mi^2.

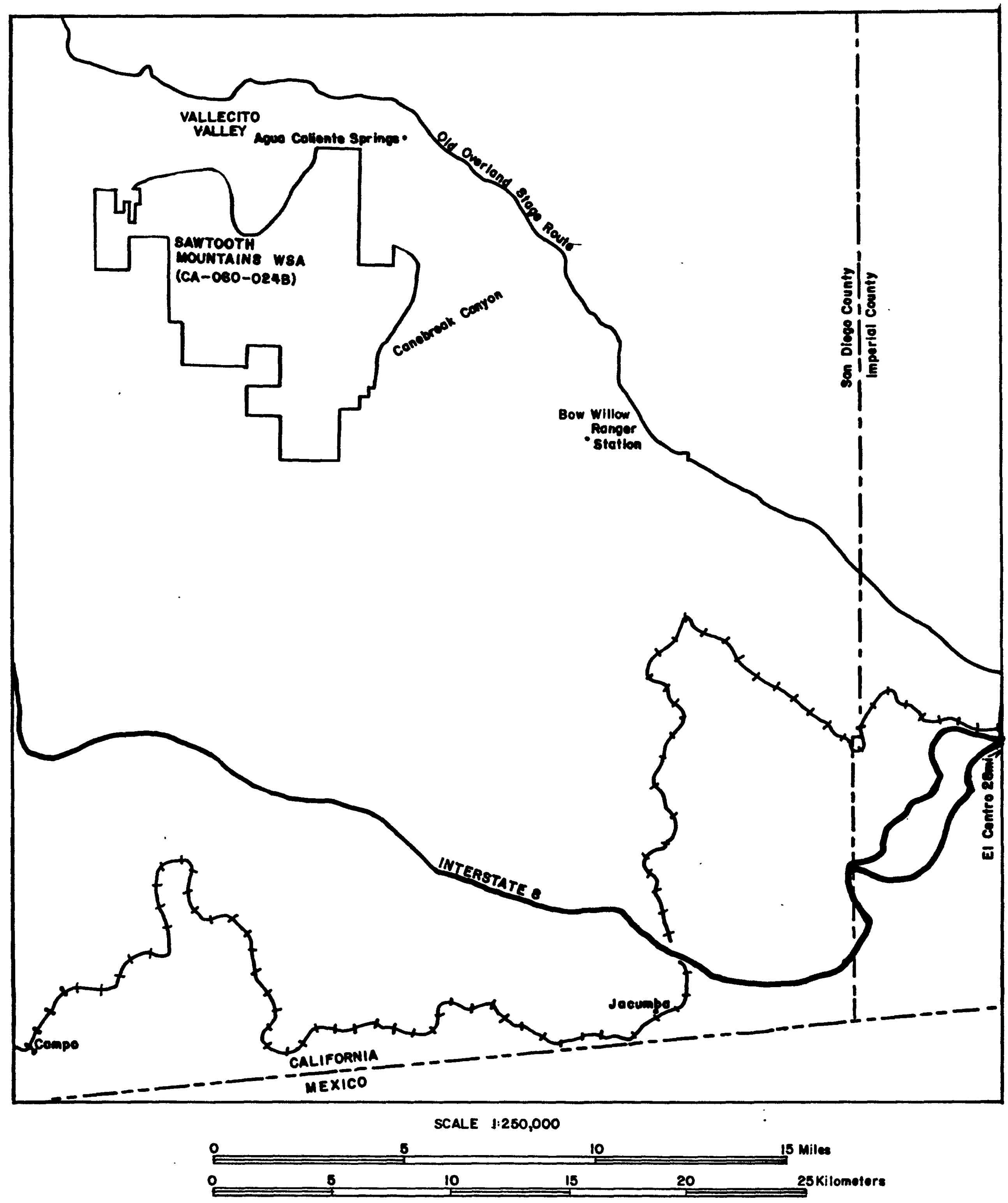

Figure 1. Location map of the Sawtooth Mountains Wilderness Study Area, San Diego County, California

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples consisted of active alluvium collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on 1:24,000 topographic maps. Each bulk sample was screened with a 2.0-mm (10-mesh) screen to remove the coarse material. The less than 2.0-mm fraction was panned until most of the quartz, feldspar, organic material, and clay-sized material were removed.

Sample Preparation

After air drying, bromoform (specific gravity 2.8) was used to remove the remaining quartz and feldspar from the heavy-mineral-concentrate samples that had been panned in the field. The resultant heavy mineral sample was separated into three fractions using a large electromagnet (in this case a modified Frantz Isodynamic Separator). The most magnetic material, primarily magnetite, was not analyzed. The second fraction, largely ferromagnesian silicates and iron oxides, was saved for analysis/archival storage. The third fraction (the least magnetic material which may include the nonmagnetic ore minerals, zircon, sphene, etc.) was split using a Jones splitter. One split was hand-ground for spectrographic analysis; the other split was saved for mineralogical analysis. These magnetic separates are the same separates that would be produced by using a Frantz Isodynamic Separator set at a slope of 15° and a tilt of 10° with a current of 0.1 ampere to remove the magnetite and ilmenite, and a current of 1.0 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.

Sample Analysis

Spectrographic method

The heavy-mineral-concentrate samples were analyzed for 30 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968). The elements analyzed and their lower limits of determination are listed in Table 1. Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the analytical method is approximately plus or minus one reporting interval at the 83 percent confidence level and plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from the Sawtooth Mountains Wilderness Study Area are listed in Table 2.

ROCK ANALYSIS STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into a computer-based file called Rock Analysis Storage System (RASS). This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC) for computerized statistical analysis or publication (VanTrump and Miesch, 1976).

DESCRIPTION OF DATA TABLES

Table 2 lists the analyses for the heavy-mineral concentrate samples. In the tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on the site location maps (plate 1). Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in table 1. If an element was observed but was below the lowest reporting value, a "less than" symbol (<) was entered in the tables in front of the lower limit of determination. If an element was observed but was above the highest reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced Table 2, some of the elements listed in these tables (Fe, Mg, Ca, Ti, Ag, and Be) carry one or more nonsignificant digits to the right of the significant digits. The analysts did not determine these elements to the accuracy suggested by the extra zeros.

REFERENCES CITED

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Motooka, J. M., and Grimes, D. J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analyses: U.S. Geological Survey Circular 738, 25 p.

VanTrump, George, Jr., and Miesch, A. T., 1976, The U.S. Geological Survey RASS-STATPAC system for management and statistical reduction of geochemical data: Computers and Geosciences, v. 3, p. 475-488.

TABLE 1.--Limits of determination for the spectrographic analysis of rocks and stream sediments, based on a 10-mg sample

[The spectrographic limits of determination for heavy-mineral-concentrate samples are based on a 5-mg sample, and are therefore two reporting intervals higher than the limits given for rocks and stream sediments]

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	20
Titanium (Ti)	.002	1
	Parts per million	
Manganese (Mn)	10	5,000
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SAWTOOTH MOUNTAINSWILDERNESS STUDY AREA, CALIFORNIA.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s
ST100	32 52 46	116 19 16	.5	.15	20	>2	1,000	N	N	N	20
ST101	32 53 14	116 19 18	.5	.20	20	>2	1,000	N	N	N	20
ST102	32 51 13	116 21 36	.5	.30	20	>2	3,000	N	N	N	50
ST103	32 51 16	116 21 41	.3	.10	10	>2	500	N	N	N	100
ST104	32 51 27	116 21 55	.3	.10	10	>2	300	N	N	N	70
ST105	32 55 32	116 24 55	.3	.15	10	>2	700	5	N	N	100
ST106	32 55 55	116 23 19	.5	.20	15	>2	1,000	N	N	N	50
ST107	32 55 18	116 23 4	.5	.10	20	>2	1,500	N	N	N	30
ST108	32 55 11	116 23 42	.3	.10	15	>2	700	N	N	N	30
ST200	32 53 50	116 18 40	.5	.10	20	>2	1,000	N	N	N	20
ST201	32 53 16	116 19 17	.3	.10	20	>2	1,000	N	N	N	20
ST202	32 51 59	116 21 43	.5	.15	10	>2	700	N	N	N	100
ST203	32 52 14	116 21 42	.5	.20	10	>2	700	N	N	N	100
ST205	32 55 56	116 24 3	.3	.10	20	>2	1,500	N	N	N	30
ST206	32 54 13	116 23 18	.5	.50	30	>2	2,000	N	N	N	200
ST207	32 54 24	116 23 42	.3	.20	5	>2	300	N	N	N	70
ST300	32 51 16	116 21 16	.2	.05	10	>2	700	N	N	N	30
ST301	32 51 17	116 20 47	.2	.70	15	>2	1,000	30	N	N	30
ST302	32 52 19	116 20 28	.3	.70	15	>2	1,500	N	N	N	20
ST303	32 55 35	116 25 48	.2	.07	20	>2	1,500	N	N	N	30
ST304	32 54 45	116 24 35	.7	.20	15	>2	1,000	N	N	N	70
ST305	32 55 1	116 24 49	.2	.15	10	>2	700	N	N	N	70
ST306	32 54 36	116 24 14	.3	.15	7	>2	500	N	N	N	100
ST400	32 54 18	116 20 33	.5	.10	20	>2	1,000	N	N	N	30
ST401	32 54 5	116 20 21	.5	.07	20	>2	1,000	N	N	N	20
ST402	32 54 15	116 20 12	.3	.20	10	>2	700	N	N	N	100
ST403	32 52 12	116 19 27	.2	.15	5	>2	300	N	N	N	70
ST404	32 57 18	116 20 42	.3	.10	15	>2	1,000	N	N	N	20
ST405	32 56 48	116 20 44	.3	.20	15	>2	700	N	N	N	50
ST406	32 53 36	116 22 12	.3	.07	20	>2	1,000	N	N	N	30
ST500	32 54 36	116 19 24	.5	.20	15	>2	500	N	N	N	50
ST501	32 54 45	116 18 47	.3	.10	20	>2	700	N	N	N	20
ST502	32 55 2	116 20 58	.3	.15	7	>2	200	N	N	N	50
ST503	32 54 48	116 20 50	.5	.10	20	>2	1,000	N	N	N	20
ST505	32 51 30	116 19 33	.5	.20	50	>2	1,500	N	N	N	30
ST506	32 56 8	116 21 11	.5	.10	15	>2	700	N	N	N	30
ST507	32 56 25	116 20 59	.5	.10	20	>2	1,000	N	N	N	20
ST508	32 54 51	116 21 51	.2	.05	10	>2	300	N	N	N	20
ST510	32 53 0	116 22 55	.5	<.05	5	>2	200	N	N	N	20
ST511	32 53 30	116 23 42	.3	.10	30	>2	1,500	N	N	N	30

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SAWTOOTH MOUNTAINSWILDERNESS STUDY AREA, CALIFORNIA.--Continued

Sample	Ba-ppm s	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s
ST100	700	<2	N	N	10	20	N	N	N	100	N
ST101	1,000	<2	N	N	10	30	N	N	N	70	N
ST102	1,500	<2	N	N	10	700	N	100	N	300	N
ST103	1,000	<2	N	N	N	100	N	50	N	150	N
ST104	500	N	N	N	N	20	50	50	N	N	15
ST105	2,000	2	N	N	10	300	N	150	N	200	N
ST106	1,000	2	N	N	N	30	N	50	N	50	N
ST107	1,000	<2	N	N	10	30	N	100	N	200	N
ST108	1,000	<2	N	N	N	50	N	100	N	<50	N
ST200	500	<2	N	N	15	50	N	N	N	100	N
ST201	700	2	N	N	10	30	30	N	N	200	N
ST202	700	2	N	N	N	50	N	100	N	<50	10
ST203	1,000	2	N	N	N	50	N	100	N	70	N
ST205	500	2	N	N	10	30	N	100	N	200	N
ST206	2,000	3	N	N	10	300	1,000	150	N	150	10
ST207	1,000	2	N	N	N	100	N	100	N	<50	10
ST300	200	N	N	N	N	100	N	N	N	300	N
ST301	200	<2	<20	N	10	200	N	50	N	500	N
ST302	1,000	<2	N	N	N	20	N	N	N	50	N
ST303	700	<2	N	N	N	300	N	150	N	100	10
ST304	1,000	2	N	N	10	200	N	200	N	500	20
ST305	700	<2	1,000	N	N	500	N	100	N	300	10
ST306	1,000	<2	N	N	N	100	N	100	N	<50	10
ST400	500	<2	N	N	N	50	N	50	N	100	N
ST401	500	<2	N	N	N	30	N	N	N	200	N
ST402	700	<2	700	N	15	500	N	50	N	300	10
ST403	700	<2	N	N	N	150	N	50	N	50	10
ST404	500	<2	N	N	N	30	N	N	N	200	N
ST405	5,000	<2	N	N	N	70	N	50	N	50	N
ST406	700	<2	N	N	N	20	N	N	N	100	N
ST500	1,000	2	N	N	N	20	N	50	N	70	N
ST501	500	<2	N	N	10	30	N	N	N	200	N
ST502	1,000	3	N	N	N	20	N	N	N	<50	N
ST503	700	<2	N	N	10	20	N	50	N	150	N
ST505	700	<2	N	N	N	30	N	N	N	200	N
ST506	3,000	2	N	N	10	50	N	N	N	100	N
ST507	700	<2	N	N	10	50	300	100	N	150	N
ST508	1,500	2	N	N	N	20	N	N	N	<50	N
ST510	200	N	N	N	N	<20	N	N	N	N	15
ST511	700	<2	N	N	15	150	100	50	N	50	20

TABLE 2.--SPECTROGRAPHIC RESULTS FROM THE ANALYSIS OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE SAWTOOTH MOUNTAINSWILDERNESS STUDY AREA, CALIFORNIA.--Continued

Sample	Pb-ppm s	Sb-ppm s	Sn-ppm s	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s
ST100	20	N	300	N	150	N	500	N	>2,000	N
ST101	N	N	200	200	150	N	500	N	>2,000	N
ST102	50	N	200	200	1,000	2,000	500	N	>2,000	N
ST103	N	N	50	200	300	N	500	N	>2,000	200
ST104	N	N	50	300	100	N	700	N	>2,000	500
ST105	20	N	300	200	700	200	300	N	>2,000	N
ST106	30	N	200	700	100	N	300	N	>2,000	N
ST107	20	N	300	500	150	N	700	N	>2,000	N
ST108	20	N	150	500	100	N	500	N	>2,000	N
ST200	20	N	200	200	150	N	500	N	>2,000	N
ST201	70	N	300	500	150	N	300	N	>2,000	N
ST202	50	N	70	700	100	N	500	N	>2,000	N
ST203	50	N	150	700	100	N	300	N	>2,000	N
ST205	20	N	300	700	100	N	700	N	>2,000	N
ST206	1,000	N	150	200	700	2,000	500	N	>2,000	N
ST207	30	N	200	200	200	300	300	N	>2,000	N
ST300	30	N	500	500	300	300	700	N	>2,000	N
ST301	50	N	500	700	700	150	500	N	>2,000	N
ST302	20	N	200	200	500	N	500	N	>2,000	N
ST303	30	N	100	N	700	1,000	700	N	>2,000	N
ST304	20	N	100	200	300	2,000	500	N	>2,000	N
ST305	200	N	200	N	1,000	5,000	500	N	>2,000	N
ST306	N	N	200	N	200	300	700	N	>2,000	N
ST400	20	N	300	200	200	N	500	N	>2,000	N
ST401	20	N	500	N	200	N	500	N	>2,000	N
ST402	200	N	200	N	2,000	3,000	300	N	>2,000	N
ST403	20	N	150	N	200	200	500	N	>2,000	N
ST404	N	N	500	200	200	<100	700	N	>2,000	N
ST405	20	N	150	500	200	N	500	N	>2,000	N
ST406	50	N	200	N	100	N	500	N	>2,000	N
ST500	20,000	N	100	1,000	100	N	300	N	>2,000	N
ST501	N	N	200	200	200	N	500	N	>2,000	N
ST502	50	N	N	1,000	70	N	200	N	>2,000	N
ST503	30	N	300	700	200	N	300	N	>2,000	N
ST505	100	N	500	700	100	500	700	N	>2,000	N
ST506	20	N	150	700	200	N	300	N	>2,000	N
ST507	20	N	200	300	200	N	500	N	>2,000	N
ST508	N	N	50	1,000	100	N	300	N	>2,000	N
ST510	N	N	20	N	50	N	2,000	N	>2,000	N
ST511	1,000	N	20	200	300	1,000	1,500	N	>2,000	N