

# ALASKA VOLCANO OBSERVATORY

A cooperative program of the U.S. Geological Survey<sup>1</sup>, University of Alaska Geophysical Institute<sup>2</sup>, and the Alaska Division of Geological and Geophysical Surveys<sup>3</sup>

**SUMMARY REPORT: January 1, 1991 - February 28, 1991**

compiled by C.A. Neal<sup>1A</sup> and J. Power<sup>1C</sup>

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## SUMMARY

Redoubt was quiet in January and February. Steam emission events - detected seismically - continued at roughly a constant rate until early February when they became more irregular. The number of high frequency events beneath the lava dome held steady with the exception of a brief period in early February when there was a slight increase lasting a few days.

Field activities during this period included a redeployment of GPS equipment at benchmarks around Redoubt by Jack Kleinman and John Ewert (CVO), continuing WRD surveys of snowpack and discharge in the Drift River and its principal tributaries, and servicing of the time-lapse cameras on the north flank of Redoubt. The first COSPEC flight since November 8 documented that the Redoubt magma system is still degassing although at a low rate compared with most of last year.

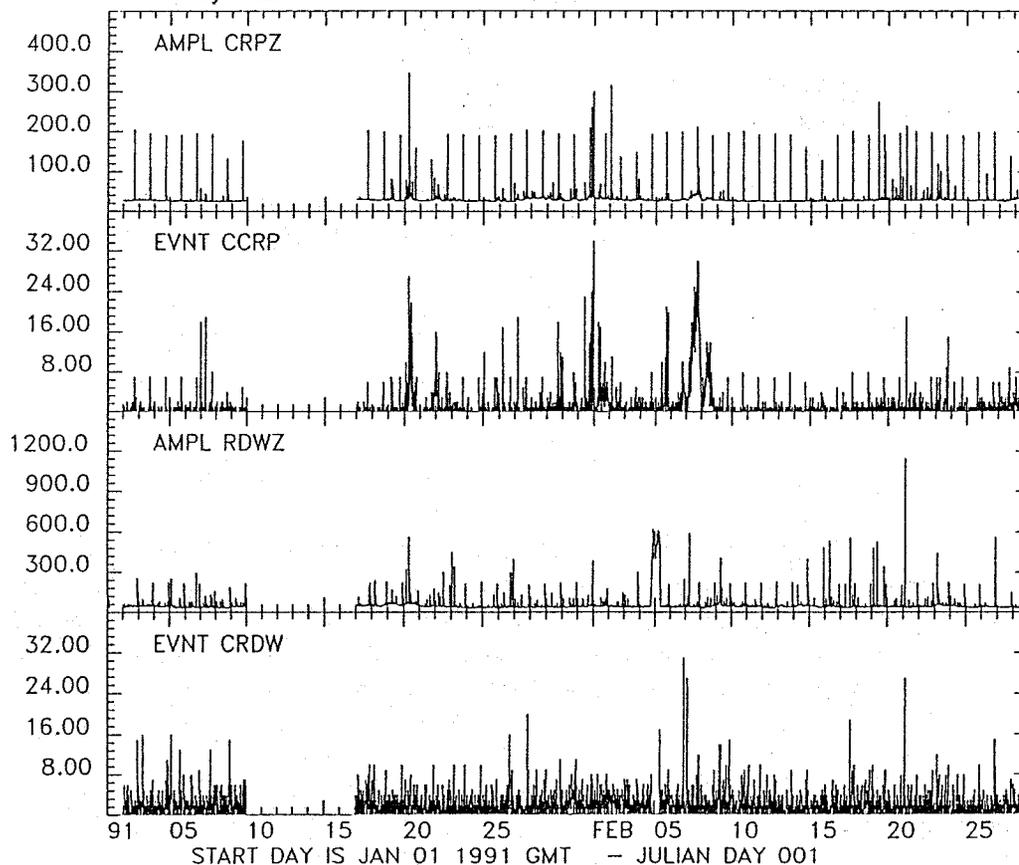
The annual AVO review meeting took place on January 23-24 in Fairbanks.

## SEISMICITY

### MT. SPURR

No unusual activity. On January 1, 1991 stations in the Mt. Spurr network were again recorded on the PC/AT acquisition system in Fairbanks. Telemetry problems beginning on about January 15 caused recording problems for much of the rest of the month. The problem was eventually located in the filter bridge in Anchorage, which once rectified brought the entire network back on line about February 5. Small events were recorded south of the volcano in the Chakachamna Lake area, beneath the Mt. Spurr edifice, and north of the Capps Glacier. The overall seismic patterns closely match those of earlier months (see April - August 1989 monthly reports). RSAM average amplitudes and event counts for station CRP are shown in figure S1. Ten events were located on the PC/AT acquisition system in the Spurr area during this report period, hypocenters are shown in figures S3 and S4.

Figure S1) RSAM average amplitudes and event counts for stations CRP and RDW. Software Problems resulted in data loss from the Fairbanks RSAM system between January 10 and 17.



### REDOUBT VOLCANO

No unusual activity, The volcano-tectonic earthquakes 5 to 9 km beneath the volcano which began with the eruptions on December 15, 1989 continued through January and February (Figure S2). Shallow long period events generally too small to locate continued at approximately the same rate which has characterized the volcano since the fall of 1990 (see AVO Summer Report). RSAM data from station RDW is shown in figure S1. 231 events were located on the PC/AT seismic acquisition system at Redoubt during this report period, hypocenters are shown in figures S5 and S6.

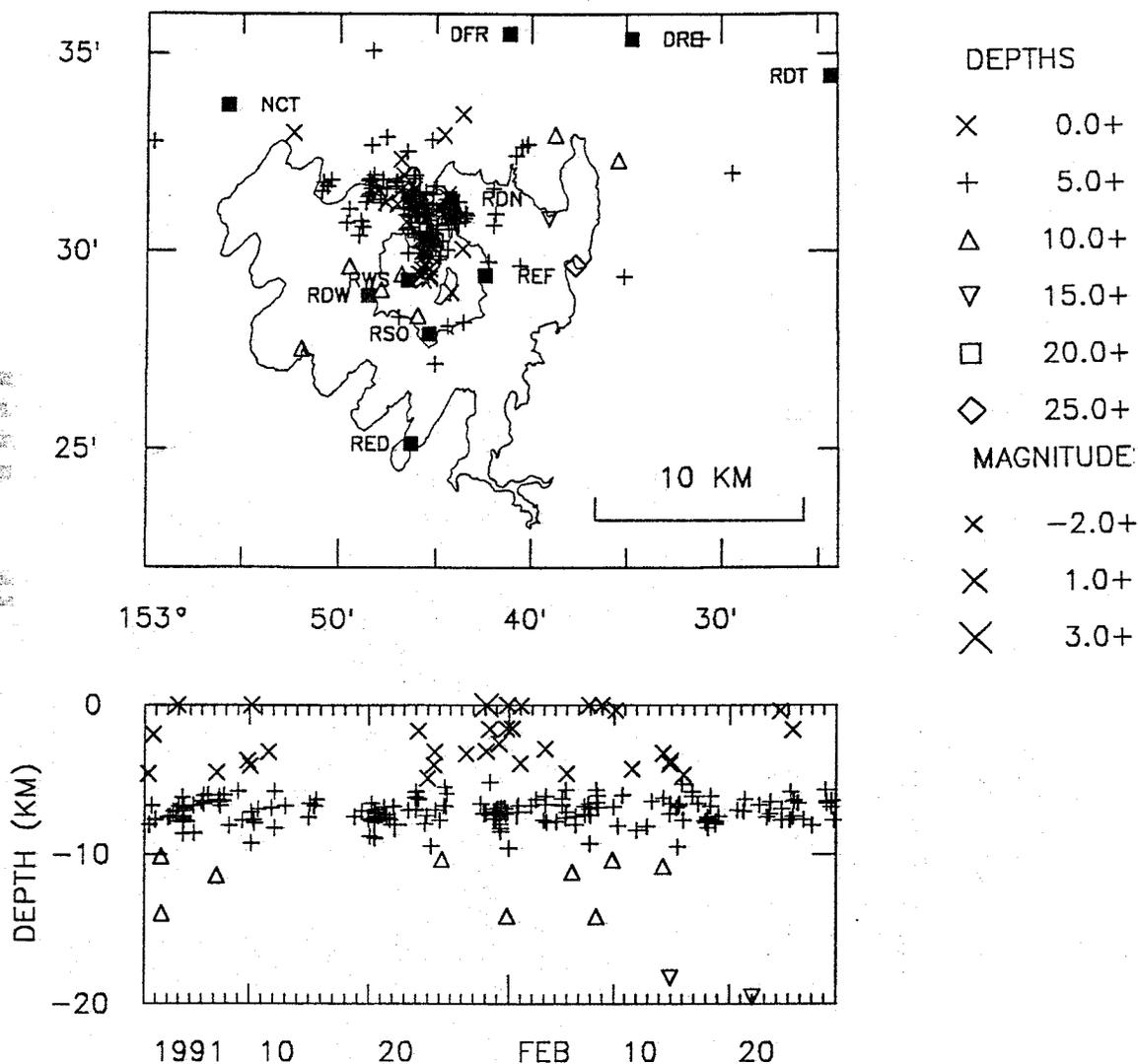
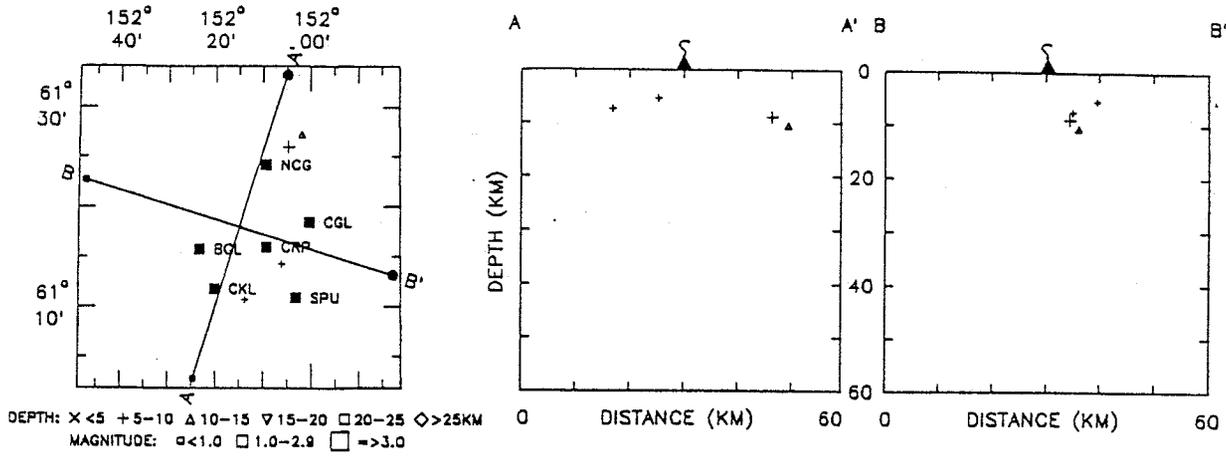


Figure S2) Epicentral map and time-depth plot of Redoubt seismicity, January 1, to February 28, 1991. Hypocenters have not been checked for accuracy.

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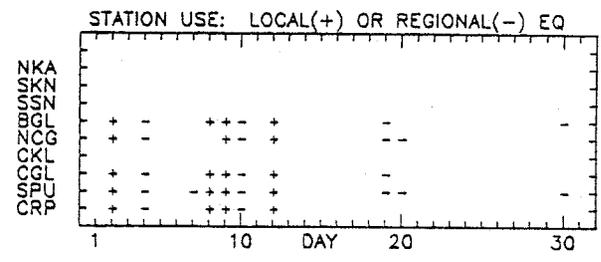
ALASKA VOLCANO OBSERVATORY MONTHLY REPORT  
 SPURR VOLCANO JANUARY 1991



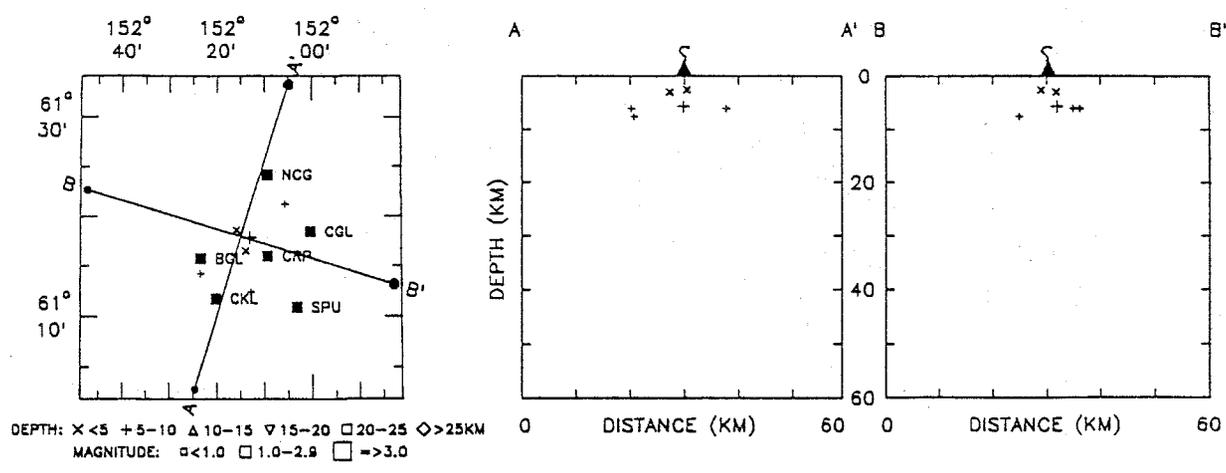
----- LARGEST EQ(S) -----

DA HR:MN	LAT	LONG	DEP	MAG	Mag	#
2 13:18	61N26	152W 5	8	1.0A	< 0	0
					0-1	3
					1-2	1
					2-3	0
					3-4	0
					> 4	0
					TOTAL:	4

Figure S3



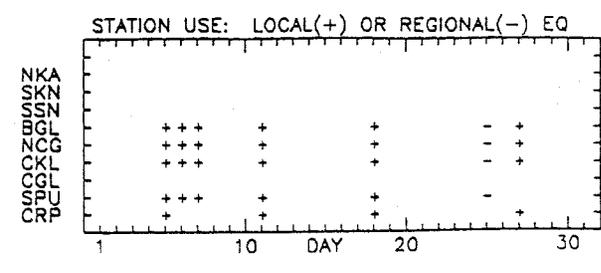
ALASKA VOLCANO OBSERVATORY MONTHLY REPORT  
 SPURR VOLCANO FEBRUARY 1991



----- LARGEST EQ(S) -----

DA HR:MN	LAT	LONG	DEP	MAG	Mag	#
27 17:24	61N18	152W13	5	1.2A	< 0	1
					0-1	4
					1-2	1
					2-3	0
					3-4	0
					> 4	0
					TOTAL:	6

Figure S4

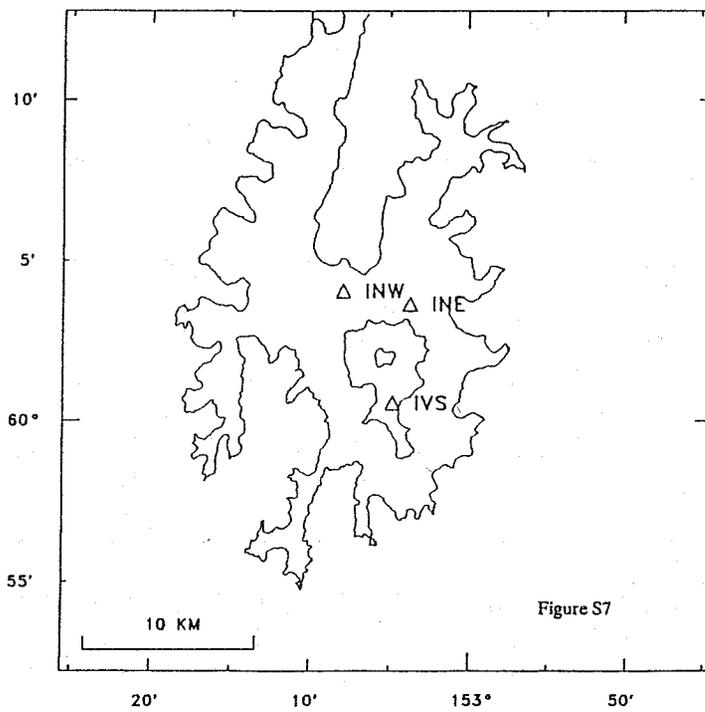


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## ILIAMNA VOLCANO

On September 7, 1990 3 seismic stations, INE, INW, and IVS, were installed on Iliamna Volcano (figure S7). Earthquake counts from station INW (September 7 - 24) and INE (September 24 - January 19, 1991) are shown in figure S8. IVS died about October 29, 1990, INW died about December 14, 1990 and INE went out of operation on January 19, 1991.



### ALASKA VOLCANO OBSERVATORY MONTHLY REPORT ILIAMNA VOLCANO            JAN 1991 DATA THROUGH 1/19/91

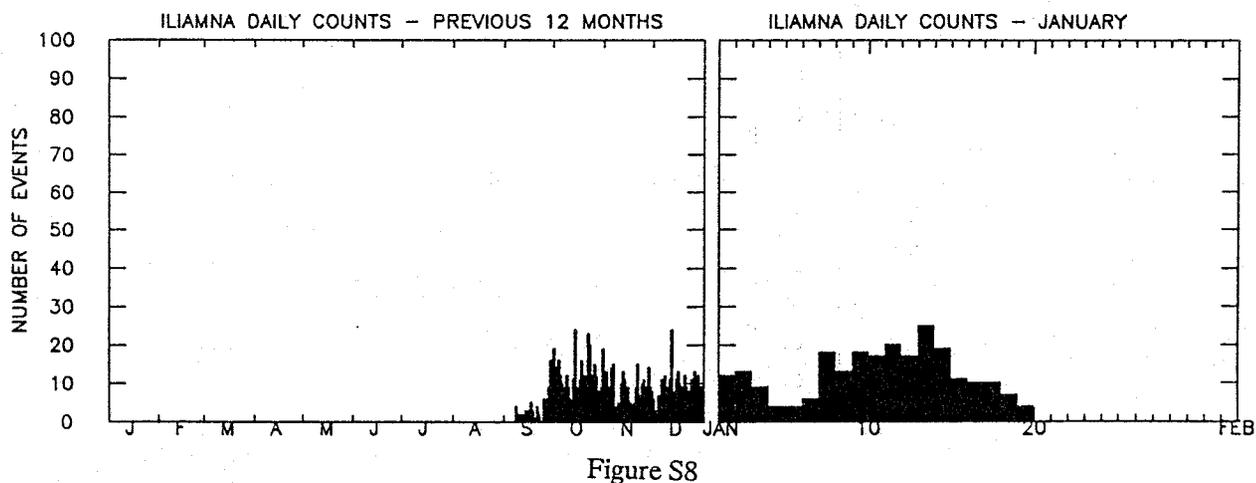


Figure S8

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## AUGUSTINE VOLCANO

No unusual activity. Station AUP began experiencing intermittent trouble on about January 9. Augustine earthquake counts are shown in figure S9.

### ALASKA VOLCANO OBSERVATORY MONTHLY REPORT AUGUSTINE VOLCANO JAN - FEB 1991

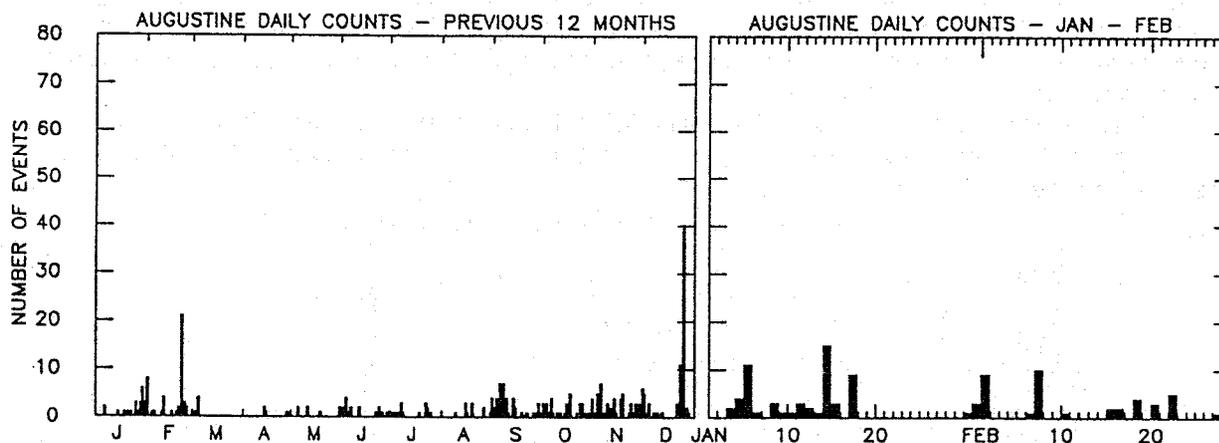


Figure S9

## DUTTON VOLCANO

Four small earthquake swarms were recorded on February 2, 6, 16, and 20 (Figure S10). All the events in both swarms were of small magnitude. These swarms constitute the highest rate of activity since the present count began in 1988, however, in view of the size of the events, the overall level of seismic activity remains low.

*John Power, Guy Tytgat, John Lahr*

### ALASKA VOLCANO OBSERVATORY MONTHLY REPORT DUTTON VOLCANO JAN - FEB 1991 DATA THROUGH 2/23/91

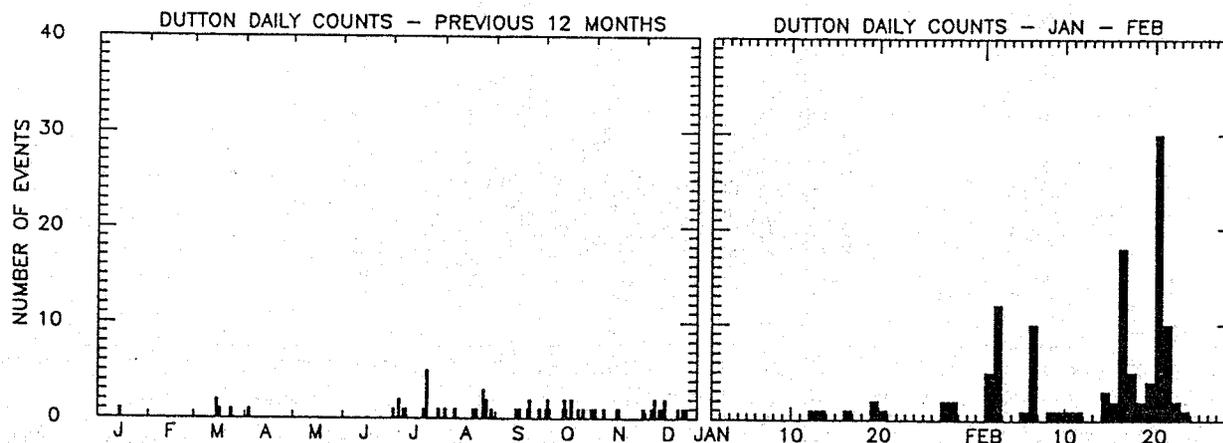


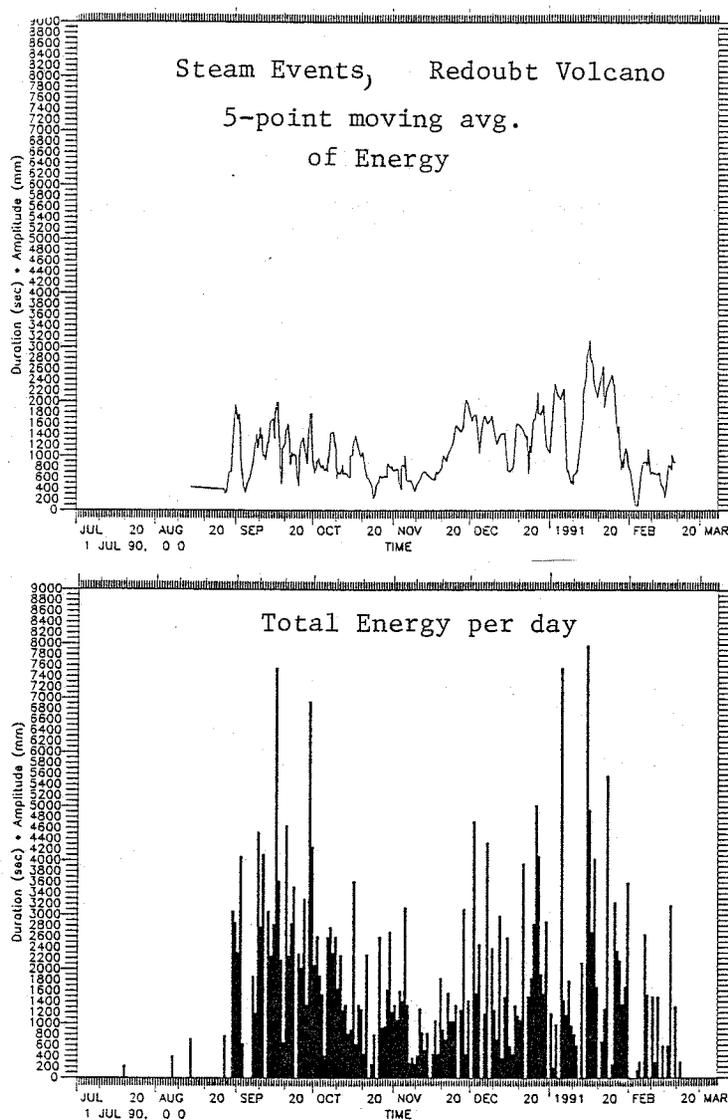
Figure S10

## REDOUBT STEAM EVENTS

Starting mid-July, a series of unusual seismic events occurred on Redoubt Volcano. They are characterized by a long coda (up to 40 minutes in some instances), relatively low amplitude, and a frequency content ranging from high frequency ( $> 10$  Hz) for the first few minutes, to low frequency ( $\approx 2$  Hz) for the rest of the events. In a few cases, when visibility across Cook Inlet is sufficient, a small steam plume is visible simultaneously. Since these events are believed to be caused by more vigorous steaming at the vent, we refer of these events as "Steam Events".

In an attempt to quantify these "steam events", we made measurements of their durations and amplitudes, and plotted these values on a time scale. The bottom of figure G1 is a time-series histogram of the product of the durations of these events in seconds and the average amplitude in millimeters. The top figure uses the identical data, but is smoothed by a five point moving average. It is an attempt to show a trend in frequency of occurrence and intensity.

The last measurement was made on February 20th. Though no measurements were made after that, quick visual observations of the helicorder records shows that very few steam events, if none at all, occurred from then through the rest of February.



Guy Tytgat

Figure G-1

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## COSPEC STUDIES

Encouraged by low AGC readings near the solar noon, we attempted a COSPEC flight on the 23rd of January. During five orbits of Redoubt, only two deviations from a noisy baseline could be confidently interpreted as a plume signal. Resulting emission rates were 290 and 310 tonnes/day, respectively. These values are at the low end of the range of values measured during 1990 (Fig. C-1) and reflect continued low-level degassing of the Redoubt magma system. The plume is still visible from aircraft and has a moderately strong odor when you fly through it. Chart recorder problems began in late January and have prevented more flights during February.

We are currently awaiting the arrival of a new COSPEC V system from Barringer - it should arrive by early April. We plan to test it against the existing COSPEC IV and then send the older system to Barringer for refurbishment before returning it to CVO.

*Tina Neal, Mike Doukas and Game McGimsey*

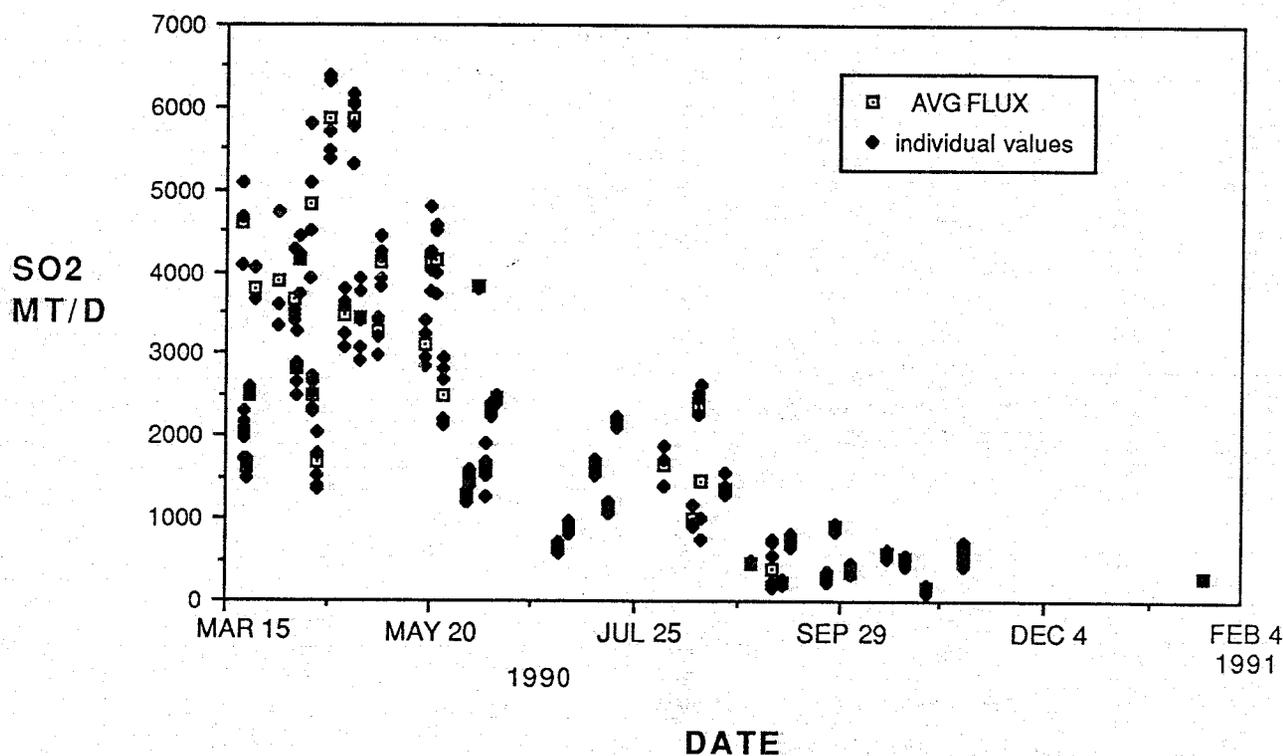


Figure C-1. COSPEC data collected at Redoubt Volcano, March 20, 1990 - January 23, 1991.

## AVO SAMPLE LOG

Table 1 contains summary collection information about all Redoubt eruption samples cataloged and residing at AVO Anchorage. See the summer, 1990 report for Geophysical Institute sample information. Additional sample sets include a comprehensive tephra collection (Game McGimsey and Willie Scott) and a suite of lahar samples (Dick Janda).

*Tina Neal*

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Table 1. AVO sample log - Redoubt eruption, 1989-90

AVO #	COL. DATE	Collector	Description	Orig Samp #	ANALYSIS
RV90-1		Miller	Prismatically jointed block of Jan 2 dome (?)	90AMM-1	chem/ts/UAF
RV90-2		Miller	JAN 2 dome fragments w/ oxid. stain	90AMM-1A	chem
RV90-3		Miller	Jan 2 lapilli, RDN site	90AMM-2	chem
RV90-4			1/2/90, mud (tephra?) partially dried		
RV90-5		Miller	12/15/89 pumice	90AMM-3	chem/UAF
RV90-6		Miller	12/15 dome fragments	90AMM-4	chem/UAF
RV90-7		Miller	Jan 8 eruption dome fragments	90AMM-5	chem/UAF
RV90-8	1-23-90	Hoblitt	hot block from 1/89 lahar, 1 mi downstream from Dumbbell Hills	USGS 1/8-01	ts/UAF
RV90-9	2-1-90?	Schneider	rounded dome fragments from channel - 2 bags		
RV90-10	2-15-90	Miller	2/15 dome block	90AMM-10	chem/ts/UAF
RV90-11	2-15-90	Waltt	dome fragments, clasts in 2/15 pf on northeast piedmont lobe	90R.01A	grain size
RV90-11A	2-15-90	Waltt	2/15 pf deposit on piedmont glacier, northeast	RBW90R.01B	grain size
RV90-12	3-4-90	Hoblitt	2/28 block from surface of pf, 2800' DR gorge	90AMM-11	chem/ts/UAF
RV90-13	3-4-90	Hoblitt	pumice, 2/28/90 eruption, coll. from surface of pf in DR Gorge, 2800'		
RV90-14	3-13-90	Casadevall	sandy matrix from 3/9 pf 1840'	900313-2	grain size
RV90-15	3-13-90	Casadevall	clasts from 3/9 pf, pumice, dense, basement	900313-3	ts/UAF
RV90-16	3-15-90		slightly pumiceous rock with coarse grained xenolith		
RV90-17	3-15-90	Trabant	3/14/90 dome rock, collected hot steaming	90DTR53	chem/ts/UAF
RV90-18	3-23-90	Wolfe	Hot, prismatically jointed block col. at 2150' Drift Glacier	USGS 3/23-01	UAF/ts
RV90-19	3-23-90	Wolfe	3/23 dome rock collected hot from near glacier terminus, west side	3/23-02/90AMc-002	UAF/chem/ts
RV90-20	3-23-90	Wolfe	3/23 pf from Redoubt ravine	USGS 3/23-03	UAF/gs
RV90-20A	3-23-90	Wolfe	pumice and dome fragments, west canyon, 3/23 deposit		
RV90-21	3-23-90	Wolfe	pumice cobbles, including banded clast, from 3/23 pf, wst canyon	USGS 3/23-04	
RV90-22	3-23-90	Wolfe	3/14 Dome sample from 3-14 debris flow-upper DR valley ~ 900' elev.	3/14-01/90AMc-001	UAF/chem/ts
RV90-23	3-26-90	Casadevall	sublimate incrustations and blocks from 3/23 pf from fumarole	900326-1	
RV90-24	3-26-90	Casadevall	12/15/89 pumice coll. at Dumbbell Hills		
RV90-25	3-30-90	Miller	slightly vesicular block with xenolith	3-30-90-2	
RV90-26	4-7-90	Miller	hot, vesicular block from channel, east edge piedmont, from 4/6 event	90AMM-15	chem/ts
RV90-27	4-13-90	Miller	12/15 pumice, repeater site	90AMM21	
RV90-28	4-13-90	Miller	12/15/89 pumice from W. end Dumbbell Hills		
RV90-29	4-16-90	Miller	12/15/89 Pumice coll. from Ptarmigan Ridge, 2 bags		
RV90-30	4-16-90	Miller	4/15 pf bulk, wet, 1900', piedmont	90AMM23A	grain size
RV90-31	4-16-90	Miller	4/15 pf, dry/hot 350 C 20 cm down, 1900' piedmont	90AMM23-B	
RV90-32	4-16-90	Miller	4/15/90 pf incl. inflated dome rx, western piedmont	90AMM24	ts
RV90-33	4-16-90	Miller	4/15 pf, 1500', v. fine surge material, could be older than 4/15	90AMM25	grain size
RV90-34	4-16-90	Miller	4/15/90 dome rock, coll. at granite knob	90AMM26	chem/ts/UAF
RV90-35	4-20-90	McGimsey	Lapilli of 4/15/90	4-20-90-2	chem/UAF
RV90-36	5-5-90	Major	Lithics & pumice between 2 ice congl. layers. Upper DRV. 2 bags		
RV90-36A	5-17-90	Gardner	banded pumice in Jan 2 deposit or floater	G900517-1	
RV90-37	5-21-90	Miller	sulfide-bearing granodiorite from lahar at base of ice congl., west canyon	90AMM28	
RV90-38	5-24-90	Gardner	sulfur encrusted cobbles, Crater Creek, east of piedmont		
RB90-39	5-24-90	Gardner	lahar section	ORG201 A-D	
RV90-40	5-24-90	Gardner	pyroclastic section	ORG202 A-C	
RV90-41	5-24-90	Neal	lahar section, near granite block, Crater Creek	ORG203 A-D	
RV90-42	5-24-90	Neal	upper pyroclastic unit, west drainage	NR90-16	
RV90-43	5-24-90	Neal	coarse pyroclastic flow, west drainage	NR90-18	
RV90-44	5-24-90	Neal	fine-grained pf, western drainage	NR90-17	
RV90-45	5-24-90	Neal	coarse pyroclastic flow, western drainage	NR90-19	
RV90-46	5-30-90	McGimsey	pumice??	5-30-90-2	
RV90-47	6-1-90	Neal	Lithics, pumice, vegetation beneath ice avalanche, north of DH	NR90-20	
RV90-48	6-1-90	Neal	white pumice scattered on surface of 2/15 lahar, north side DR, north of Dumbbell Hills	NR90-21	
RV90-49	6-5-90	Miller	12/15 green-grey pumice, 3200', Crescent Glacier	90AMM35	
RV90-50	6-5-90	Miller	12/15 pumice, 3200', Crescent glacier	90AMM35A	
RV90-51	6-5-90	Miller	12/15 pumice and older (?) glassy blocks, 3200', Crescent Gl.	90AMM35B	
RV90-52	6-5-90	Miller	12/15 pumice and dense blocks, 3200', Crescent Gl.	90AMM35C	
RV90-53	6-5-90	Miller	4 boxes assorted 12/15 pumice, 3200', Crescent Gl.		

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RV90-54	6-7-90	Neal	4-21 (?) PF west drainage.	NR90-22	
RV90-55	6-7-90	Neal	Lahar(?) pre 4-15 W. drainage.	NR90-23	
RV90-56	6-7-90	Neal	surface lag of avalanche deposit, south side	NR90-24	
RV90-57	6-7-90	Neal	banded and unbanded pumices, south side	NR90-26	
RV90-58	6-19-90	Miller	granitic bedrock, near S-curve, sulfide-bearing	90AMM36-B	
RV90-59	6-19-90	Miller	prismatically jointed dome rock, Crater Creek	90AMM36-A	
RV90-60	6-25-90	Miller	light colored 12/15 pumice, 3200', Crescent Gl.	90AMM37A	chem/ts
RV90-61	6-25-90	Miller	mixed 12/15 pumice, 3200', Crescent Gl.	90AMM37B	ts
RV90-62	6-25-90	Miller	green-grey 12/15 pumice, 3200', Crescent Gl.	90AMM37C	chem/ts
RV90-63	6-25-90	Miller	light colored, xtaline 12/15 pumice, 3200', Crescent Gl.	90AMM37D	chem/ts
RV90-64	6-25-90	Miller	prism. jointed dome blocks from ice congl., 1680', piedmont	90AMM38	chem/ts
RV90-65	7-4-90	Miller	prism. dome block, from ice congl., 1550' on piedmont	90AMM40	
RV90-66	7-30-90	Gardner	pumice from 4/15?	G800730-2	
RV90-67	7-30-90	Gardner	pumice from upper ice conglomerate?	G800730-1	
RV90-68	8-2-90	Waltt	Pf/surge, airfall section on piedmont	RBW90R.109 A-G	
RV90-69	8-2-90	Waltt	12/15 pumice, collected on piedmont		
RV90-70	8-2-90	Neal	Lithic-rich 2/15 surge at RDN site	NR90-30	grain size
RV90-71	8-2-90	Neal	Bulk 12-15 airfall pumice and lith. @ RDN.	NR90-30A	
RV90-72	8-3-90	Neal	Surface lag, ice aval. prism blk where fell apart. 4350' S. side.	NR90-32	
RV90-73	8-3-90	Neal	Dense glassy dacite block. 4350' S. side.	NR90-32A	
RV90-74	8-3-90	Neal	dense, 2 m block on surface of south side avalanche	NR90-32B	
RV90-75	8-9-90	Neal	bulk sample, 2/15 pf, just east of piedmont lobe	NR90-37	grain size
RV90-76	8-9-90	Gardner	clasts from pf deposit on piedmont	G900809-1	
RV90-77	8-9-90	Gardner	?	G900809-2	
RV90-78	8-9-90	Gardner	2/15 pf (?) east of piedmont	G900809-3	
RV90-79	8-9-90	Gardner	?	G900809-4	
RV90-80	8-12-90	Neal	pyroclastic section, north margin of piedmont glacier	NR90-40A-1	grain size
RV90-81	8-20-90	Gardner	?	900820-1	
RV90-82	8-24-90	Miller	Dome rock, collected from the north face of the dome	90AMM48A	chem/UAF
RV90-83	8-24-90	Miller	Dome rock, with xenolith, from north face of dome	90AMM48B	UAF
RV90-84	8-24-90	Neal	pyroclastic section, 1740', east side of glacier	NR90-29	grain size
RV90-85	8-24-90	Neal	lahar/avalanche deposits in the 'pits'	NR90-44	grain size
RV90-86	8-30-90	Gardner	pumice from pyroclastic unit at 6200'	G900830-1	
RV90-87	8-30-90	Gardner	12/15 (?) pumice at 6200'	G900830-2	
RV90-88	8-30-90	Gardner	?	G900830-3	
RV90-89	8-31-90	Neal	pyroclastic section, 2300', glacier	NR90-49	
RV90-90	8-31-90	Neal	partial pyroclastic section, 1380', north margin of piedmont glacier	NR90-52	grain size
RV90-91	9-6-90	Neal	partial pyroclastic section, second ridge west of piedmont	NR90-56	
RV90-92	9-6-90	Gardner	scattered 12/15 pumices, west of piedmont lobe, 1660'	90080906-1	
RV90-93	9-14-90	Neal	pyroclastic section, south central piedmont	NR90-64	grain size
RV90-94	9-30-90	Neal	pyroclastic section, central piedmont	NR90-69	grain size
RV90-95	10-2-90	Neal	pyroclastic section, west piedmont	NR90-71	grain size
RV90-96	10-2-90	Neal	partial section, west piedmont	NR90-72	
RV90-97	10-2-90	Neal	frozen pink accretionary lapilli layer, west flank Redoubt	NR90-74	
RV90-98	10-2-90	Neal	pyroclastic section, base of north flank, west of piedmont	NR90-75	

## OTHER VOLCANOES AND AVO ACTIVITIES

### Katmai

Tina spent time helping prepare documents to hire a contractor to prepare the EIS for the Katmai drilling project and getting modern skills tuned up for anticipated heavy text transfer with NPS during the upcoming EIS writing.

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## Chiginagak

On January 31, AVO received a report of increased steaming at Chiginagak (Chi-gi-na'-gak) Volcano from a longtime resident of the sparsely populated region south of King Salmon. Chiginagak is a young, 1340-m-high cone 600 km southwest of Anchorage. There have been several reports of activity in historic times although the nature of the events is uncertain. The last reported activity was in 1972 and was probably entirely phreatic. Chiginagak has a continuously active fumarole high on its north flank, however reports of significant change in the character of steam emission are unheard of. This news, in combination with a pilot report of similar activity on 10 January and a more ambiguous report last July, prompted AVO to investigate.

Weather Service satellite images for the time period in question were consulted and showed nothing unusual. The FAA and airlines who frequently overfly the volcano were also contacted and could not corroborate any significant changes. Bad weather precluded any overflights from Anchorage. We tentatively interpret this report to reflect either blowing snow or an apparent anomaly related to an extended period of cold, dry, clear weather on the Peninsula. Not surprisingly, on 5-6 February, we received two more reports of "unusual plumes" over volcanoes from Redoubt down the chain to Makushin. These were most certainly the product of weather conditions.

During the Chiginagak exercise, John Paskievitch established a menu driven procedure to change the origin of hypothetical plume trajectories to any volcano that may be of interest. This allows us terrific flexibility in tracking potential ash paths as activity shifts to any volcano in the state. In addition, Hiroshi Tanaka of the Geophysical Institute demonstrated the capabilities of his plume simulation routine by sending down, within a day, modeled Chiginagak plume travel paths and shapes.

## MISCELLANEOUS NOTES

Game McGimsey and Mike Doukas have successfully completed duplication of a series of 12 videotapes of Redoubt. These tapes were taken by Eric Thompson of Kenai and include footage of lightning, explosive eruption plumes, secondary explosions off the pyroclastic avalanche debris, and some outstanding sunsets. Rick Hoblitt spent time at AVO in late February viewing the tapes in his quest to ascertain better location of lightning strokes and strikes. In a future report we will try and list our known photographic resources for each eruptive event.

John Paskievitch, Tom Murray (CVO), and Bruce Furukawa (CVO) attended LDS school in Florida.

## VISITORS TO AVO ANCHORAGE

John Ewert and Jack Kleinman, CVO, 23 -31 January, GPS survey at Redoubt

Bruce Furukawa, 16 February - 2 March, LDS installation

Tom Murray, 20 February - ? March, LDS installation

Rick Hoblitt, 20 February - ? March, LDS installation and lightning video viewing

## ATTENDEES OF THE AVO COORDINATION MEETING IN FAIRBANKS, JAN 23-24, 1991

Jim Beget	UAF/Geology/Fairbanks
Niren Biswas	UAF/GI/Fairbanks
Phil Carpenter	USGS/WRD/Anchorage
Bernard Chouet	USGS/Seismology/Menlo Park
Bob Christiansen	USGS/IGP/Menlo Park
John Davies	UAF/AVO/GI/Fairbanks

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Dan Dzurisin	USGS/CVO/Vancouver
John Eichelberger	Sandia Labs
Steve Estes	UAF/AVO/GI/Fairbanks
Will Harrison	UAF/GI/Fairbanks
Jurgen Kienle	UAF/AVO/GI/Fairbanks
John Lahr	USGS/Seismology/Menlo Park
Peter Lipman	USGS/IGP/Denver
Gail March	ADGGS/AVO/Fairbanks
David Meyer	USGS/WRD/Anchorage
Tom Miller	USGS/IGP/AVO/Anchorage
Chris Newhall	USGS/Reston
Chris Nye	ADGGS and UAF/AVO/GI/Fairbanks
Bob Page	USGS/Seismology/Menlo Park
John Power	USGS/IGP/AVO/Fairbanks
Hans Pulpan	UAF/GI/Fairbanks
David Stone	UAF/GI/Fairbanks
Sam Swanson	UAF/Geology/Fairbanks
Hiroshi Tanaka	UAF/GI/Fairbanks
Dennis Trabant	USGS/WRD/Fairbanks
Guy Tytgat	UAF/AVO/GI/Fairbanks
Richard Waitt	USGS/CVO/Vancouver
Rob Wesson	USGS/Reston
Ed Wolfe	USGS/CVO/Vancouver

## CHANGES TO AVO STAFF

Mike Doukas and family have relocated to Anchorage. Mike brings a wealth of experience, an office overflowing with volcano gear and good taste in coffee beans to the AVO staff: we are glad to see him!

John Paskievitch returned to AVO Anchorage from two months in Antarctica. He is now a full time, permanent geologist for the USGS.

### INSTRUCTIONS FOR CONTRIBUTORS TO AVO BIMONTHLY REPORTS:

AVO welcomes and encourages submissions from anyone involved in AVO-related projects. We will try and incorporate contributions in the next bimonthly cycle if they are received in Anchorage by the end of the final week of the month - e.g. by the end of April for inclusion in the March-April report. If at all possible, send text on a 3.5" diskette with the original word processing program identified. We will gladly accept photographs and linework for supporting figures. If you have any questions, please call AVO.

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